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The effect of analogy instruction on young children's metaphor comprehension

Castillo, Lisa Carmen, Ph.D.

City University of New York, 1994

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THE EFFECT OF ANALOGY INSTRUCTION ON YOUNG CHILDREN'S METAPHOR COMPREHENSION

by

LISA CARMEN CASTILLO

A dissertation submitted to the Graduate Faculty in Educational Psychology in partial fulfillment of the requirements for the degree of Doctor of Philosophy, The City University of New York.

1994

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Abstract

THE EFFECT OF ANALOGY INSTRUCTION ON YOUNG CHILDREN'S METAPHOR COMPREHENSION

by

Lisa Carmen Castillo

Advisor: Professor Barry J. Zimmerman

This study explored the use of analogy instruction as a method of enhancing the ability of children 5.6 - 6.6 years old to paraphrase metaphors. Analogies and metaphors are related in that both require reasoning about complex comparisons. A modeling procedure was used to highlight the parallelism constraint of analogy solution, namely the requirement that one rule governs the relationship between terms in both pairs of a four term analogy. Mapping was chosen as the focus analogy component. The puppet model solved picture analogies and used parallel explanations for its answers. Children were asked to solve a new set of 10 picture analogies using the puppet's method. Then they were asked to explain sentences (metaphors) whose meanings had been "disguised" by the puppet.

On total number of analogies solved correctly and on the number of analogy responses given parallel explanations, the instructional group outperformed the

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exposure group. On the metaphor interpretation task, the instructional group again outperformed the exposure group and a control group which had not participated in the analogy assessment phase.

In the past, stage theorists have assumed deficits in children's language and thinking abilities based upon performance. However, the need to consider contextual issues, such as task and domain knowledge, has guided more recent work. When contextual considerations are made in task design and performance assessment, a clearer picture of ability emerges.

Language in general - figurative language in particular - requires contextual support to resolve possible ambiguities. When this support is provided, young children are better able to interpret metaphors.

Analogies and metaphors are both powerful tools for assimilating new information, and fitting it into one's existing knowledge base. Enhancing children's ability to understand and learn from analogies and metaphors has useful and varied classroom applications.

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Chapter 1

Introduction

Young children's difficulty with metaphors has been a source of research attention for the past three decades, beginning with a classic study in 1960 by Asch and Nerlove that concluded children under the age of twelve could not comprehend the meaning of dual-function terms. For these children, a person described as "warm" was assumed to be wearing a heavy coat -- the notion that "warm" could describe a personality trait as well as one's body heat was thought to be beyond their understanding.

Over the years, various researchers have arrived at similar conclusions when children were asked to interpret metaphors. It seemed that young children were incapable of understanding this type of figurative language. Paradoxically, these same children have been given credit as prolific producers of metaphors. Young children's symbolic play is replete with examples of objects used and labelled metaphorically. Their spontaneous language reflects an interest in making non-traditional comparisons, such as describing the moon as a ball (or an orange) in the sky.

Researchers have taken care to make a distinction between overextensions of language and deliberate violations of traditional boundaries (Winner, 1988); when children use utterances judged to be metaphors, they are well aware that they are using language in an unusual way; they know that the moon is not really a ball, and the

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green carpet is not really grass. Their metaphors reflect observations made concerning their surroundings.

So why have these young poets been so unsuccessful at interpreting metaphors given to them for explication? Various reasons have been suggested, some based upon notions of children's cognitive development, others on issues of task demands, and others related to language meaning and cueing.

Piagetian stage assumptions preclude assigning metaphoric competence to young children prior to the onset of formal operational thinking because metaphors require flexible processing of word meaning (e.g. Lunzer, 1965). However, researchers of a more contextualist bent deny that formal operations is required for understanding metaphoric language (e.g. Vosniadou & Ortony, 1983). They have modified task demands in various ways in order to focus greater attention on context issues, such as the embedding of words in settings (for a review see Vosniadou, 1987). Such modifications have consistently shown children's ability to be greater than indicated on standard tasks.

However, inconsistencies in children's performance remain, probably because the influence of context has been narrowly defined, and thus has not been considered from a broader, meta-linguistic view. Missing has been a consideration of what children understand about metaphors. Researchers have not addressed whether children are aware of the metaphor's underlying analogical structure. A metaphor, like an analogy, is a comparison.

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An approach is needed that recognizes the role of context as an influence not only in what the child encounters in the task but also in what the child brings to the task. Children need support in dealing with figurative language. In order to modify children's receptive language in this area, metalinguistic supports, such as the knowledge that a metaphor is a comparison, should be part of a child-centered context.

Children's dependence on contextual cues is apparent in their play, where they use perceptually similar objects to represent each other, such as holding a block to the ear to represent a telephone, and in their conversation, which tends to concern persons, things, and situations that are present. The role of context in children's interpretation of metaphoric language is the subject of the present investigation.

The present study examines the effectiveness of instruction that is contextually tailored to children's metalinguistic level in order to highlight the underlying analogical structure of metaphors and to demonstrate how this information can be used to interpret them.

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Chapter 2

Review of the Literature

Children's Metaphoric Competence

A metaphor is linguistically defined as a figure of speech in which one term, the topic, is described in relation to another, the vehicle. Their common property, or similarity, is the ground, the basis of comparison. Psychological considerations further define metaphor: the comparison made must be via a link formed intentionally across known category boundaries and must highlight a similarity that will be apparent to others.

Non-literal language makes great metalinguistic demands on the listener, for it requires him/her to find the truth in a statement that is, on the surface, false. The listener must detect the non-literal intent, recognize the relation between what's said and what's meant, and arrive at a conclusion about the speaker's meaning (Winner, 1988).

Piagetian Views. In their study, Asch and Nerlove (1960) examined children's understanding of double-function terms: these are terms that are used to describe both sense impressions and psychological traits (words such as sweet, hard, warm). Correct usage of these words in their psychological sense increased with age; children younger than 6-years-old had little awareness of the psychological meanings. In fact, familiarity with the psychological denotations did not help children younger than 11- and 12-years-old explain the dual meanings: 7- and 8-year-olds often denied that there

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was any connection between the word used in its psychological sense and in its physical sense; 9- and 10- year-olds had greater sensitivity to the connections, but couldn't explain them; 11- and 12-year-olds were able to describe connections between the two domains.

On the basis of their findings, Asch and Nerlove postulated three stages of comprehension -- mastery of object referent, mastery of psychological referent, awareness of the relationship between the two. This final stage they considered to be tied to formal operations.

Pollio and Pollio (1974) felt that these conclusions had some limitations because the dual-function terms used were frozen figures of speech, already assimilated into the language as separate entries, thus separate lexical items. They considered it more useful to look at children's own use of figurative language rather than to evaluate children's explications of someone else's. They found that even third graders, their youngest subjects, produced a substantial number of metaphors. They concluded that concrete operational thinkers can and do make use of figurative language within a specific context, but are unable to explicate such language in abstract terms until formal operations, a finding not unlike that of Asch and Nerlove (1960). Smith (1976), working with sixth and eighth graders, also concluded that formal operational thinking produced the best interpretations of metaphors.

Billow (1975) concentrated his efforts on the relationship between metaphor comprehension and concrete operations. To boys aged 5- to 13-years, he presented metaphors and inclusion questions using the stimuli of the metaphors. Even the

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youngest subjects displayed some comprehension although their interpretations were made on a preoperational or intuitive basis that had limitations: 5-year-olds correctly interpreted less than a third of the metaphors. Concrete operational mechanisms contributed to comprehension; as the proportion of metaphors solved operationally increased, so did the overall number of metaphors solved correctly.

Another study that posited a relation between concrete operations and metaphor interpretation was by Cometa and Eson (1978). They gave subjects at four cognitive stages two different metaphor interpretation tasks -- paraphrase and interpret. Preoperational children gave idiosyncratic and anomalous responses. Children in early phases of concrete operations began to paraphrase correctly. With the development of intersectional class systems, children in the later phases of concrete operations effected correct interpretation 90% of the time. The authors concluded that intersection rather than inclusion (Billow, 1975) is the concrete operational construct that contributes to metaphoric interpretation.

Gardner (1974) probed metaphoric ability in a wide range of ages. He asked subjects from 3.5- to 19-years-old to project pairs of antonyms onto domains not generally associated with them (for example, colors described as loud/soft). Although preschoolers demonstrated a great deal of ability at this task, there was improvement with age.

Gardner also investigated strategies used by the subjects in their matching. Preschool children were reluctant to explain their choices, and the explanations that they did offer were often irrelevant, based on assimilation or literal description. They

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wanted to touch the items, in an apparent attempt to base their explanations on tactile evidence rather than on linguistic ruminations. The 7-year-olds gave reasons that were more appropriate, but their answers were concrete and subjective. The 11-year-olds gave more varied and relevant responses -- new lines of reasoning brought affective answers and multiple explanations, presumably related to formal operations. College students showed even more variety in their responses.

Gardner, Kircher, Winner, and Perkins (1975) examined children's metaphoric preferences. Subjects from 4- to 19-years-old were presented with short stories, each ending with an incomplete simile statement (a simile is a metaphor that uses "like" in its linguistic construction). They were asked to complete the simile on their own, and then to select from among four choices the most appropriate simile ending for the story.

Preschoolers produced a relatively large number of metaphors. Appropriate endings usually came immediately upon completion of the stories, suggesting that the metaphoric link is spontaneous, a conclusion in common with that of later studies (for example, Glucksberg, Gildea, & Bookin, 1982). Many of the children's responses were anomalous or idiosyncratic. On the selection task, their reasoning, even for correct metaphor choices, was generally inappropriate.

Interestingly, although 7-year-olds produced simile endings, they preferred literal endings in the selection task perhaps because they felt more comfortable defending literal choices. These findings reinforce the conclusion that explaining metaphoric comparisons is more difficult than using them.

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Contextualist Views. In the 1980's, researchers moved away from Piagetian constructs for their conceptualizations of developmental differences in metaphor comprehension. In an effort to determine the types of cognitive structures required to deal with metaphor, Vosniadou and Ortony (1983) investigated children's ability to distinguish among literal, metaphoric, and anomalous comparisons when presented in two different task contexts.

On the basis of their results, they made a case for attributing some metaphoric competence to children as young as 4-years because these children could not only reject anomalous comparisons but could also recognize the terms in similarity statements as belonging to different conventional categories. The 3-year-olds, while rejecting anomalies, were unable to consistently choose the necessary literal response in a categorization task. However, they did treat metaphoric similarity statements as legitimate comparisons. No-preference responses were found at all ages. Pearson (1990) also found that children aged 3- to 5-years-old viewed metaphors as semantically valid.

Both sets of results vitiate against any developmental notion that literal similarity is understood before metaphoric or figurative similarity. Such notions had induced earlier researchers to reject attributions of figurative language ability to young children.

It was once thought that figurative language was first interpreted literally, then reprocessed when it could not be understood as a literal utterance. However, when Glucksberg, Gildea, and Bookin (1982) asked college students to judge the literal

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falseness of a given statement, they found that subjects took significantly longer to make judgements about metaphors. One of their examples is "some marriages are like jails," a statement which takes longer to judge literally false (because a figurative interpretation is viable) than a statement such as "some marriages are like oranges." In other words, possible metaphoric interpretations interfered with subjects' ability to make literal judgements, something the authors called a metaphor interference effect, demonstrating that metaphoric meanings are automatically registered.

Many factors have contributed to underestimation of young children's capacity for figurative language. A fundamental issue in assessing children's metaphoric understanding is vocabulary. Obviously, a child must know the words used in a metaphor. However, a child's familiarity with the particular words does not guarantee understanding of their use in a given metaphor.

Young children's word meanings are typically based upon characteristic features or familiar instances rather than criterial semantic features (Keil, 1987; Keil & Batterman, 1984). Characteristic features tend to be easily perceived and presumably easily accessed. For example, a jail characteristically has bars on its windows. In contrast, defining features are conceptual, not directly observed, and so less readily assessed. A jail's defining feature is that it imprisons and does not allow one to leave. Preschoolers give characteristic features almost exclusively when asked to define a variety of concepts while fourth graders tend to rely on defining features, as do adults. Young children's word meanings include attributes that adults' do not and exclude attributes that adults' do. Additionally, attribute salience on particular concepts differs

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for children and adults. For example, an uncle need only be the brother of a parent whereas children may tend to think of an uncle as an adult male who gives them presents.

The saliency of terms is an important consideration in understanding metaphor comprehension (Ortony, 1979; Ortony, Vondruska, Foss, & Jones, 1985); the vehicle -- the B term -- is high on the grounds of comparison, while the topic -- the A term -- is relatively low on the ground attribute (Katz, 1982; Ortony, 1979), providing a contrast that allows the topic to be seen from the perspective of the vehicle (Vosniadou, 1987). Thus, like in an analogy, new information is assimilated into old, more familiar or more salient knowledge (Miller, 1979).

Evans and Gamble (1988) asked third, fifth, and seventh graders to list the attributes that came to mind for each of 44 terms. These terms were then used in the construction of 22 metaphors, and presented to the subjects six weeks later. Third graders were significantly more likely to interpret a metaphor correctly if they had spontaneously listed the attribute that formed the basis of comparison as salient for the vehicle. At each grade level, the most common error (53%) was to incorrectly apply an attribute previously listed to a metaphor interpretion.

Modifying Context. A major consideration in assessing young children's metaphoric ability is context. Vosniadou, Ortony, Reynolds, and Wilson (1984) found that predictability of context significantly improved the metaphoric understanding of preschoolers. Similarly, Billow (1981) found a high incidence of metaphoric production and explanation among children in the context of a play situation.

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In the attempt to provide a useful context in which children's metaphor comprehension can be aided, researchers first need to let the child know that a non-literal response is required. As Brown (1989) points out, knowing the rules of the game contributes to flexible access to knowledge. In their investigation of various types of metaphors, Nippold, Leonard, and Kail (1984) explicitly informed the children, aged 7 and 9 years, that the sentences were of the "pretend" variety. Ortony (Vosniadou, 1987) has found that metaphors phrased as similes serve to cue the child that a non-literal interpretation is required. Given appropriate cueing, children as young as 4-years can interpret metaphors in order to act them out (Vosniadou et al., 1984) and are able to preserve semantic relations during analogical mapping, an ability required in metaphoric processing (Gentner, 1977).

The use of target attributes as primes is effective in providing a context in which metaphoric interpretation is more viable. Gildea & Glucksberg (1983) used literal and figurative priming sentences for metaphors. For example, "some tools are cutting" and "some remarks are cutting" served as primes for "smiles are razors." Adults can benefit from being primed on the attributes used as metaphor grounds because novel metaphors presented to adult subjects do not receive consistent interpretation (Fraser, 1979). By highlighting the metaphor's ground, primes serve to focus attention on the specific/vehicle relationship required to understand the metaphor, similar to the way that mapping highlights the "ground" of an analogy.

Gentner (1983; 1988; 1989) applies a theory of analogy structure mapping to metaphor. She distinguishes several types of metaphor, the most basic being the

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attributional metaphor, which is constructed upon a ground of perceptual similarity, for example, the sun is a ball, eyes are pearls, or a road snakes. Relational metaphors grow from relational matches -- topic and vehicle are compared on a ground of common function, such as the president is the head of state or the eyes are windows to the soul. She has found that older children and adults have a relational focus in their interpretation of metaphor. She attributes this to a developmental shift away from an emphasis on perceptual features; younger children tend to interpret metaphors based on perceptual similarity (Gentner, 1988; 1989). Other researchers have also noted that perceptual metaphors are more accessible to, and preferred by, younger children (Billow, 1975; Cicone, Gardner, & Winner, 1981: Silberstein, Gardner, & Phelps, 1982). Brown (1989) attributes developmental changes from perceptual to relational focus to increased domain knowledge; children restructure their conceptual knowledge to include functional information (Carey, 1985). Vosniadou (1989) also argues that when domain knowledge is limited, children, as well as adults, reason on the basis of perceptual similarity. Therefore, modifications in context that take into account existing domain knowledge are helpful.

Vosniadou (1987) summarizes three possible sources of difficulty for the young child in metaphor comprehension: (a) failure to realize that an implicit comparison is required; (b) failure to recognize the nature of the relationship between the topic and vehicle due to lack of relevant knowledge, inattention to terms, or differences in saliency attributions; (c) difficulty in verbalizing an explanation despite adequate comprehension.

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Also contributing to the underestimation of young children's capacity for figurative language is children's unfamiliarity with "frozen" metaphors -- those used in everyday conversation, whose meanings are known to older subjects, such as time flies, Joe eats like a pig, or sleeps like a log -- that are often used in metaphor comprehension tasks, a criticism Gentner (1977) addressed in designing her tasks.

The ability to perceive similarity and the ability to conceive of one object as if it were another are requisite metaphoric capacities that are available to young children as demonstrated in their symbolic play. Young children have and express some metaphoric competence, and as research in this area has progressed, they have gotten more credit for their abilities. They are, however, highly susceptible to variables such as the abstractness of the metaphoric ground, and the context in which the metaphor is presented. The tailoring of task demands must proceed from an understanding of what children need to know about metaphors before they can approach an interpretation task; only then can children's metaphoric comprehension be assessed.

The importance of context in the interpretation of language is not limited to metaphors - children are better able to understand unfamiliar idioms when the context encourages figurative interpretation (Levorato & Cacciari, 1992). Contextual cuing aids in the understanding of literal language as well (e.g. Barsalou, 1989).

Summary on Children's Metaphoric Competence. In summary, much research has demonstrated the difficulty young children have when they encounter figurative language. In the 1960's, it was thought that children younger than 12 years could not interpret metaphors successfully, due to their lack of formal operational

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thinking. In the 1970's, there was greater refinement of tasks and a willingness to concede that concrete operational thinkers could offer some metaphoric interpretations.

The 1980's saw a great deal of research in this area, tackling the problem from alternative points of view. Finer distinctions among metaphor types were made, leading to conclusions that certain kinds of metaphors, such as those based on perceptual similarity, were more accessible to children. Additionally, aspects of context, including phrasing, cueing both to the non-literal nature of the language and to pertinent comparison attributes, and task demands, were examined. Metaphoric language was seen as being processed non-optionally, as demonstrated by the metaphoric interference effect, rather than only by default when a literal interpretation fails.

This view cast doubt on the belief that figurative language developed later than literal and made the study of children and metaphors more viable. The result of all this work was to delineate more precisely the circumstances under which children are more likely to interpret metaphors correctly.

The age at which children were successful at metaphor varied with the nature of the tasks set for them. However, most of the research of the late 1970's and 1980's indicated the age of onset for metaphoric understanding was younger than had been thought previously (approximately 7- to 9-years-old).

Three and five-year-old children were seen as having some emergent or precursor ability. They could discriminate an anomaly from literal and metaphoric statements, and they identified metaphors as legitimate statements in contrast to

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anomalous sentences. They performed well on non-traditional tasks, such as acting out metaphoric sentences.

It seems clear that children are better at producing and using metaphors than they are at explaining them. In order for children to interpret metaphors successfully, they need to have task demands modified. If young children are given metalinguistic information that clarifies the underlying structure of metaphor, they will be better prepared for interpretation tasks.

Analogical Reasoning

Analogies are the logical underpinnings of metaphors. An analogy serves as a necessary but not sufficient condition of metaphor (Mac Cormac, 1985). A metaphor expresses an analogical relation, highlighting certain properties of one object by calling it another (Nippold, Leonard, & Kail, 1984). For example, the metaphor "a frame is a picture's fence" has as its analogy the relation between frame/picture and yard/fence. Metaphors demonstrate analogical reasoning at a linguistically creative level. Analogies and metaphors share an emphasis on the discovery of similarities.

Similarity. According to Rumelhart, one of three common processes for reasoning about novel situations is reasoning by similarity, wherein a problem is solved by comparing and assimilating it to one for which a solution is known (Rumelhart, 1989). At one end of the reasoning-by-similarity continuum is remembering, in which the two problems map feature-for-feature, and a new solution requires only the recall and direct application of the original solution. At the other

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end of the continuum is analogical reasoning which requires transfer of relational features.

Vosniadou (1989) agrees that analogical reasoning reflects the transfer of structural information from a source to a target system. Gentner (1989) concludes that an analogy is an assertion that a relational structure from one domain can be applied to another. Analogy is thought to be a major factor in the flexibility of the human problem solver (Holyoak, 1984; Holyoak & Koh, 1987), and so has been a subject of study over several decades in the area of intelligence (Sternberg, 1982b).

Analogy produces information about a novel target domain by transferring knowledge from a source domain that is familiar and better understood. Holyoak and Koh (1987) believe that this transfer takes place in four not necessarily sequential steps: (a) construction of mental representations of the source and target; (b) selection of a source analog; (c) mapping of source to target components; (d) extension of the mapping to generate a solution. In the effort to coordinate multiple pieces of knowledge, learners conduct a wide-ranging, bidirectional search over an extensive body of information in long-term memory. The search for relations among elements results in new interconnections forged in the nodes of the mental network system.

Because no direct retrieval pathway exists for two never-before associated domains, Holyoak and Koh (1987) offer a theory of summation of activation. When multiple shared features exceed some threshold, a representation becomes available for more processing, such as the initiation of explicit mapping. Superficially similar features aid in the initiation of a mapping which ideally highlights some structurally

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similar feature. The ability of adults to notice possible analogies has consistently been shown to be limited, even when the analog is presented in the same experimental session (for example, Gick & Holyoak, 1980; 1983). In contrast, Holyoak and Koh (1987) found much (69%) spontaneous transfer among adults when both surface and structural commonalities connected the source and the target.

However, when problem solvers are less dependent on surface similarities, they can focus more closely on structural features and improve their chances of retrieving a useful analog. Analogies are more helpful when they share exclusively structural features such as in the comparison between a baby and a teenager's first car. Adults recall more information, more readily make inferences and solve new analogies when the source of their instruction is an analogy whose referents come from distant domains (and thus do not share surface similarities) (Halpern, Hansen & Riefer, 1990).

In fact, surface similarities can impair transfer because they distract from the investigation of deeper connections and can cause confusion if the problem solver cannot discriminate them from the structural features that are in common. Children are particularly vulnerable to difficulty in ignoring non-pertinent information even when the source analog is given (Zook & Di Vesta, 1991). Surface similarities may also lead to an overestimation of the role of associative techniques for solving analogies (Gentile, Kessler, & Gentile, 1969). For these reasons, the theory of summation of activation is limited and superficial. It is necessary to delve deeper into the workings of analogy.

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Mapping. A potent theory of analogy is that of structure mapping. The central theoretical notion is that an analogy reflects a mapping of a system of relations. The analogy focuses upon relational commonalities that are independent of specific objects and seeks correspondence between the domains for maximum structural match. Only systems of relations are matched; any incidental similarity between objects is ignored in favor of preserving the structural mapping, such as comparing the functioning structure of the atom with that of the solar system (Gentner, 1983, 1989).

An analogical mapping requires the linking of the first half of the analogy with the second by finding the higher-order relation between the two lower-order relations, the A:B and the C:D (Sternberg, 1982a). For example, "puppy: dog :: kitten: cat" links the two halves of the analogy on the basis of development, from immature to mature and young to adult. The ability to consider second-order (operations upon operations) relations is thought by Piagetians to mark the shift from concrete to formal operational thinking (Piaget, 1947/1963).

Holyoak (Holyoak & Koh, 1987) includes mapping in his definition of analogy, as does Sternberg (1982a, 1982b), who has described analogy in terms of the following component processes: (a) encoding of terms, (b) drawing inferences, (c) making applications, (d) mapping, (e) selecting a response, (f) justifying a response. Encoding is the only attribute-identification component. During encoding, a stimulus is translated into an internal representation which is stored in working memory and is thought by Sternberg to consist of an attribute-value list.

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Inference is the discovery of the rule which links the A and B terms. Mapping is the discovery of the rule which links the domain (A and B) of the analogy with the range (C and D), so a rule that connects A and C is required. Application is the generation of a rule that forms an image of the correct answer for the D term and evaluates possible alternatives against it. The outcomes of these three attribute-comparison components are stored in working memory. Selection and response are control components that monitor solution (see Figure 1).

Attribute Identification	**Discovery of Rules**	**Solution**
Encoding	Inference (A-B) Application (D) Mapping (AB-CD)	Selection Justification

Figure 1. Sternberg's components of analogy processing.

Children's Analogical Reasoning

From these components, Sternberg has created several models of analogy solution (1982a), which he and his colleagues have tested and fit to various populations (Sternberg & Rifkin, 1979; Sternberg & Nigro, 1980). For example, Sternberg and Rifkin (1979) found increased analogical reasoning from second grade through college. The younger children's poor performance was largely attributed to their tendency to use self-terminating procedures, which limit the number of attributes under consideration at one time, on encoding and inference. Self-terminating operations require only one attribute be stored in working memory at a time, thus

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minimizing processing demands, but leading to greater inaccuracy of response. Exhaustive operations increase memory load but pay off in correct responses.

<u>**Associative Strategies**</u>. Sternberg has repeatedly found that children younger than 10 years old do not solve analogies in the same way as older and/or more skilled subjects do. These children do not perform the required component of mapping (Sternberg, 1982a), relying instead on word association to arrive at solutions. Sternberg and Nigro (1980) found that the degree of association between the analogy stem and the correct response was predictive of performance for the 9- and 12-year-olds, but not for older subjects. For these children, processing is partially analogical but is easily displaced by associative reasoning when the demands placed upon working memory become too great.

Sternberg (1982b) investigated incremental latency in the solution of pictorial analogies by manipulating the number of attribute values changed from the first to the third term (A to C). For example, with people pieces, the figures vary on several dimensions such as male/female, tall/short, fat/thin, hat/hatless. Analogies are drawn to show comparisons between figures that differ on one or more of these dimensions. The greater the number of changed attributes the longer the latency to solution.

Older children (grades 4 and 6) and adults did map according to the estimated latencies. However, for the second grade children, number of attribute values changed was not a source of incremental latency in their solutions.

Sternberg concludes that these children solve pictorial analogies without mapping second-order relations, relying instead on association. He offers his findings

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as evidence for the Piagetian three stage model of analogical reasoning. During the concrete operational period, children are unable to recognize second-order relations. However, they display some preliminary ability during the middle, transitional stage. Finally, with formal operations children become able to comprehend second-order relations fully.

Goldman, Pellegrino, Parseghian, and Sallis (1982) also found evidence for the use of associative strategies among younger and among less skilled reasoners. These children were easily distracted by high associative alternatives in a forced-choice task, despite their having previously generated correct responses.

Associative reasoning is not restricted to children; Sternberg and Downing (1982) found that adolescents reverted to an associative strategy for solution when the task demands of solving analogies between analogies became too great.

Encoding Overload. The use of associative strategies might indicate that the encoding component has overpowered and preempted the other components. In a figural analogy, there are a limited number of attributes that must be encoded (Sternberg & Rifkin, 1979). However, for verbal analogies, the number of possible attributes that might be encoded for each term is unlimited. Sternberg has no mechanism for describing when the encoding process is considered completed and shuts itself off so that inference may begin, nor can he account for developmental variations in attribute lists. Presumably, the attribute listing continues until enough values are listed to guarantee overlap among subjects.

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However, child-basic categories are not isomorphoric to adult-basic categories (Mervis, 1987). Children de-emphasize certain object attributes adults consider important while highlighting others that adults consider less central. Therefore, the encoding taking place in an adult's mind is probably very different from the attribute listing occurring in the child's mind.

If encoding does indeed involve attribute listing, the child is at a disadvantage from the beginning. The analogy task is posed by an adult and ruled by adult-basic word categories. Even if it were possible for children to generate attribute lists similar to adults', the task would require extensive memory capacity beyond their ability (Sternberg & Nigro, 1980).

Although Sternberg (Sternberg & Rifkin, 1979) has attempted to generalize his theory to children, his conclusions about children's reliance on associative strategies due to an inability to map are premature. In fact, Sternberg's methods of measuring latency as a simple additive formula have been criticized by Bisanz (reported in Goldman & Pellegrino, 1984). He found speed of processing to be equivalent across age groups on one element analogies, but that 10 year-olds were slower than two older groups (12- and 19 year-olds) when processing three element analogies. Bisanz felt these findings demonstrate that the greater the complexity of an analogy, the greater the possibilities for interactions among the processes required for solution. He concludes that a source of developmental change might be the ability to maintain efficient processing in the face of complex stimuli.

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Analogical Inferencing. Levinson and Carpenter (1974) believed that the source of children's difficulty with analogy comes in the inference process. They offered 9-year-old subjects quasi-analogies, such as "birds fly in the sky, and fish swim in the (sea), " in lieu of standard ones. They felt that children given the relational inference would outperform those completing a standard analogy task.

Not surprisingly, children found the quasi-analogies easier to answer. However, the comparison is irrelevant because the analogy is changed to an incomplete sentence where the first half of the sentence is unnecessary for the completion of the second. In constrast, the first half of an analogy (the A and B terms) is vital in determining what D term to select for C. It seems unreasonable to draw conclusions about children's analogical reasoning by assessing their ability to do sentence completion.

Goldman et al. (1982) conducted a study with children 8 and 10 years old that examined sources of differences in verbal analogical reasoning ability. They felt that children's difficulty with drawing relational inferences might have to do with general inattention to the A and B terms of the analogy and that the use of a forced-choice task, in which an answer had to be selected rather than generated, would give children an opportunity to recognize a relation that might have otherwise been elusive or outside of the search space.

Selection tasks have the advantage of a recognition factor. A child unable to generate an answer might still be capable of recognizing it from among several

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choices. These tasks have a disadvantage as well since alternate (incorrect) choices serve to distract the child from the correct response.

All the children first received a generation task in which they had to produce the fourth term of the analogy. Two weeks later, they received the forced-choice task in which they had to select the fourth term from among five alternatives and justify their choice. An overall age effect was found in favor of the older children on the forced-choice analogy task. However, there was a wide range of ability within each age group and overlap between groups. The children were also asked to justify their responses. The third graders had a tendency toward non-parallel and idiosyncratic explanations of their responses. Again, individual differences were substantial; less skilled children in both groups justified only half their correct responses with parallel relations.

In a second experiment, with a second sample of third and fifth graders, the researchers took each subject through the steps involved in analogy solution. First, the child was asked to produce a relationship between A and B, then produce a completion term for the three-element stem, then choose a response from among the alternatives.

The process components of inference, application, response recognition, and distractor interference were all statistically significant, although inference was the least important contributor. The two components unique to the forced-choice measure -- recognition and interference -- together made a larger contribution to individual differences than did the combination of inference and application. The probability of a

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correct response being tied to a parallel relations justification was significantly correlated with overall forced-choice accuracy. The overall general level of performance was higher on the second experiment, probably due to the explicit procedural directions given the subjects. Again children are shown to be susceptible to association in their leaning toward distractors.

Using Inference. The advantage of focusing on inference as a component of analogy is that inference helps to place limits on the encoding process. Finding the A-B relation helps define each of the terms. Take, for example, the word "foot" as the A term of an analogy. Unrestrained encoding would cause a subject to spend time generating a list of attributes including, perhaps, "toes," "walk," "shoes," "bunion," etc. (The difficulty of predicting what would be on any particular person's list is apparent.)

The B term might be "sock." Generating a second list, this time for sock ("wool," "hole," etc.) doesn't seem to get any closer to solution. However, if one were to consider "foot: sock" as a unit, s/he would immediately fix on the foot's attribute of desiring warmth and the sock's attribute of providing it. On the other hand, if one were to find that the word "inch" was the B term of the analogy, s/he would have to discard the attribute list generated for "foot" when it was thought a part of the body was indicated. It would seem that inference is the mechanism that delineates the parameters of the encoding component.

The difficulty in forming an inference is that in many cases, there are many possible relationships. Sorting through them may tax the memory capacity of young reasoners. Also, children are less likely to identify the most promising or most

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probable of these relationships, and may follow a false path which further complicates the task for them.

Analogical Reasoning in Context. In an effort to improve the conditions under which young children respond to analogy tasks, several investigators have tried non-traditional approaches. Gentner (1977) looked at children's (aged 4.4 -- 5.2 years, and 6.7 -- 7.1 years) and adults' ability to use spatial analogies to map six body parts onto trees in an orientation task, and two face parts onto mountains in a local-features task. For example, a question was, "if a (tree) had a (knee), where would it be?"

Gentner chose to use conceptual domains (body parts and common physical objects) that are familiar even to young children thus avoiding any differential familiarity that might put adults at an advantage. She used a nonconventional task to avoid the effects of prelearning, and she used phrasing that made it clear that analogical reasoning was required. As a result, there were no significant age differences on the orientation task. However, on the local-features task, the two groups of children, whose scores didn't differ significantly, outperformed the adults.

Holyoak, Junn, and Billman (1984) wanted to know when children are first able to apply simple analogies in solving a problem solving task and to delineate some of the conditions and components of analogy that might pose particular difficulty. Children were read one of two stories about how a genie solved a transfer problem. Then they were given a variety of materials and asked to solve the experimenter's problem, which was analogous to the one in the story.

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Preschool children (aged 4.7 -- 6.0 years) were successful in arriving at a solution when the story and the target material were similar in function and in perceptual features (a magic staff for the genie and a cane for the experimenter); half the children arrived at the target solution spontaneously, while the other half responded after hearing the experimenter's hint to use the story. About one third of the children who heard the second version of the story in which the genie uses a rolled-up carpet to transfer jewels, rolled up a sheet of paper to solve the experimenter's problem prior to any sort of hint.

Brown (1989) worked with even younger children and found that they could transfer across tasks of analogical reasoning if they were given the proper contextual supports. In one study, she contrasted functional fixedness -- in which a tool's potential for use in a situation is masked by its habitual function -- with flexibility (where a tool is used in a variety of ways), and with a neutral condition. She found that children's experience with paper's many potential uses enhanced their ability to transfer and to use paper as a solution tool in a new task. This was true for even the 2-year-olds. However, using paper in only one function impeded transfer at all ages studied. Only in the neutral condition were younger children at a disadvantage in comparison to older children, who transferred more readily. Brown attributes this finding to metacognitive knowledge. In her view, older children provide for themselves the supports that younger children rely upon the context to give them.

Based upon her own research, Vosniadou (summarized in Vosniadou, 1989) concluded that children are capable of mapping from a source analog to a target

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domain when they have sufficient background knowledge about both source and target, and when the mapping is consistent with what is already known about the target. Kindergarteners and second graders were able to use an explanatory analogy to understand an infection as having qualities in common with war (Vosniadou & Schommer, 1988). Children, however, lack general rules and domain-free heuristics for solving problems that involve analogical reasoning.

Summary on Children's Analogical Reasoning. In summary, children as young as 5-years-old are thought to have an emergent ability to solve analogies. This ability improves in the years from 5 -- 7. However, there is a wide range of individual differences at each age level, i.e., a skilled 5-year-old performs better than a less skilled 6- or 7-year-old, for example. Similarly, a wide range of ability has also been noted among 8- to 12-year-olds; poor performance under certain circumstances has been found with adolescents.

Young children have difficulty in standard tasks of analogical reasoning despite their clear ability to make transformations in their imaginative play and social interactions, where they modify their language, behavior, and object use in accordance with the requirements of the context (Garvey, 1977; Shatz & Gelman, 1973). Some researchers have blamed analogy task demands for children's poor showing. Variations in traditional methods have shown off children's skills to better advantage. Children as young as 4-years have mapped parts and story analogs. Children as young as 2-years have demonstrated some ability when tasks were tailored to their needs.

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Children 9-years-old do better on quasi-analogies, where the inference is given. However, reducing an analogy to a sentence completion task is not the only way to improve children's performance.

Highlighting Parallelism

When children are given specific procedural directions regarding standard analogies, children's performance improves. Therefore, it seems that children can infer A-B relationships when they are sufficiently aware of the parallelism constraint upon solution. Evidence that children don't sufficiently attend to the A-B relationship comes from the justifications that 8-year-olds give for their responses -- they rarely mention parallel relations. Also, these children are easily distracted by alternate choices for the D term. They will bypass the D term that offers a relational completion in favor of an alternative with high associative ties to the C term, even when they had previously generated a correct response (Goldman et al., 1982). A similar lack of parallelism was noted among fourth graders (Gallagher & Wright, 1979). Sixth graders were better able to give symmetrical explanations.

It may be that children's processing ability is overtaxed by the requirements of the analogy task as typically presented and so they rely on a simpler, associative strategy for solution. Again, analogy response justifications by third and less skilled fifth graders indicate this is a possibility. Even adolescents use associative strategies when task demands become too great (Sternberg & Downing, 1982). Also, if Sternberg's description of encoding as attribute listing is accurate, children are at a

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disadvantage from the start by virtue of having word categories that are not isomorphic with those of older subjects.

Inadequate understanding of the constraints of analogy solution, the most pertinent of which is the requirement of A-B and C-D parallelism, contributes to children's poor performance on analogy tasks. Children need to know that an analogy requires the preservation of the A-B relationship when applied to C-D. Clarifying the mapping component should be successful in improving the ability of young children to solve analogy problems.

<u>Mapping Applied to Metaphors</u>

Metaphors rely upon analogical reasoning for their interpretation (Miller, 1979), so children who have become proficient at analogy solution should demonstrate an improved ability to interpret and explain metaphors.

The difference between analogy and metaphor has to do with the degree of difference between referents (Mac Cormac, 1985). Although the most memorable and most useful analogies are from far domains (Halpern, Hansen, & Riefer, 1990) (for example, "words: page :: grass: ground"), it is possible to find meaningful analogies whose referents are from near domains ("puppy: dog :: kitten: cat"). In contrast, metaphors require a distance between referents in order to be considered apt (Tourangeau & Sternberg, 1981) and distinctive from literal similarity statements (Vosniadou & Ortony, 1983). The other difference, of course, is that analogies involve literal language whereas metaphors do not. Metaphors are "context-bound" and more likely to need additional supports in order to be understood (Sticht, 1979).

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The growing attribution of metaphoric competence to children under 12 years is mirrored in the growth of analogy research, where children have also been found to understand analogies at younger ages when task demands have been modified. Also, children benefit from direct and explicit directions when dealing with analogies (Goldman et al., 1982). However, to optimize analogy instruction, feedback and structuring, in order to highlight parallelism, are necessary additions, even for adolescents; Whitely and Dawis (1974) found that only the most comprehensive of five experimental interventions was helpful in improving the subjects' performance on analogy items. Instructions given with structure and feedback was the most effective method.

In an earlier study, the researcher found that 5-year-old children taught to discover a functional relationship between two objects were not only able to use this rule but were also better able to understand functional metaphors than were children who did not receive instruction (Castillo, 1990). A modeling technique was used to demonstrate correct performance, to transmit the rules of the game (Rosenthal, Zimmerman, & Durning, 1970), and to help the children replace one strategy, namely a perceptual response set, with a more abstract one (Zimmerman, 1974).

Children were shown pictures of objects in pairs and asked, "how are these alike?" Possible relationships were either perceptual or functional. For example, in comparing a crown with a roof, the perceptual similarity is that both are pointy, while the functional similarity is that both cover. The instructional group of children was then asked to watch how a puppet model used a rule to play the game. The puppet

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related each pair by function. These children were then asked to play the game for the puppet. Not only were their responses overwhelmingly functional but their metaphor interpretations in a later phase were functionally based. This was in contrast to children of the non-modeling group (Castillo, 1990).

Although the connection between analogy and metaphor seems to be one of great potential, the only study that has investigated this relationship is by Nippold and Sullivan (1987). They compared children's performance on two types of analogies, figural and verbal, with their performance on interpreting proportional metaphors. They found a small but significant relationship between figural analogies and metaphor but no relationship between verbal analogies and metaphors. This second, very surprising result is no doubt due to the fact that they used metaphors that violated the constraints of the study. That is, several of the metaphors could not be decomposed into analogies, and their meanings were quite obscure. Also, there was no instruction in any of the three tasks; an orientation session was designed only to inform the children of the task.

Present Study

The present research sought to determine whether there is a relation between analogy solution and metaphor comprehension by instructing young children in analogies. This instruction was intended to provide a comprehensive context involving the interaction of task demands and child knowledge about heuristics (Zimmerman, 1983). The importance of providing a comprehensive context for analogy solution was demonstrated in a study by Whitely and Dawis (1974).

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It was hypothesized that children's ability to interpret metaphoric language would be enhanced by training in the solution of analogies. It was expected that directing children through the use of modeling to make an A-C mapping when confronted with a standard analogy would improve their ability to arrive at correct solutions and positively effect their ability to interpret metaphors.

Modeling was chosen as an instructional technique because it has been shown to be effective in rule learning and other situations in which abstract information needs to be communicated. Also, it is motivational and efficient, allowing the learner to avoid trial-and-error attempts at gaining knowledge. Modeling helps to direct the learner's attention. This is especially important when dealing with analogy because extraneous encoding or inferencing can derail the process of interpretation. Modeling procedures have the additional advantage of being readily used in classroom settings.

A model demonstrated the analogy strategy by mapping the A-C relationship, stating the A-B rule, applying it to the C term to find D, and then offering a parallel explanation to justify the solution.

The instruction used in this study focused on the mapping aspect of analogy because mapping reflects the component most closely associated with metaphor and because children have been found to have some difficulty with it. Highlighting parallelism should help children focus upon the types of relationships needed in order to interpret metaphors.

Proportional metaphors, phrased as similes, were used for the metaphor interpretation task. A proportional metaphor is an analogy with one term left unstated.

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It compares the A and C terms. For example, the analogy "jam: bread :: paint: wall" is the basis for the metaphor, "jam is paint for bread". Here, jam (A term) is likened to paint (C) used for bread (B) instead of for a wall (unstated D). The A-C mapping, which compares jam and paint as both spreadable, or adding color, helps in the solution of both the analogy and the metaphor. Mapping is the analogy component that makes clear that parallelism is required. Understanding parallelism should help in the interpretation of metaphors.

Functional comparisons were used as the basis of all the analogies and metaphors because sensitivity to functional similarities is a more abstract ability than recognition of perceptual similarities (Gentner, 1988).

In summary, children given explicit strategies to solve functional analogies, namely, children for whom the notion of parallelism in relating the A-B and C-D terms is made salient through rule use and modeling of mapping, should be able to map the A-C relationship by:

1. inferring the specific A-B relation;
2. inferring the parallel C-D relation;
3. selecting the correct D term from among three choices;
4. justifying their response in terms of parallelism;
5. identifying the missing (unstated) D term in a proportional metaphor;
6. interpreting the metaphor in terms of the underlying analogy.

The hypotheses were (1) analogy-plus-modeling group children would justify their analogy responses with parallel explanations more often than would the analogy

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exposure group children, and (2) analogy-plus-modeling group children would interpret correctly a greater number of metaphors than would the children of either the analogy exposure or control groups. The dependent measures were parallel justification and metaphor interpretation. Correct metaphor interpretations would approximate standard paraphrases of these metaphors.

The treatment condition is intended to address concerns expressed by researchers regarding domain knowledge, mapping, and parallel justification, and to extend existing research on children's metaphoric comprehension by establishing the relationship between analogy and metaphor.

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Chapter 3

Method

Subjects.

The subjects were 63 children, aged 5.6 to 6.6 years, 34 girls and 29 boys, from Hunter College Elementary School in Manhattan, an ethnically diverse school for intellectually gifted children. The subjects were representative of the school population which is middle-class, approximately 50% white, 50% minority (black, hispanic and asian). Girls and boys were fairly evenly distributed among the three groups. The original pool of children numbered 68, but five children were dropped because their parents did not give permission for their participation.

This age range was targeted in order to expand on an earlier study that had been successful in influencing a similar group of children to offer functional responses on a literal comparison task and a metaphor comprehension task (Castillo, 1990) and to contribute to recent work which has explored the metaphoric understanding of very young children (e.g. Pearson, 1990). Also, children of this age are of interest because they are considered between the precursor ability of 4-year-olds (e.g. Vosniadou et al., 1984) and the beginning ability of 7-year-olds (e.g. Nippold, Leonard, & Kail, 1984). A verbally gifted population was chosen in the hope of recording elaborated explanations of responses for both analogy justification and metaphor interpretation that would offer additional insight into children's thinking as they approach this type of language task.

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Materials

The materials consisted of three sets of 5 X 8 in. index cards, each divided into four squares, with three pictures drawn in the top two and the bottom left squares and the final square blank. The pictures represent the first three terms of a standard analogy problem (A:B :: C:D). Drawings of three alternative choices for the D term were presented simultaneously. The metaphors, written on sentence strips, were read to the subjects. Each sentence strip was mounted under pictures of the three terms named in the metaphor. A small stuffed animal puppet, with a hidden pull-forward mask, was the model. The puppet uses an arrow as a prop when looking at the analogy cards.

In order to avoid constructing analogy items that could be solved by simple word association - an issue noted by Willner (1964) - possible items for the C term were listed and presented to sixth grade students who were asked to write the first thing they thought of when they read each word. Any pair generated by word association was not used as the final pair of an analogy. (For example, "money: bank :: bird: cage" was rejected as a potential analogy item because in the word association task, children responded to the word "bird" with the word "cage.") Thus, the possibility of correctly solving an analogy on the basis of word association alone was diminished. All of the analogies and the metaphors as well were constructed on the basis of functional (rather than perceptual) comparison.

Possible metaphors were evaluated by students in a high school honors English class. Students rated metaphors for aptness on a Likert-like scale (1-not apt at all... 5-

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very apt) and offered interpretations. A metaphor needed an aptness rating of 3 or more from at least 15 of the 25 students and consistent interpretation in order to be included as an item in the metaphor measure used in this study.

Procedure

Children were randomly assigned to one of the three conditions. Each child was seen individually in one 20 - 30 minute session (see Figure 2).

	Group I **Analogy-Plus-Modeling**	**Group II** **Analogy Exposure**	**Group III** **Control**
Phase I	Analogy Instruction		
Phase II	Analogy Assessment	Analogy Assessment	
Phase III	Metaphor	Metaphor	Metaphor

Figure 2. A description of groups' inclusion in the phases of the study.

Group I - Analogy-Plus-Modeling. During the analogy instruction phase, pictures representing three terms of an incomplete analogy were shown on an index card, with a blank square for the fourth term. Choices for completion were shown simultaneously. All pictures were named. A total of 10 analogy completion items was used. All the analogies were based on functional relationships. Instruction consisted of modeling, explanation of a mapping rule, and feedback. A puppet, same sex as the child, demonstrated his/her way to play the game.

Children were told, "I have a game about putting things together. Each of these cards needs to have four pictures on it, and the pictures should go together in

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pairs. These two things (A and B) go together; this thing (C) needs something to go with it in the same way that these two go together. This is Maryann (George). She plays this game with a special rule to be sure that the two pairs on each card go together in the same way. First, she tries to think of something these two (A and C; cover B) both do. Then, she predicts what this is (B). If she's right, then she knows she's found the right relationship. Then she predicts the missing picture, and looks for the answer among the choices. She has a special pointer to remind her that both pairs must go together in the same way. Watch and listen to what she does."

Puppet: "What do a crown and a roof both do? A crown and a roof both cover something -- a crown covers a king's head and a roof covers a house. There's the king. I'll look for a house. (Selects the house) Crown goes with king in the same way roof goes with house because a crown covers a king and a roof covers a house."

The child and the puppet took turns practicing this technique on three more analogies; the puppet gave feedback.

During the analogy assessment phase, the child was given 10 new analogies to solve without the model's assistance, but using the model's method. Children were told, "Maryann has to go take a nap. She'll be back soon, but she'd like you to finish playing this game for her."

During the metaphor phase, the non-literal nature of the task was explained through the model's use of a mask -- the facial disguise was the signal that the words would be disguised. There were 12 metaphors, phrased as similes, for the child to interpret. All were based on new analogies.

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To introduce the task, the researcher said, "Here's another game about putting things together. I have some sentences that Maryann wrote about these cards, but the sentences are disguised. Maryann wrote them while she was wearing her mask, so she decided to put a disguise on the words. I'll explain one to you. For this card, the sentence is 'a crown is like a roof for a king.' She means that a crown covers the head of a king like a roof covers a house. A crown is like a roof for a king because a crown covers a king like a roof covers a house." Children practiced one example with the puppet.

"Maryann was being tricky when she wrote these sentences but now that you know about her disguise she thinks you will be good at understanding what they mean." Children interpreted the 12 assessment metaphors read aloud.

Group II - Analogy-Exposure. This group did not receive analogy instruction. During the analogy assessment phase, children saw the same materials as seen by the children in the analogy-plus-modeling group with only a brief introduction to the task.

Children were told, "I have a game about putting things together. Each of these cards needs to have four pictures on it and the pictures should go together in pairs. These two things (A and B) go together; this thing (C) needs something to go with it in the same way that these two go together. A crown (A) goes with a king (B) in the same way that a roof (C) goes with a ... house (D). A crown covers a king and a roof covers a house." Children had 10 new analogies to solve.

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During the metaphor phase, the children were given 12 metaphors, phrased as similes, to interpret. The non-literal nature of the task was explained through the model's use of a mask. Children were told, "This is Maryann. She likes to disguise herself, so she puts on a mask. When she's wearing her disguise, she likes to disguise her words. Here are some sentences that Maryann wrote when she was wearing her mask, so she decided to put a disguise on the words. I'll explain one to you. For this card, the sentence is, 'a crown is like a roof for a king.' She means a crown covers a king's head like a roof covers a house. A crown is like a roof for a king because a crown covers a king like a roof covers a house." The child practiced another example with the puppet.

"Maryann was being tricky when she wrote these sentences but now that you know about her disguise she thinks you will be good at understanding what they mean." The child then interpreted the metaphors read aloud.

Group III - Control. This group did not participate in the analogy instruction and analogy assessment phases. However, these children did have the opportunity to look through the analogy picture cards.

During the metaphor phase, the children were given the same interpretation task used for the analogy-exposure group.

Scoring

The analogy posttest was scored by the number of correct D-term selections. For example, in "crown: king :: roof: ___," the correct D term is "house."

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Response justification was scored separately on the number of correct parallel explanations. A parallel explanation is one that refers to the second order relation between the two halves of the analogy (Goldman et al., 1982). Non-parallel and incomplete (one that refers only to the A-B or C-D relation) explanations were each scored zero. Using the same analogy for example, a non-parallel explanation is "kings have crowns, a house is a place to live;" an incomplete explanation, "a king wears a crown;" a parallel complete explanation, "a king's head is covered by a crown and a house is covered by a roof."

The third assessment -- metaphor interpretation -- was conducted for all groups. To be scored correct, a response required paraphrasing that approximated interpretations given by high school seniors, including the functional verb or its equivalent and the missing term or the functional verb applied to both terms in the comparison. For "a crown is like a king's roof," the target interpretation is "a crown covers (is on top of) a king's head like a roof covers a house," or "a crown is like a roof because they are both for covering."

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Chapter 4

Results and Discussion

Results

A one-way analysis of variance showed significant differences among the three groups on the metaphor measure, $F(2) = 8.88$, $p = .0007$. The means and standard deviations for the groups are shown in Table 1.

Table 1
Means and Standard Deviations for the Analogy-Plus-Modeling, Analogy Exposure, and Control Groups on Three Dependent Variables

Group	Variable 1	Variable 2	Variable 3
	Analogy	Parallel Justification	Metaphor
APM			
M	8.05	6.76	7.24
SD	1.12	2.28	2.98
AE			
M	6.00	.76	3.19
SD .	1.38	1.30	3.43
Control			
M	-----	-----	3.48
SD	-----	-----	4.08

Note. APM, n=21; AE, n=21; Control, n=21
The total number of items on both analogy and justification measures is 10; the item total for the metaphor measure is 12.

The analogy-plus-modeling (APM) group significantly surpassed the analogy exposure (AE) group on the comparisons of interest -- the number of complete correct analogy explanations given $t(40) = 10.48$, $p < .0001$ and the number of metaphors

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correctly interpreted t(60)= 4.19, p= .0002. (See Table 2.) Also, the APM group solved more analogies than did the AE group, t(40)= 5.29, p<.0001.

Table 2
Results of t-Tests for Group Differences on Three Dependent Measures

Variable	t	df	p
Analogy			
APM	5.29 **	40	<.0001
AE			
Justification			
APM	10.48 **	40	<.0001
AE			
Metaphor			
APM	4.19 *	60	.0002
AE			
APM	3.41 *	60	.0016
Control			
AE	-.29	60	.7744
Control			

* p < .005. ** p < .0001.

The APM group interpreted more metaphors correctly than did the control group, t(60)= 3.48, p= .0016. The AE and control groups did not differ significantly on the metaphor measure.

Frequency distributions for the analogy, justification, and metaphors measures are shown in Figures 3 - 9.

Children receiving analogy instruction and modeling achieved 80% success (an average of 8 correct of the total 10 items) on the analogy measure. Of the correct responses, 85% (almost 7 of the 8 correct) were given complete justifications. Even

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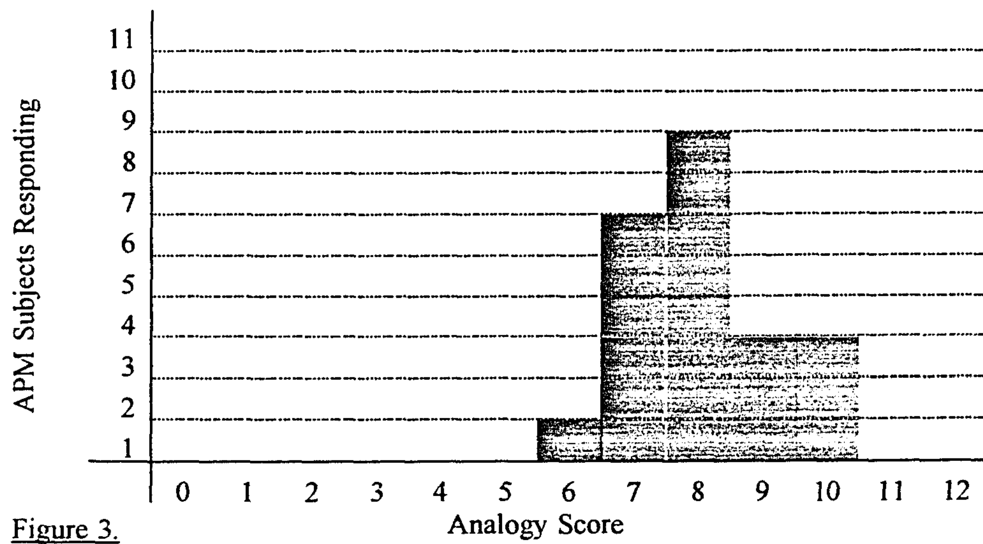

Figure 3.
Frequency Distribution of Analogy Scores for Analogy-Plus-Modeling Group

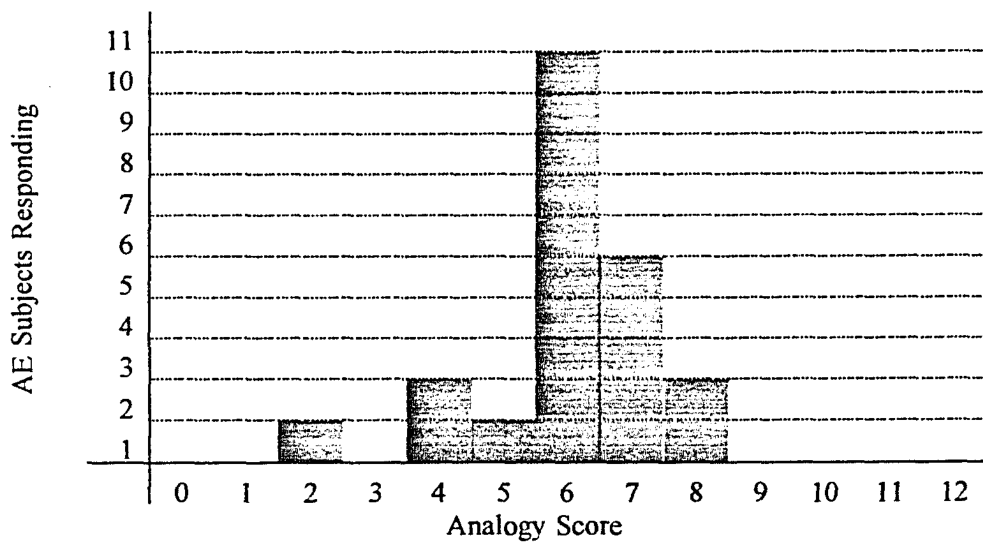

Figure 4.
Frequency Distribution of Analogy Scores for Analogy Exposure Group

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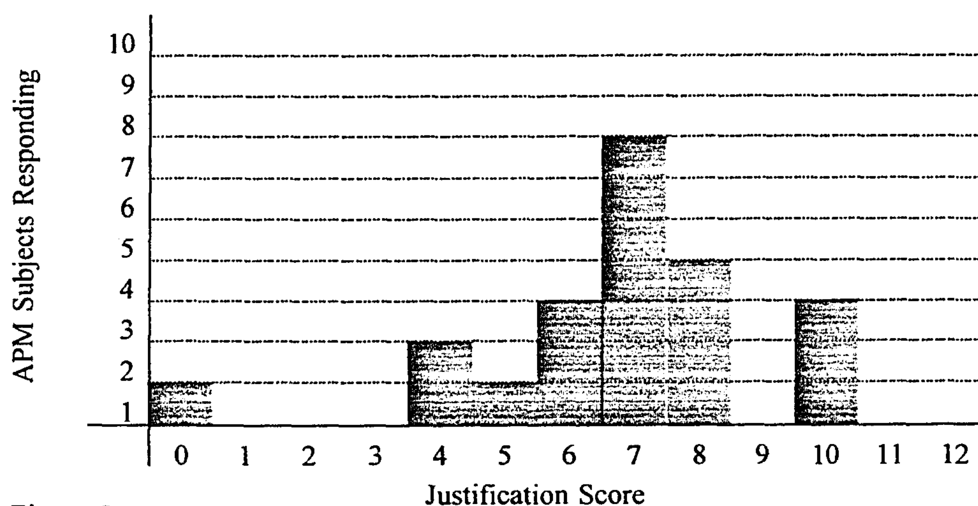

Figure 5.
Frequency Distribution of Justification Scores for Analogy-Plus-Modeling Group

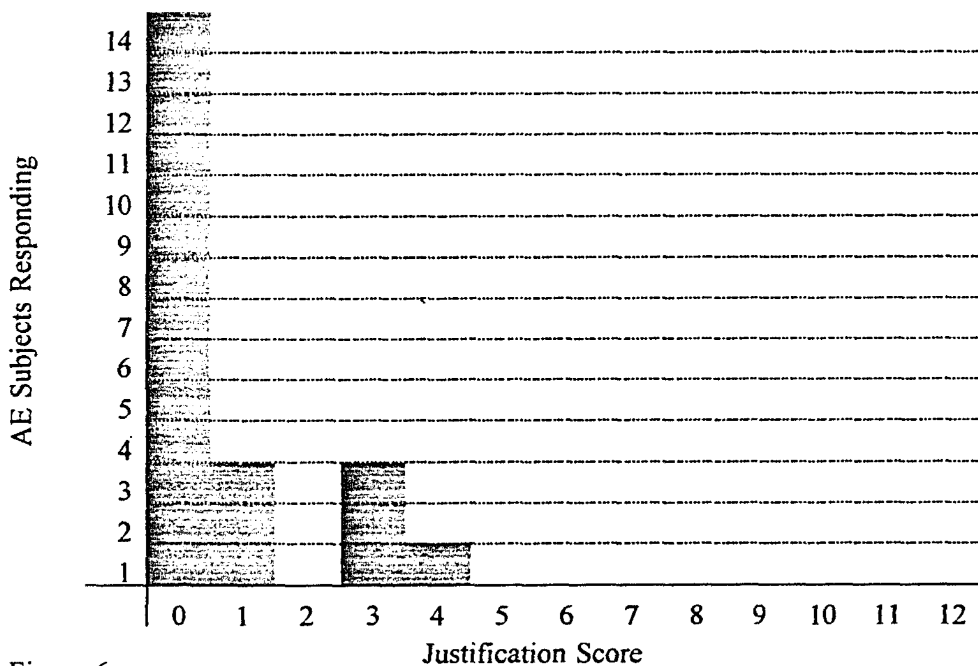

Figure 6.
Frequency Distribution of Justification Scores for Analogy Exposure Group

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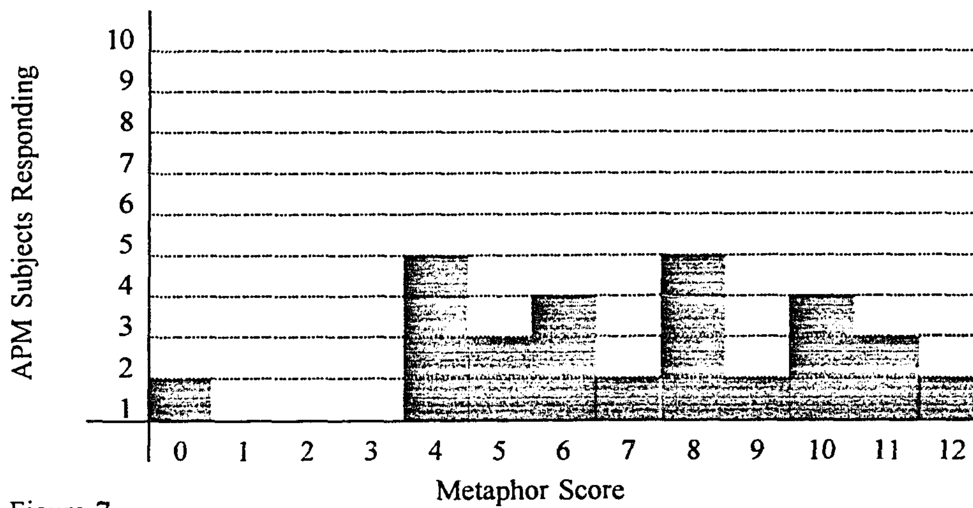

Figure 7.
Frequency Distribution of Metaphor Scores for Analogy-Plus-Modeling Group

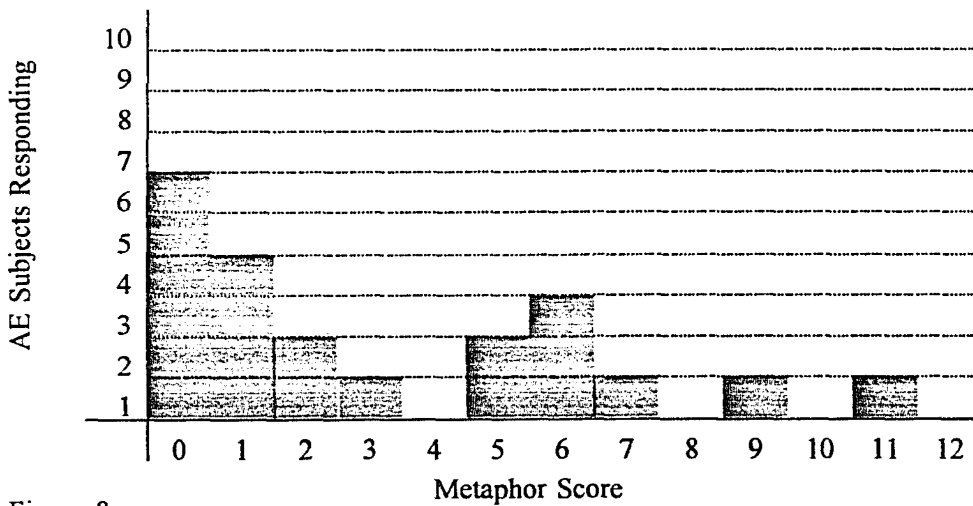

Figure 8.
Frequency Distribution of Metaphor Scores for Analogy Exposure Group

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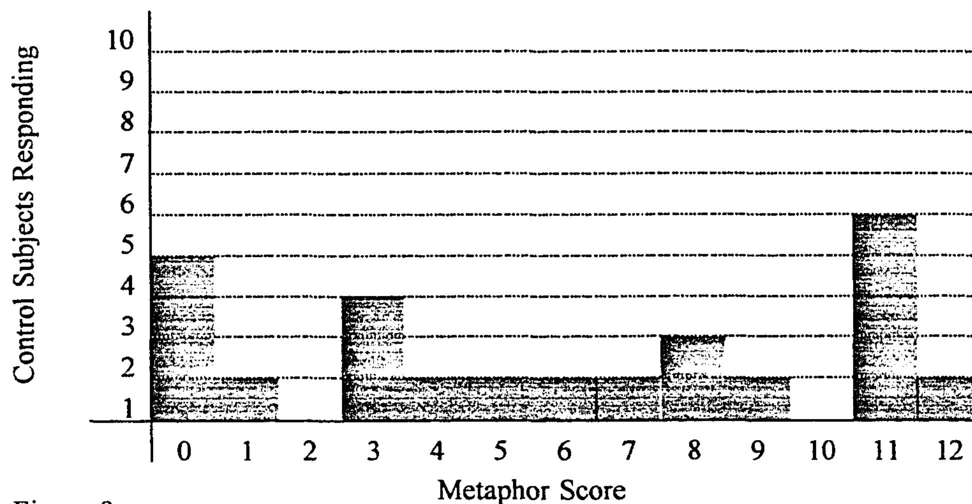

Figure 9.
Frequency Distribution of Metaphor Scores for Control Group

the incomplete justifications were primarily functional explanations. Errors involved alternate choices that were strong associates of the C term, such as "brush" for "paint" when the correct choice was "wall." Other errors involved directionality switches. For example, the analogy "train: track :: person: ____" needed "sidewalk" as its final term because a train moves on a track and a person moves on a sidewalk. However, children often choose "sweater," saying that a train goes on a track and a sweater goes on a person. APM group children answered all the analogy items and offered explanations for all their selections.

The AE group children correctly solved 60% of the analogies with parallel explanations for 15% of their correct responses. Most of their explanations focused only on the final two terms of the analogy. Incomplete explanations were both functional and attributional. Examples of the latter included "flour with eggs" because

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they are both white and "spoon with fork" because they are both silverware. A common explanation was simply "because they go together" and occasionally, the response was "I don't know."

Turning to the metaphor measure, APM children gave correct interpretations for about 60% (7.24 correct of 12 total) of the items. They sometimes included the reversal of the metaphor as part of their explanation, such as "legs are like stems for people" in explaining the item "stems are like legs for flower." Children often said, "I get it," or "I agree" before launching into their interpretations. Several metaphors elicited laughter. One child offered a revision for "bread is like the walls of a sandwich;" he suggested that "bread is like the floor and ceiling of a sandwich" would be more apt.

The AE group children correctly interpreted about 27% of the metaphors, the control group, about 29%.

While the control group's interpretations were similar to those of the AE group, the variety of the responses was greater. Some children were completely stumped and repeated each metaphor verbatim as their only response, yet one child correctly interpreted all twelve.

Metaphor interpretations fell into several categories (see Table 3). There were functional interpretations which included all the interpretations scored as correct as well as interpretations such as "grass and hair both grow," and "string and leash both attach." Attributional interpretations included examples such as "a string and a leash are both long." Interpretations in the concrete category treated the metaphor as a

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literal statement, for example, "if you put glue on bread, it would taste bad." Into this category also were put interpretations that stated a missing term without explaining the metaphor, such as "paper" in response to "lipstick is like a crayon for a mouth." Missing-term responding was the case for several of the AE group children who seemed to have difficulty "switching gears" from the analogy to the metaphor task. Finally, the category of non-response included "I don't know" and answers that only repeated part of the metaphor, like "hair for the ground" in response to "grass is like hair for the ground."

The great majority of the APM group's metaphor interpretations were functional (85%) whereas slightly less than half the responses of the AE and control groups were functional. Approximately 30% of the AE group's responses were concrete (24% for the control group).

Table 3
Category Means and Standard Deviations for Metaphor Interpretation Responses

	Functional		Attributional		Concrete		Non-Response	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
APM	10.14	2.73	0.67	0.97	0.43	0.87	0.76	2.43
AE	5.33	3.82	1.29	2.80	3.71	3.59	1.71	2.69
Control	5.90	4.36	1.48	2.11	2.91	3.80	1.71	2.24

Differences among the groups on the functional category were significant, $F(2)= 10.59$, $p=.0003$. Post hoc contrasts confirmed that the APM group children gave

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significantly more functional interpretations than did either of the other two groups (Scheffe, p<.01). Differences on the concrete category were also significant, F(2)= 6.58, p< .005. The AE group gave significantly more concrete responses than the APM group (Scheffe, p<.01), as did the control group (Scheffe, p<.05). (See Table 4.)

Although APM scores were superior on all three measures, there is room for improvement. Only three children answered all 10 analogy items correctly. (In the AE group, eight was the highest score.) These same children received comparable perfect scores on the justification measure. Only one APM child scored correct on all the metaphor items.

Table 4
Results of Scheffe Comparisons of Metaphor Interpretation Response Categories

Category	Comparison	F	Category	Comparison	F
Functional			Concrete		
	APM / AE	8.87 **		APM / AE	6.06 **
	APM / Control	6.89 **		APM / Control	3.44 **
	AE / Control	.13		AE / Control	.37
Attributional			Non-Response		
	APM / AE	.62		APM / AE	.79
	APM / Control	1.06		APM / Control	.79
	AE / Control	.06		AE / Control	0.00

* p < .05. ** p < .01.
Note. Values are computed using the F statistic.

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Discussion

Metaphoric comprehension was improved by analogy training. Because children needed the structure of analogical reasoning modeled for them, analogy exposure alone was not effective. A brief review will put these findings in perspective.

In the three decades since Asch and Nerlove's (1960) classic study, researchers have continued to explore children's metaphoric understanding. Concrete operational thinking was believed to be the threshold requirement for comprehension (e.g. Billow, 1975; Smith, 1976; Cometa & Eson, 1978) until it was discovered that children as young as 3-years-old reject anomalous statements in favor of metaphors and recognize metaphoric comparisons as semantically valid (Vosniadou & Ortony, 1983; Pearson, 1993). These findings demonstrate the flexibility of young children's comprehension abilities. Children learning language do not make a distinction between literal and figurative language. Instead, they distinguish between meaningful and non-meaningful statements. Adults also automatically process figurative language as meaningful (Glucksberg, Gildea, & Bookin, 1982).

The figurative/literal distinction is less a dichotomy than a description of a language continuum where factual statements framed in the most prosaic manner and metaphors co-exist peacefully. A continuum view helps to explain the fluidity of language and its ability to accomodate change. A metaphor, as it enters common useage, may eventually find its way into the dictionary.

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A continuum view rejects the notion that language acquisition is divided into a literal language learning phase and a figurative language learning stage. Language users are receptive to all language that is meaningful. Figurative language needs more contextual support than literal language not because it is intrinsically more difficult. Rather, because it is at the "cutting edge," figurative language challenges its listeners with new and original comparisons that require attention.

Having arrived at this conclusion, questions remain about the difficulty researchers have had in eliciting evidence of children's metaphoric understanding. Despite general agreement that children produce metaphors (Winner, 1988), evidence of comprehension is more elusive. Researchers have modified task demands in various ways to make them "user friendly." Metaphors as story completions (Gardner, Kircher, Winner, & Perkins, 1975), in play situations (Billow, 1981), and acted out (Vosniadou et al., 1984) were successful contextual variations. However, such interventions were necessarily limited because they did not address metalinguistic concerns. Needed was an intervention that would give children a strategy and a metalinguistic framework. The logical structure of an analogy seemed the natural choice.

That earlier researchers did not turn to analogy as a method of enhancing metaphor comprehension probably had much to do with the prevalent view that children cannot solve analogies (e.g. Sternberg & Rifkin, 1979). In order to demonstrate analogy instruction as benefiting metaphor comprehension, it was also necessary to establish a context in which children could successfully solve analogies.

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An analogy is a logical construction for comparing two pairs of items. The analogies used in this study reflected functional comparisons. As a result, the instruction was directed at providing a strategy helpful for recognizing functional relationships. (Other analogy relationships such as part/whole - "branch: tree :: arm: body" - or superordinal - "elm: tree :: daisy: flower" - would require slightly different solution strategies.) Here, the A and B terms of each analogy are functionally related. Their counterpart C/D terms reflect the same functional relationship. The underlying comparison is based on action. The A and C items may be said to be the agents - they perform the action - while the B and D items are the recipients - they receive the action. Take the analogy "envelope: letter :: purse: money." Envelope and purse are the agents; they hold or contain something. Letter and money are the recipients - they are held.

Viewing the analogy as a structure for comparing two agent/recipient pairs that are related by a common action offers a direction for describing the development of analogical reasoning. The first step is **understanding** the agent/action configuration. Children learn that animals and objects have functions. Dogs bark, blankets cover, books open. An agent may have several actions. People walk, talk, eat.

The next step is to **elaborate** on the agent/action by including a recipient. The person walks on a sidewalk, the dog chases a cat, the bow tops a present. Different agents may perform the same action on different recipients.

Finally, the child must abstract the action and use it as the basis of the comparison. The child **identifies** the action that relates the agent to the recipient, then

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maps the action from a new agent (the C term) to discover a new recipient thereby solving the analogy. Modeling was effective in bringing APM group children to this final step.

The four-term configuration conveys a structure for inserting agents and recipients but does not necessarily imply a comparison. Although the AE group children had their attention drawn to all four terms, they did not consider the analogy a comparison of pairs. So, their solution strategy was to select a D term by referring only to the C term while ignoring the A-B pair. Even when they selected the correct D-term, their explanations showed that they were not reasoning by analogy. That APM group children were able to use the four-term structure to reason analogically was due to the modeling component, the major feature of the instruction. The model demonstrated how to view the analogy as a two pair comparison by abstracting the action implicit in the first pair and applying it to the second pair.

The standard four-term structure itself does not induce analogical reasoning; it just provides a framework for considering two pairs at the same time. Based on their responses, it appeared the AE group children did not recognize the underlying actions that served as the basis of comparison. They were stalled on the path to analogical reasoning by an agent/recipient matching strategy.

In contrast, the APM group children had acquired a more appropriate strategy. Modeling made apparent the need to abstract the underlying action in order to make functional comparisons. As a result of modeling, the APM children were more likely to reason analogically and they assumed a functional comparison perspective that

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carried over to the metaphor interpretation task. They offered an average of 10 functional interpretations out of a possible total of 12.

The present study contributes to both analogy and metaphor bodies of literature by offering a paradigm for improving children's performance on standard analogy items and on metaphor interpretation, and demonstrating a relationship between the two. Abstraction of the underlying basis of comparison is the key to analogical reasoning. As such, it is the common cognitive task required to solve standard analogies and interpret metaphors. Future research might examine the modeling of analogical reasoning to interpret other language puzzles, such as irony, idioms, and proverbial sayings. Another area of research might examine the use of analogical reasoning to help children organize and retrieve information in memory.

Consideration of the importance of saliency of terms in metaphor construction (Ortony, 1979) suggests another direction for research. Metaphor comprehension depends on speaker and listener sharing similar saliency judgements for the attributes of the topic and vehicle. Because children's definitions are not isomorphic with those of adults (e.g. Keil & Batterman, 1984), children are at a disadvantage when they are asked to interpret an adult's metaphors. In this study, for example, the metaphor "a stem is like legs for a flower" was understood by several children to mean that a stem helps a flower to grow like legs help people to grow. For these children, part of the definition of leg is that it causes growth.

The present study used adults' saliency judgements in the construction and selection of metaphors. In assessing comprehension, children's interpretations were

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compared to those of adults. As a result, the children's understanding may have been underestimated, particularly among the members of the APM group. Several of the APM interpretations were functional explanations with non-conventional saliency (and so were not scored as correct). For example, a non-conventional functional interpretation for "peanut butter is like glue for bread" was "peanut butter spreads on bread like glue spreads on paper." For this child, spreadability was more salient than the stick-things-together quality. The interpretation is viable but it could not be scored as correct because it didn't match the target "peanut butter sticks together bread like glue sticks together paper." Future research should explore the use of metaphors constructed with children's saliency attributions explicitly considered.

On the analogy front, a line of investigation suggested is the assessment of children's ability to learn from analogies in more complex tasks. The standard analogy task used in the present study has the advantage of ease of administration and scoring, but is limited in its application to real life problem solving.

The lack of mastery of either analogies or metaphors by children in the APM group indicates that there is room for improvement in the current paradigm. This teaching procedure might be enhanced in any future replications by revising instruction to include additional self-regulation components, such as a self-monitoring model (Zimmerman, 1989). Such a model would remind children to check that they'd mentioned all four terms in their explanations. For example, each term of the analogy could be covered with a chip as it got mentioned in justifying the response. If a picture remained uncovered, the child would know that s/he left something out. Such

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a revision coupled with more explicitly drawing the connection between analogies and metaphors might serve to improve analogy performance and boost children's metaphor interpretation further. Also, enhancing the teaching procedure might serve to address a possible limitation of the present study. Although the present method was successful with gifted young children, it might be less successful with a general population of 5½-6½ year-olds. However, a replication that couples a revision in teaching procedure as described above with slightly older children as subjects or the use of attributional (rather than more abstract functional) comparisons might answer this concern. The vocabulary of the task instructions might need to be simplified for a general population.

Finally, although the pictures provided in the metaphor measure were intended solely to keep the children focused and on-task, they may have had an adverse effect on the performance of some members of the AE group, who seemed to consider the metaphor phase a continuation of the analogy phase. The pictures may have served to distract some AE children (this was not a problem for the control group). In future, it would be interesting to contrast two conditions for each group in the metaphor phase, one with pictures and one without.

General Discussion

Children who received analogy instruction had an advantage in analogy solution both absolutely and in terms of parallel justifications. A correct answer to an analogy item is not proof of understanding. Therefore, the child's response justifications need to be explored before one can draw conclusions about his/her

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analogy skills. Often, children attempt to solve an analogy by focusing all their attention on the final pair rather than on the entire package. Faced with the increased demands of an analogy item, it is understandable that children will reduce the analogy to a simpler task, namely a pair completion.

The present study contributes another voice to the chorus answering Piagetian stage theorists and information processing advocates who advance deficits in thinking as an explanation for children's poor performance on analogy and metaphor tasks. Broadly defined contextual issues cannot be ignored when assessing ability. Sternberg (1984) has begun to address context in his triarchic theory of intelligence. His research affirms the role of practical intelligence in everyday life, including the use of analogies and metaphors to assimilate new information by relating it to old; yet, Sternberg (1988) continues to argue, based on his earlier work, that children younger than nine years cannot solve analogies and cites formal operations as the necessary prerequisite.

In contrast, the present study argues that making the parallelism constraint salient and alerting children that they need to attend to all four terms is what is required to help children solve analogies, provided that the relationships and vocabulary are familiar to them. However, solving analogies is a demanding activity and the battle for analogical understanding needs to be fought on several fronts. As Whitely and Dawis (1974) found, and the present study reinforced, a comprehensive approach - one that includes use of strategy, structure, and feedback - is necessary in order for analogy instruction to be effective.

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Of course, analogical reasoning is not limited to performance on an analogy task nor is its only benefit improved metaphor interpretation. Analogical reasoning is a powerful way of incorporating new information and of recognizing patterns and relationships. It is a way of creating interconnecting systems of knowledge and for this reason, the effort to discover how best to enhance analogical skills has great importance to teachers.

Implications for Education

Distinguishing between literal and non-literal language in everyday usage is more difficult than one might think, largely because of socially induced changes. New words and expressions are constantly finding their way into conversation whether freshly coined, resurrected from past eras, or passed about regionally. Language evolves in response to people's need to describe present situations or events and changes in thinking, politics, and technology. For example, the computer has invested "bite" ("byte") with a meaning unknown 30 years ago. The language continuum is everchanging and fluid to accomodate social advances.

Non-literal language is a prime mechanism for the rejuvenation of language in general (Lakoff & Johnson, 1980). A metaphor begins as an original observation that captures the attention of listeners who remember and repeat it so often that it becomes a cliche. Eventually, it becomes so common that it is no longer recognized as a metaphor. "Time flies," "construct an argument," "invest your time" are just a few of the many examples of metaphoric language used literally. Lakoff and Johnson (1980) argue that the metaphors of our culture not only define our attitudes and thinking but

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also help to form them. They point out the many expressions that are derived from military and monetary sources. Sontag (1988) has written about metaphors for illness, specifically cancer and AIDS. She has shown that our descriptions reflect the history of our knowledge about how illnesses develop and demonstrate our fears and attitudes about those who succumb to disease. Given the prevalence of metaphor in our midst, it certainly behooves educators to help prepare their students for the flexiblity and diversity of language.

As Pylyshyn (1979) points out, one of language's most basic functions is to convey knowledge. Metaphors, as tools of communciation (Sticht, 1979), have two major applications. They serve a comparative function by demonstrating a similarity between two dissimilar things. Metaphors are interactive when they create similarities and provide a bridge between what is familiar and what is unfamiliar. These two functions are meshed in education. From the teacher's point of view, the metaphor is comparative because s/he is familiar with the domains of knowledge to be linked via the comparison. The teacher chooses a metaphor to highlight some specific information (such as comparing an atom to the solar system). For students, the metaphor is likely to be interactive because it will provide new information about an unknown domain of knowledge (in this case, the functioning of the atom) (Petrie, 1979).

Metaphors and analogies are constructed from analogical frameworks. Therefore, metaphors and analogies both help students acquire and integrate new knowledge (Petrie, 1979; Pylyshyn, 1979). The advantage of metaphor is that it is a

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vivid and therefore memorable way of expressing a comparison (Petrie, 1979). It is also more compact an expression than analogy, another advantage when considering time constraints in teaching (Simons, 1984).

Children who are able to understand metaphors will be at an advantage both in and out of the classroom. They will have an effective mechanism for assimilating and accomodating new information.

Figurative language is creative in that it expresses relationships in new and original ways. For that reason, it places even greater demands on the listener than does literal language. Contextual issues are particularly important. Adults are more successful in providing context for themselves than are children. They have a wider range of experiences to draw from and can "fill in the gaps" when meaning is obscured. Although adults can provide some contextual supports for themselves, children need the supports to be demonstrated to them. Analogy instruction is a way of providing children with the background they need to interpret metaphors. It gives children information on how metaphors are formulated and the comparisons they communicate.

Proficiency in figurative language is an important but not exclusive benefit of analogical reasoning ability. Analogical reasoning is a useful tool both within and across curriculum areas. In the sciences, analogies help students understand new concepts and how they fit into the world (Vosniadou & Schommer, 1988). Scientists use analogies to make their theories more accessible to colleagues and to non-

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scientists. For example, physicist Kaku's (1994) recent trade book explaining hyperspace opens with a comparison of carp and human reactions to the unknown.

Analogies can be used in the construction of curriculum, to build bridges between units or between disciplines. For example, in a study of animals, analogies can highlight similarities, such as "quills: porcupine :: shell: turtle" (the ground is protection) or "kangeroo: jump :: fish: swim" (the ground is movement). Analogies can be used to compare historical events or figures, such as "Ma Barker: robbery :: Clara Barton: nursing." Teachers can preface new topics with analogies to help children fit what they are about to encounter with information they already have.

Because analogies are complex comparisons, incorporating them into the classroom requires some orientation for students. Teachers should consider introducing children to analogies via a modeling procedure such as the one described in this study. Using itself as a point of departure, a model could demonstrate how it assimilates and organizes new information about other people, animals, and things. For example, the model could observe that it likes to eat sandwiches and then wonder about other relationships that involve eating. The model could use the four-cell structure of the analogy to "plug" itself and its sandwich in the upper two cells and a comparable pair (such as "cow: grass") in the lower two. The model would encourage the students to think of new matches to complete the cells. The teacher could use these analogies to lead into a unit on living things and their need for nourishment.

A unit on habitats could begin with the model discussing its house and observing that animals have a variety of different homes. The four cells could be

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filled "person: apartment (building) :: bird: nest (tree)." Other suggestions could come from the students. The teacher would guide the class to a consideration of how homes are suited to their inhabitants' needs in the animal world and in the human world, where different climates, customs, and population densities influence the type of home constructed.

Using the self as a reference point could also lead to a language arts unit on "body language" - objects that borrow the names of human body parts, such as "hands of a clock," or "legs of a table," or "eye of the storm." Teachers could encourage children to make predictions about function or location such as "what does the **spine** of a book do?" or "where would you expect to find the **foot** of a mountain or the **head**lines of a newspaper?" or "where on the bottle is the **neck** and what is a bottle**neck** when applied to traffic?"

Children should be given many opportunities to construct analogies based on themselves. For example, when studying botany, "person: arm :: tree: branch" is relevant; when studying transportation, "person: feet :: car: wheels." After they have gained experience with self analogies, they can branch out to more distant comparisons. The next step would be same domain analogies, such as "sail: boat :: wings: plane," where the comparisons are made among objects in the same category (in this example, transportation). More distant still are analogies that cross domains (for example, "yolk: egg :: filament: lightbulb"), such as the analogies used in the present study.

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It is hoped that teachers will be encouraged to integrate analogies into curriculum areas. The ultimate goal of analogical reasoning instruction is to enable students to use an analogical framework to systematically link unfamiliar knowledge or situations to existing representations of knowledge - that is, to draw on what is known to understand what is unknown. The ultimate goal of education is a similar kind of empowerment. Future knowledge requirements cannot be known, but it is clear that the need to be an pro-active or self-regulated learner (Zimmerman, 1989) does not end with school graduation. Therefore, educators must model analogical reasoning and help students create connections between existing knowledge and unanswered questions. The educational system best serves students by offering them strategies for processing new information and ideas, and preparing them to face challenges with confidence and flexibility.

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Appendix A - Analogies

The analogies were presented to children both verbally and visually. They listened to the words, shown below, while looking at the pictures, copies of which follow. The words in parentheses are the correct D-terms for completion. The actual materials were larger and in color.

Practice Items

P1. crown : king :: roof : chimney, throne, (house)

P2. shelf : book :: plate : bookmark, fork, (food)

P3. teeth : mouth :: knife : plate, toothbrush, (hand)

P4. blanket : bed :: wrapping paper : (box), ribbon, pillow

Analogy Items

1. jelly : toast :: paint : (wall), strawberry, brush
2. shovel : snow :: spoon : (soup), snowman, fork
3. wool : sweater :: flour : button, eggs, (bread)
4. milk : carton :: ink : writing, (pen), glass
5. train : track :: person : (sidewalk), wheels, sweater
6. knob : door :: zipper : button, (jacket), key
7. river : boat :: road : anchor, traffic light, (car)
8. envelope : letter :: purse : handle, stamp, (money)
9. bat : ball :: hammer : mitt, (nail), saw
10. comb : hair :: rake : shovel, (leaves), brush

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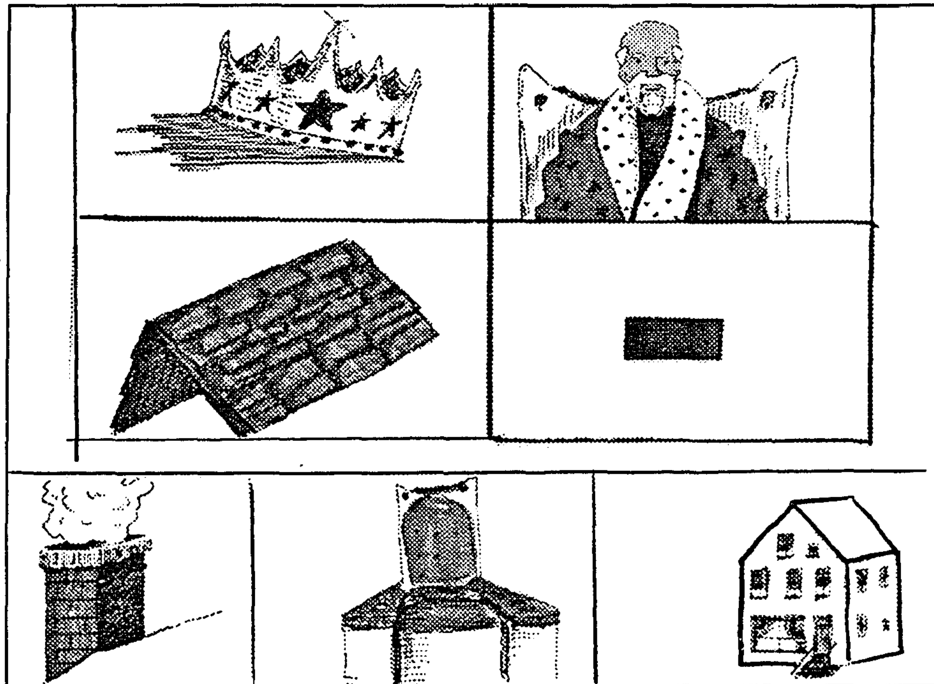
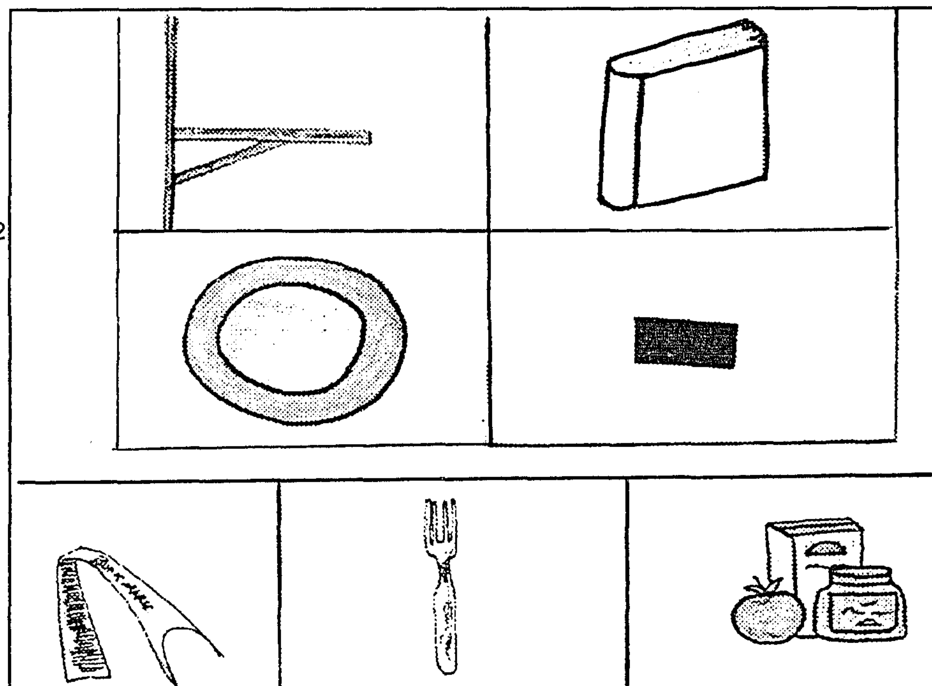
P1



P2



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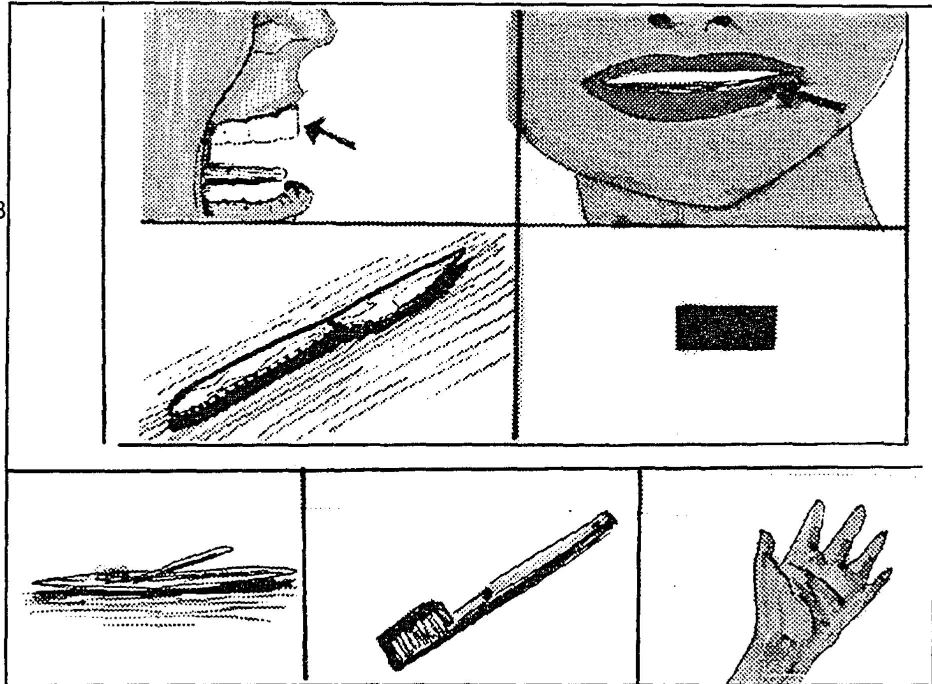

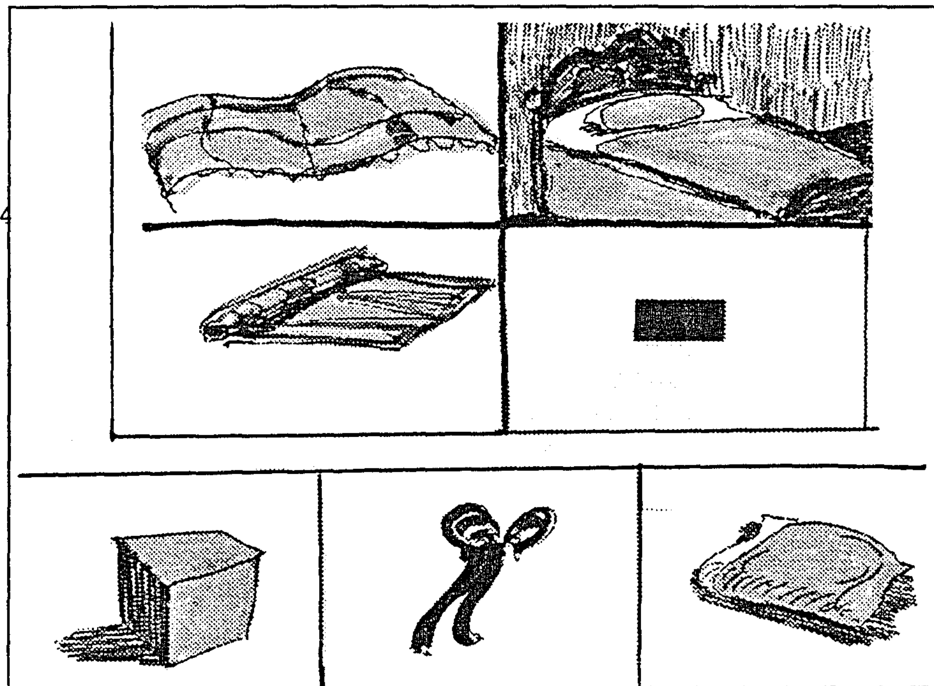

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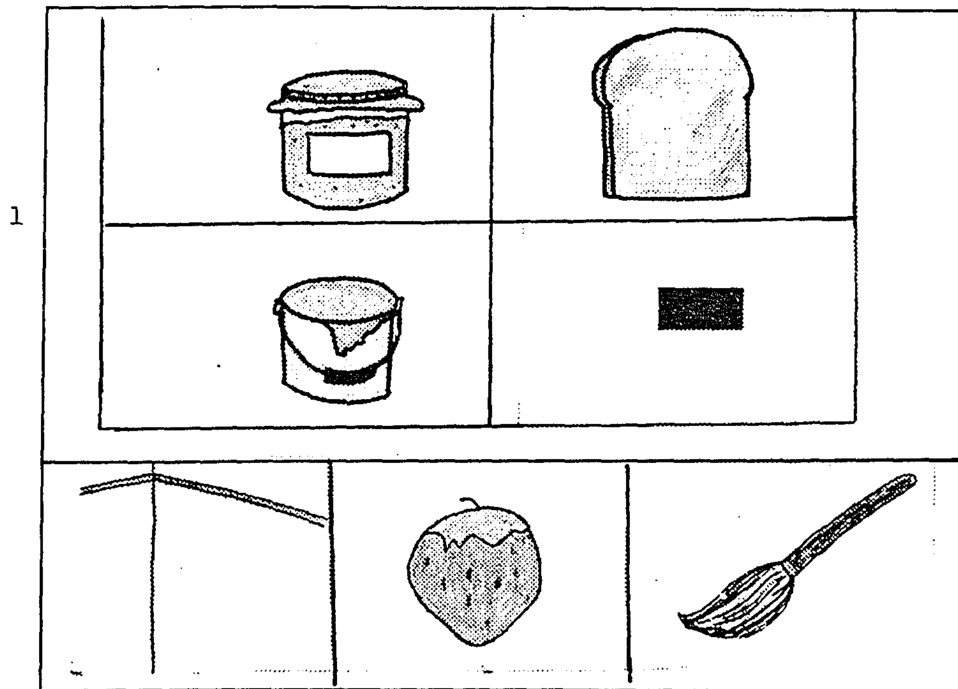

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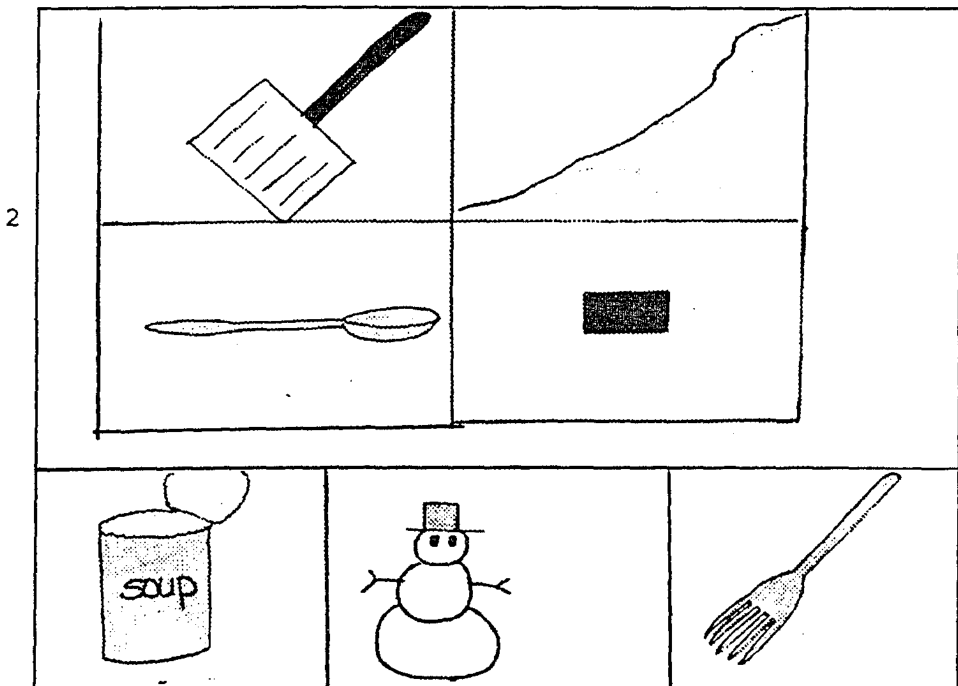

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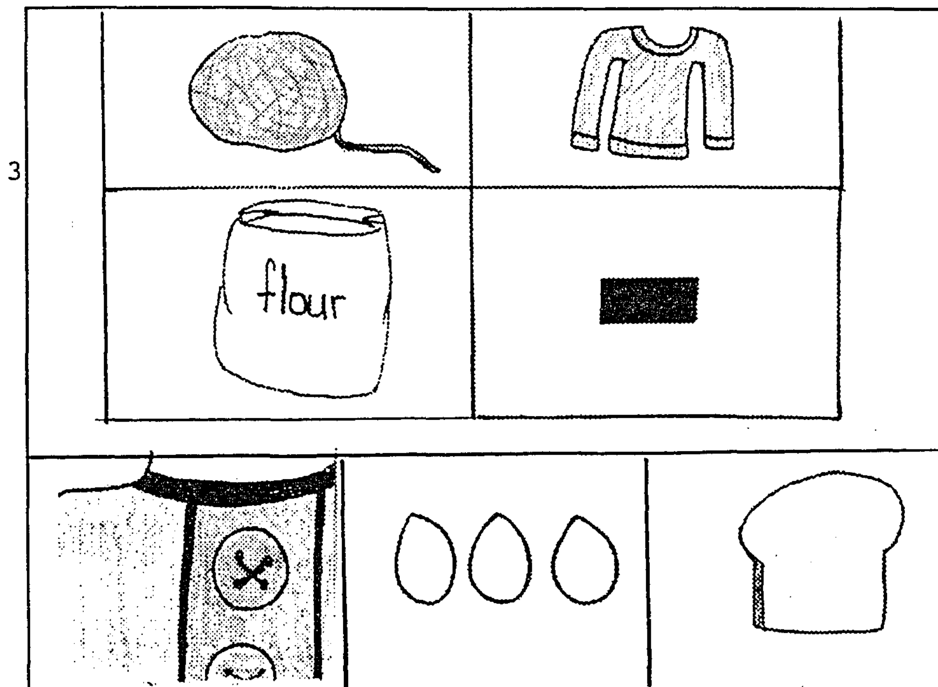

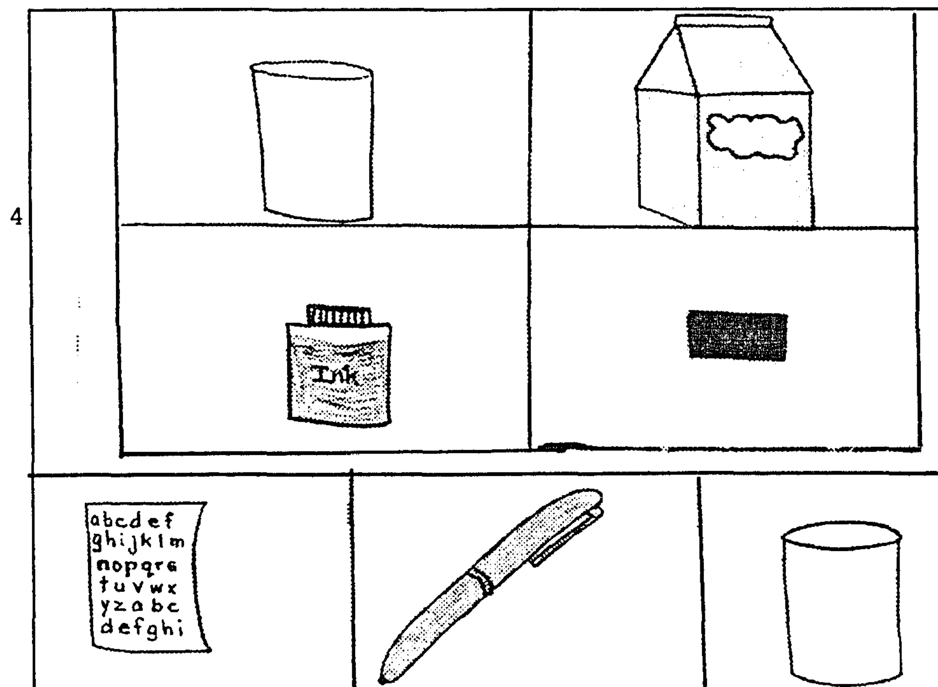

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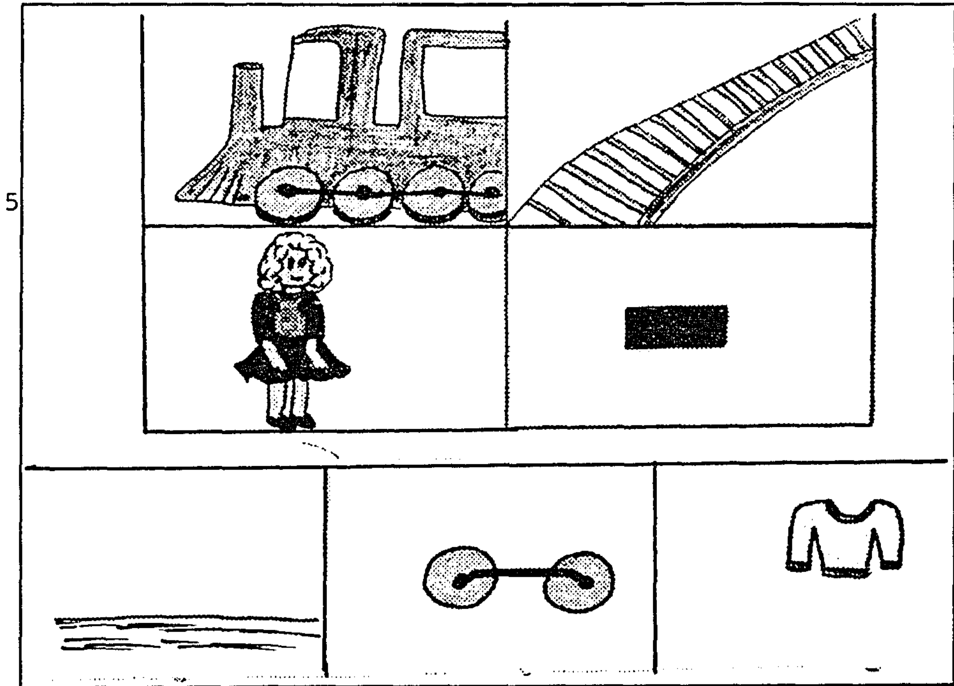

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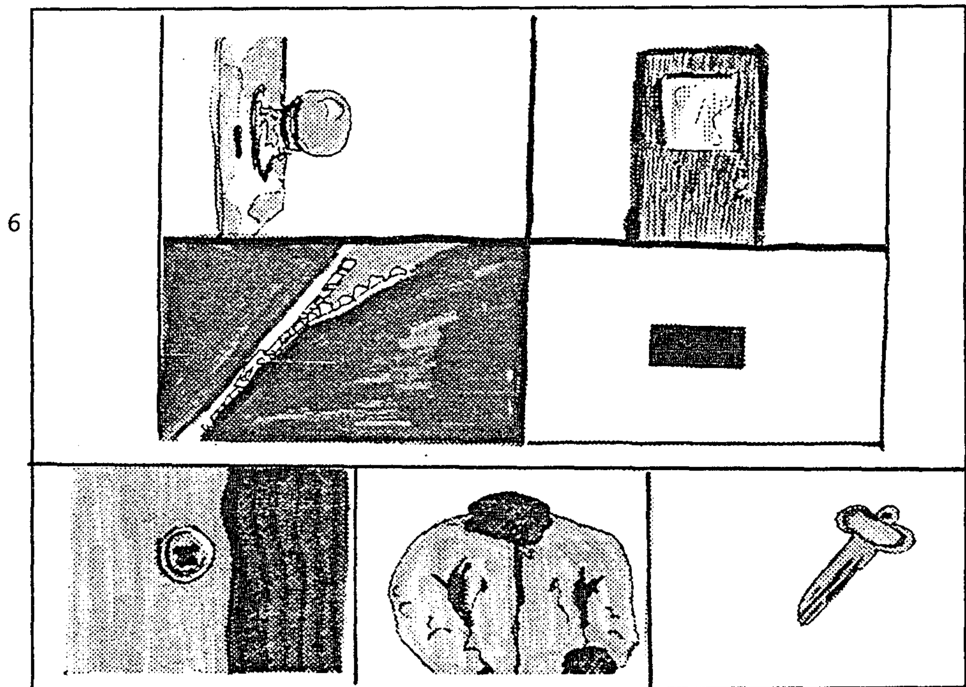

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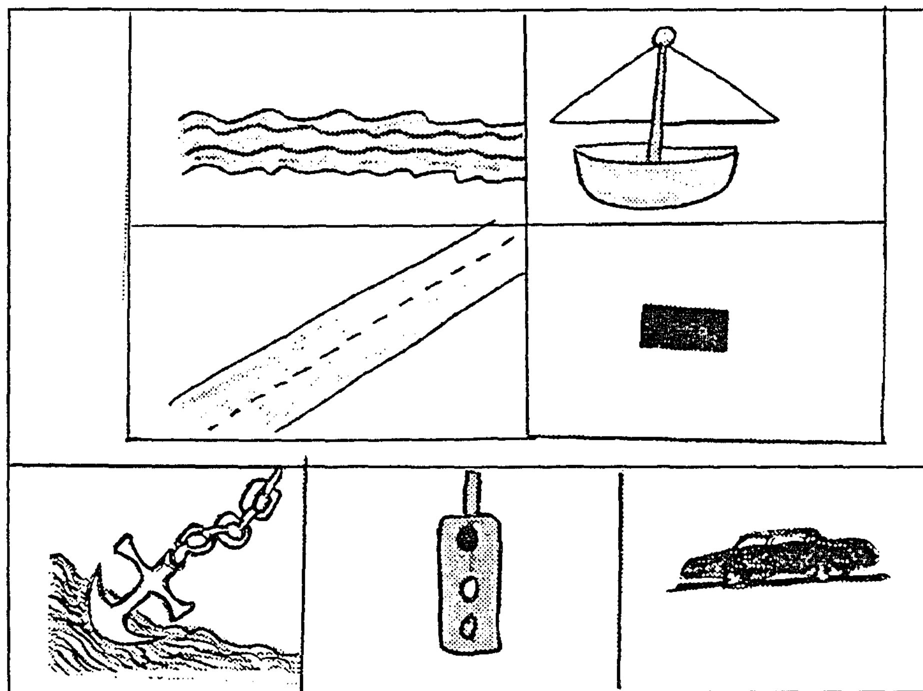

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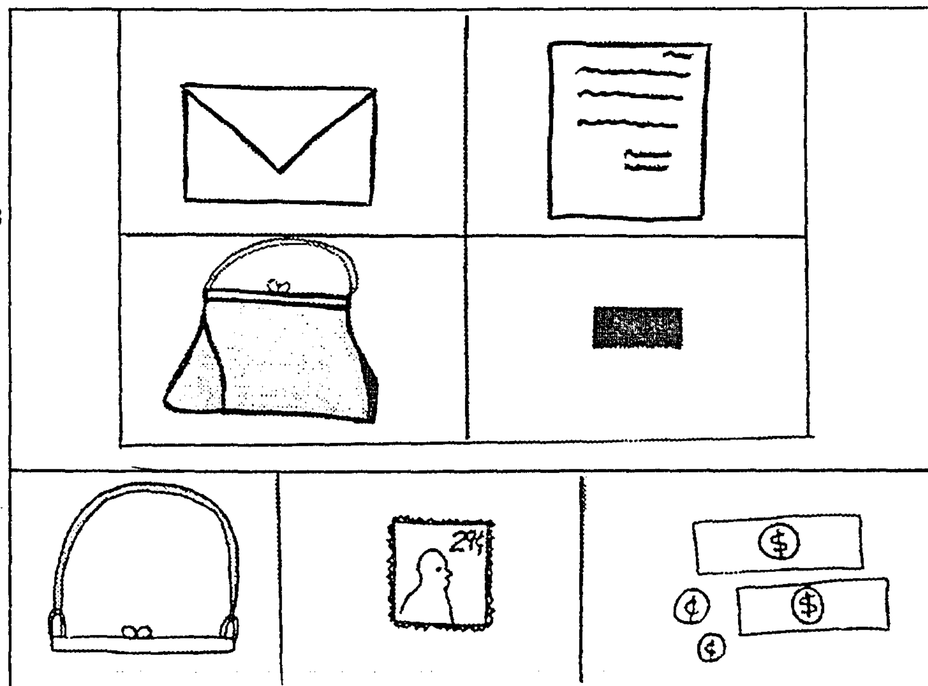

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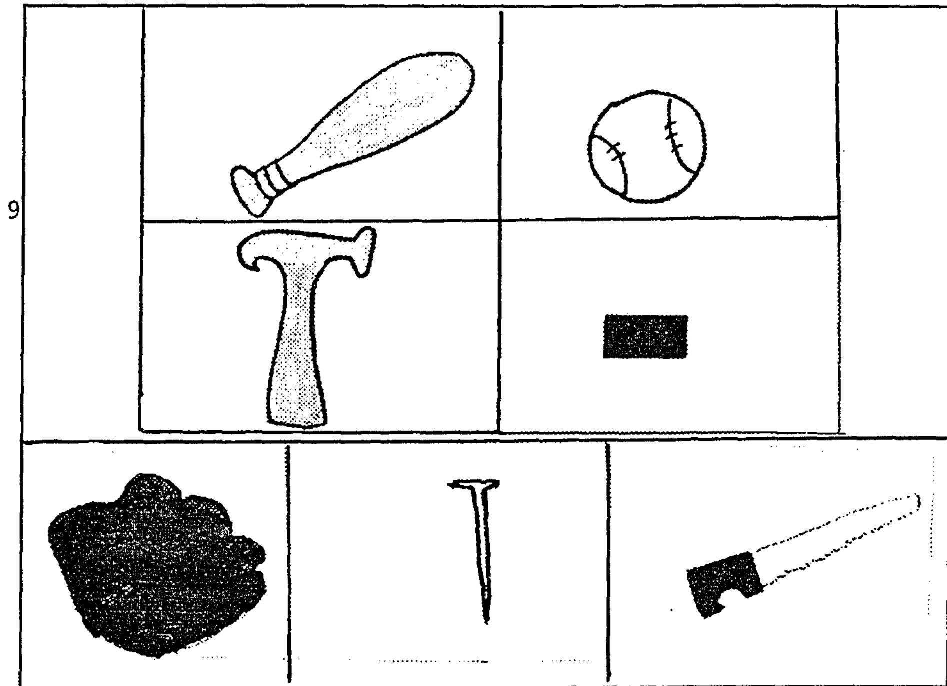

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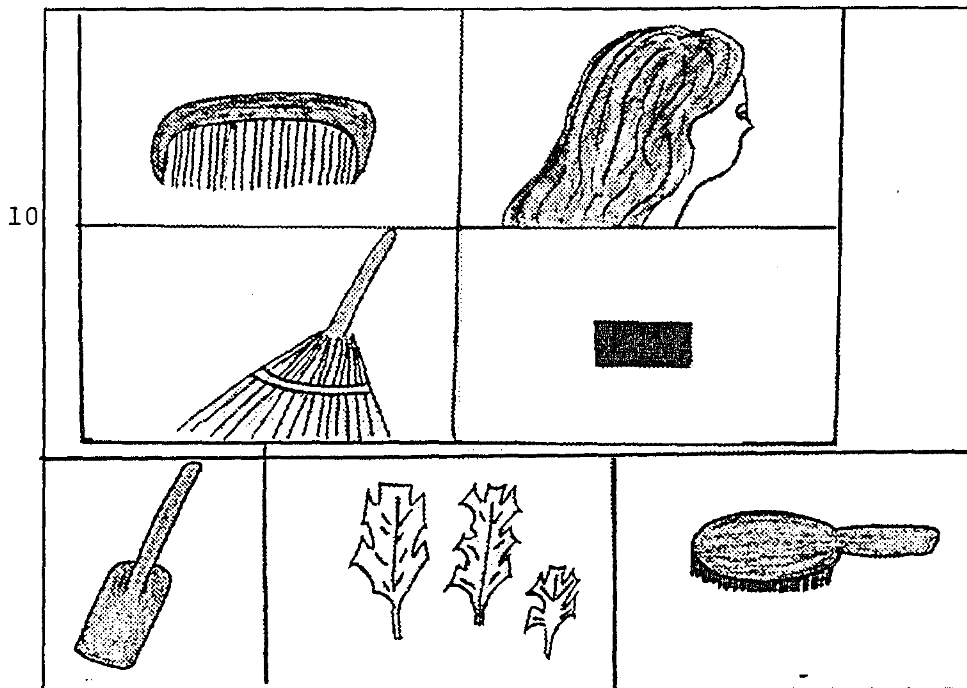

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Appendix B - Metaphors

The metaphors were presented verbally and visually. Children heard the metaphors spoken by the experimenter and saw the metaphors written on sentence strips mounted under drawings of the terms named. Below are the metaphors and their target interpretations. Following are copies of the materials.

Metaphors and Target Interpretations

1. A fence is like a frame for a yard.

TI: A fence surrounds a yard like a frame surrounds a picture.

2. Grass is like hair for the ground.

TI: Grass grows on (covers) the ground like hair grows on a person.

3. A bow is like frosting for a present.

TI: A bow decorates a present like frosting decorates a cupcake.

4. A refrigerator is like a closet for food.

TI: A refrigerator holds (stores) food like a closet holds clothes.

5. Lipstick is like a crayon for a mouth.

TI: Lipstick colors the mouth like a crayon colors paper.

6. The sun is like a lamp in the sky.

TI: The sun lights up the sky like a lamp lights up a room.

7. Soap is like an eraser for dirt.

TI: Soap clears away (cleans) dirt like an eraser clears markings.

8. A cloud is like a curtain for the sun.

TI: A cloud blocks the sun like a curtain blocks a window.

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9. Peanut butter is like glue for bread.

TI: Peanut butter sticks together bread like glue sticks together paper.

10. A stem is like legs for a flower.

TI: A stem supports (helps to stand) a flower like legs support a person.

11. Bread is like the walls of a sandwich.

TI: Bread holds together (contains) a sandwich like walls hold together a house.

12. String is like a leash for a kite.

TI: A string holds (keeps from escaping) a kite like a leash holds a dog.

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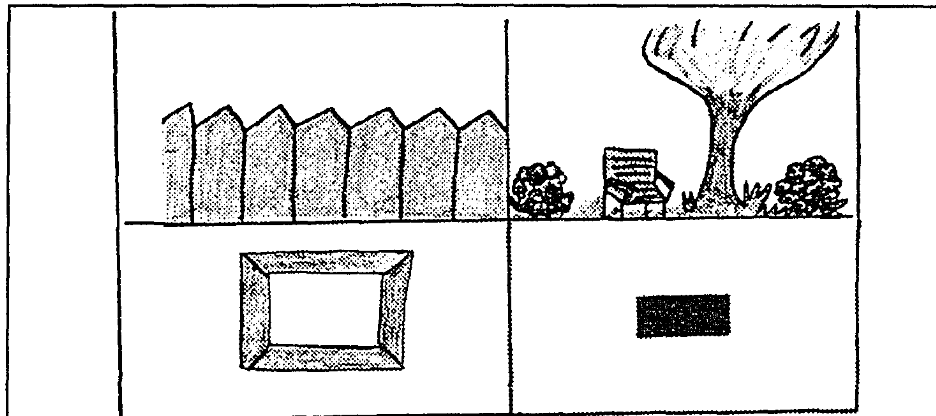
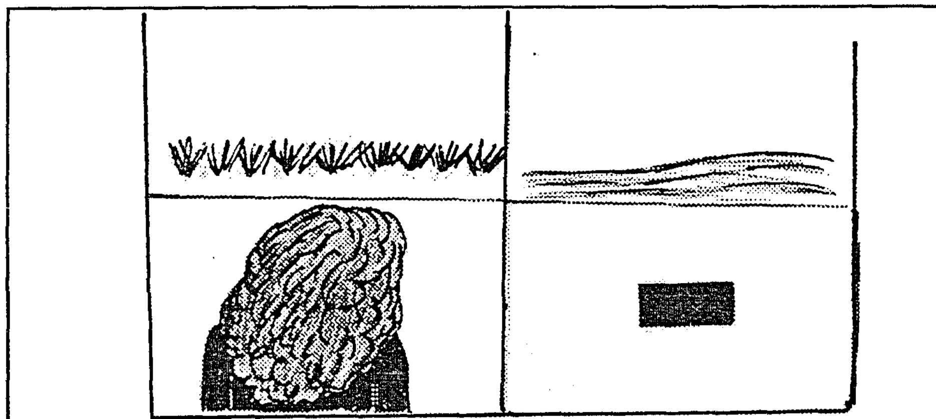


A fence is like a frame for a yard.



Grass is like hair for the ground.

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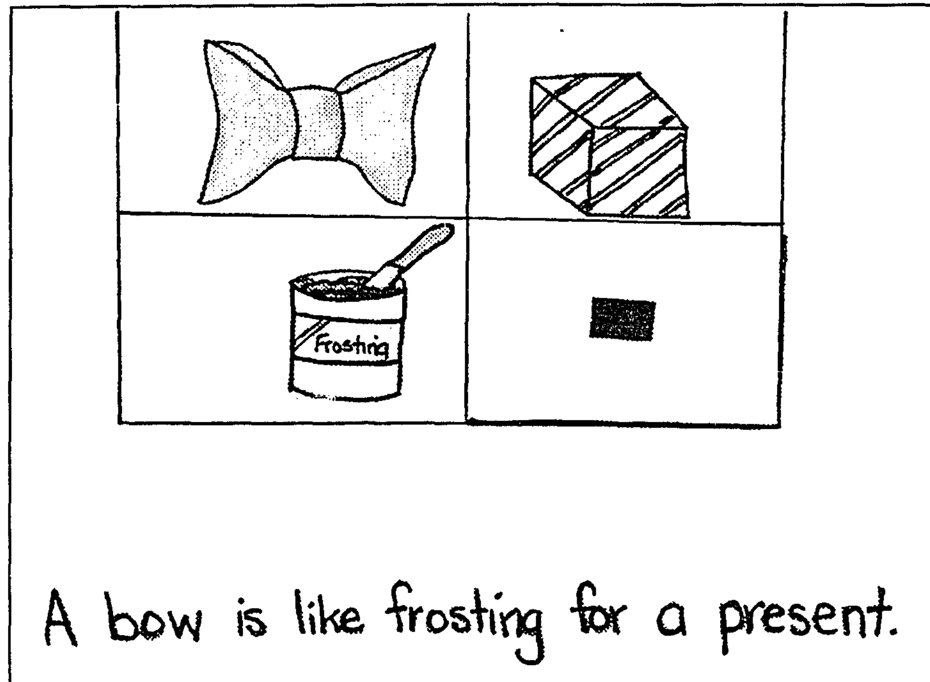

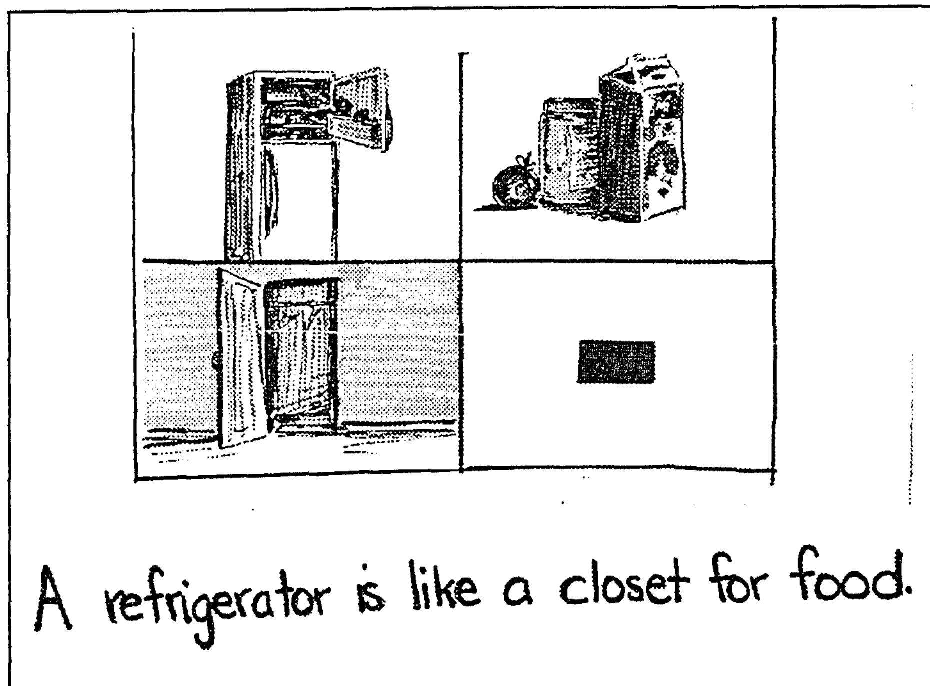

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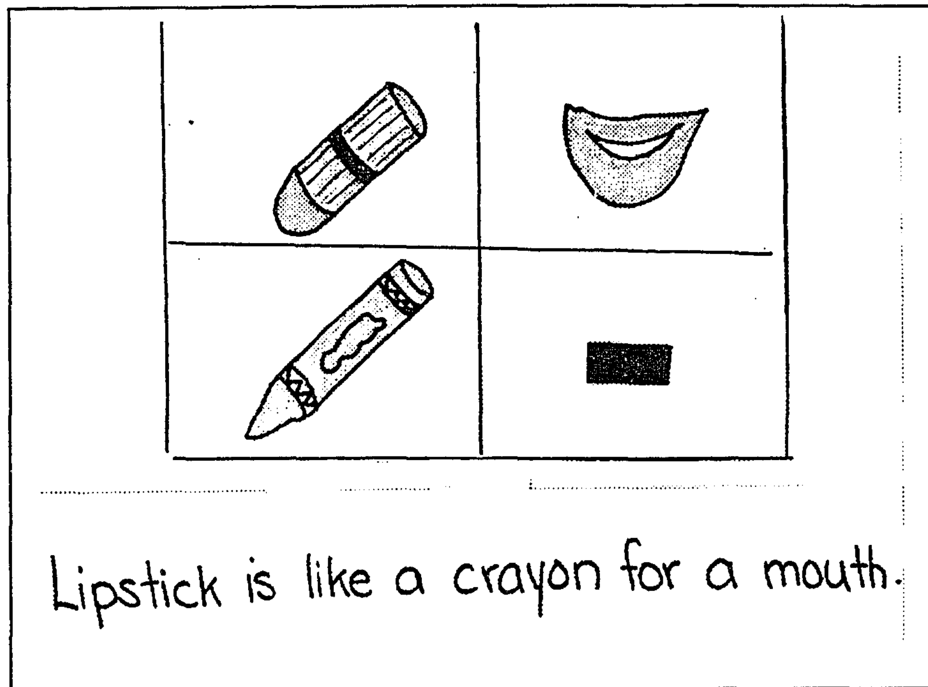

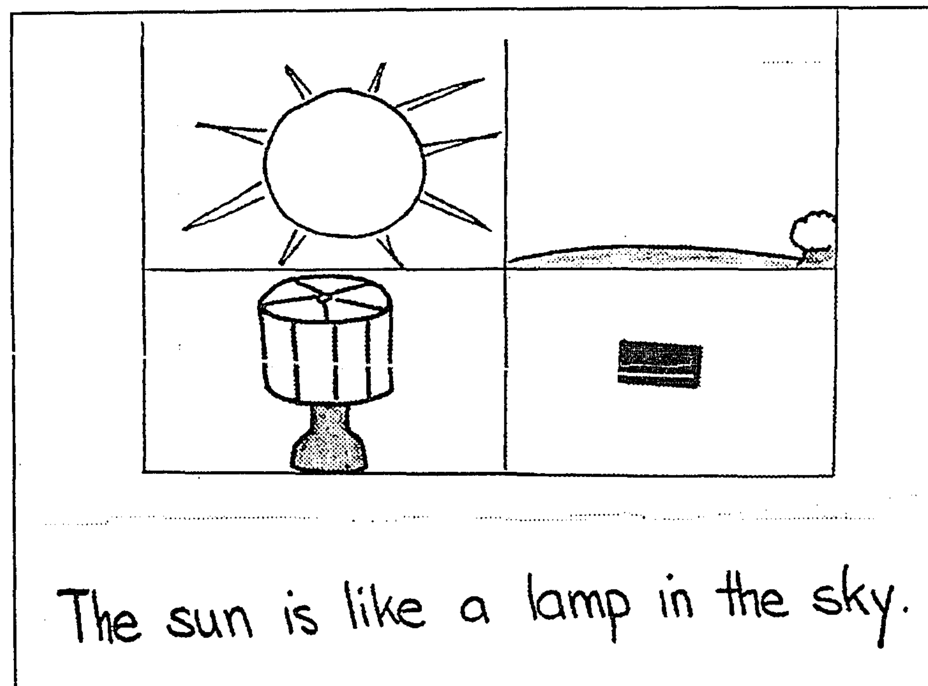

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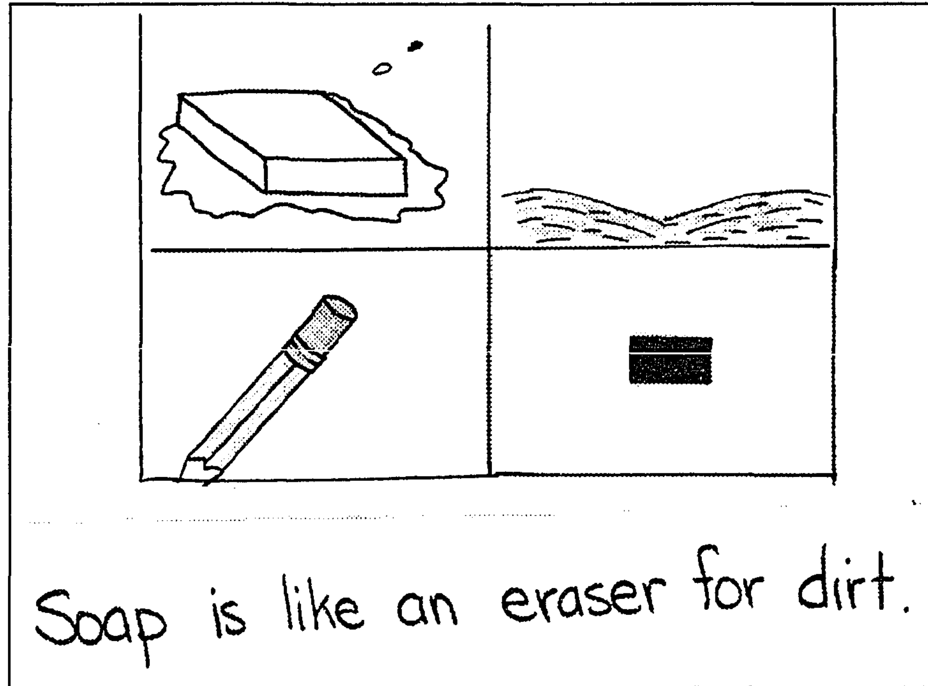

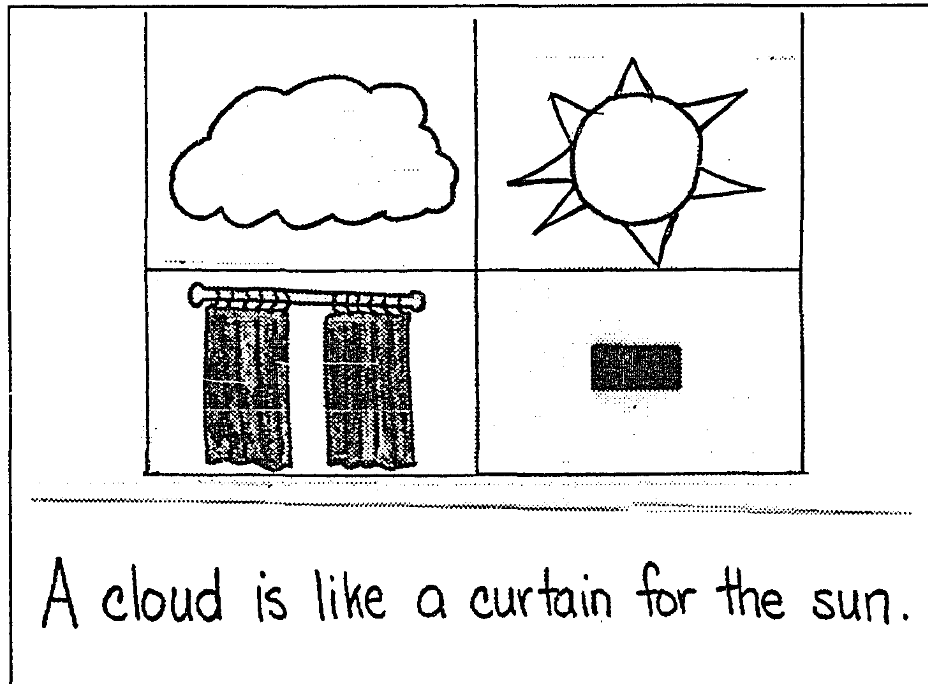

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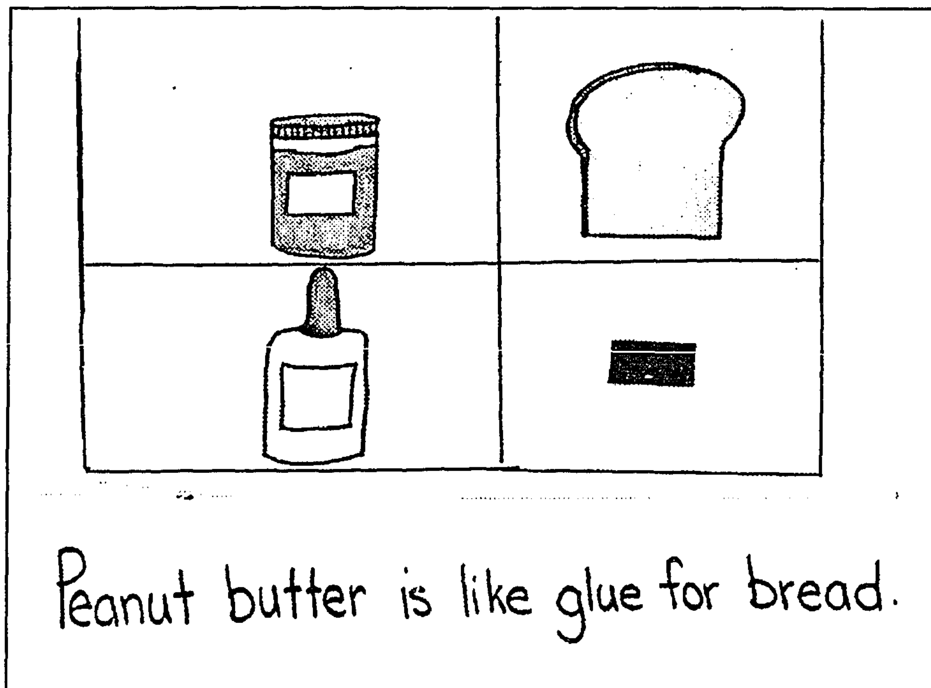

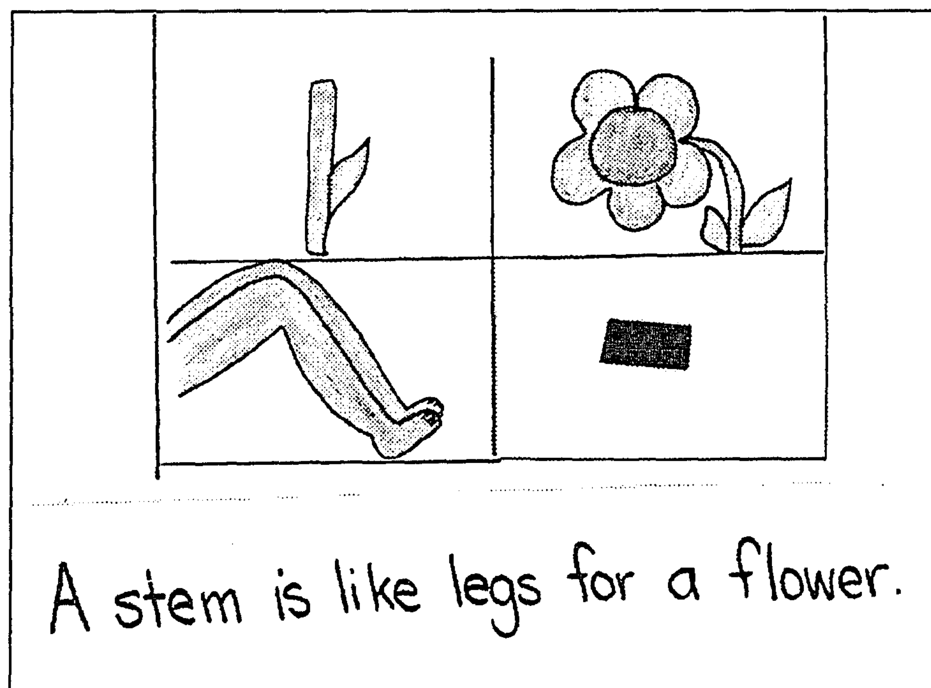

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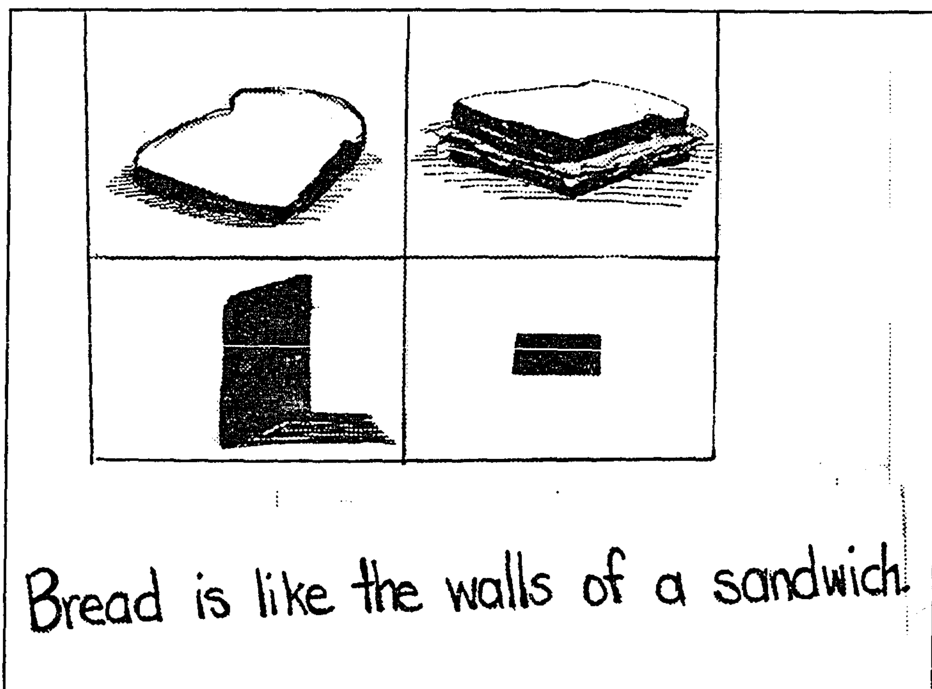

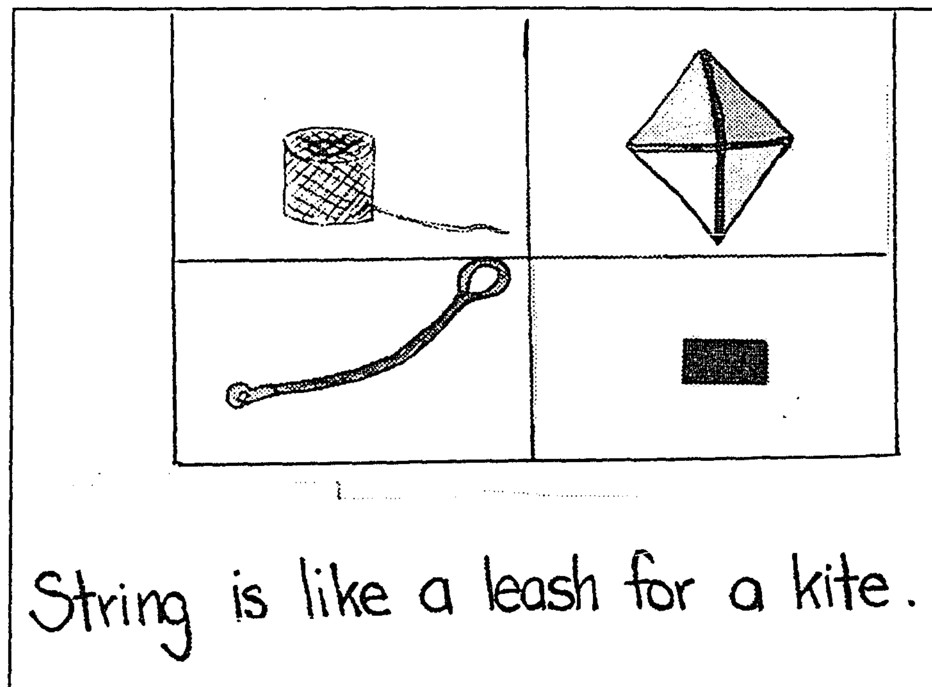

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Appendix C - Examples of Children's Metaphor Interpretations

Grass is like hair for the ground.

Functional: "The ground is just dirt and grass covers it like hair covers a person."

Attributional: "Grass sticks up and can be tall or longer and hair is curved."

Concrete: "No, grass is just grass and nothing else but grass. Hair is hair."

Lipstick is like a crayon for a mouth.

Functional: "Lipstick makes a mouth colory, and crayon on a paper makes the color of whatever color."

Attributional: "Lipstick is like - pink."

Concrete: "With lipstick, you can do lots of things, like if you got a paper."

The sun is like a lamp in the sky.

Functional: "The sun gives light around the world and the world is like your house and a lamp gives light in your house."

Attributional: "The sun is like a lamp but it's round and has points."

Concrete: "Without the sun, it's dark outside."

Soap is like an eraser for dirt.

Functional: "If you get your hands dirty, soap washes it off. An eraser gets off something you wrote that you didn't mean to."

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Attributional: "Both are white."

Concrete: "Dirt is sometimes dusty and soap cleans the dust and the dirt would be shiny."

Peanut butter is like glue for bread.

Functional: "Peanut butter can go on bread and glue sticks on things. Both stick on things."

Attributional: "It's both mushy."

Concrete: "Glue you use to make something like an eagle out of paper. Peanut butter goes on bread and doesn't stick for very long if you use it as glue, if you turn it upside down."

A string is like a leash for a kite.

Functional: "A string holds onto a kite so it won't blow away. A leash holds onto a dog's collar so the dog won't run away."

Attributional: "Both are long."

Concrete: "If you didn't have string and you put a leash on the kite, it might work."

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