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ISBN 0-315-55375-8

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THE UNIVERSITY OF ALBERTA

PROPORTIONAL METAPHOR COMPREHENSION AND VERBAL ANALOGICAL REASONING IN SCHOOL AGE CHILDREN

BY

KATHLEEN M. MORAN 

A THESIS

SUBMITTED TO THE FACULTY OF GRADUATE STUDIES AND RESEARCH

IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR

THE DEGREE OF

MASTER OF SCIENCE

DEPARTMENT OF SPEECH PATHOLOGY AND AUDIOLOGY

EDMONTON, ALBERTA

FALL, 1989

THE UNIVERSITY OF ALBERTA

RELEASE FORM

NAME OF AUTHOR: Kathleen Mary Moran

TITLE OF THESIS: Proportional Metaphor Comprehension and Verbal Analogical Reasoning in School Age Children

DEGREE: Master of Science

YEAR DEGREE GRANTED: 1989

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K. M. Moran

Kathleen M. Moran

12444-81 Street
Edmonton, AB
T5B 2T7

Date: October 10, 1989

THE UNIVERSITY OF ALBERTA

FACULTY OF GRADUATE STUDIES AND RESEARCH

The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies and Research for acceptance, a thesis entitled

Proportional Metaphor Comprehension and Verbal Analogical Reasoning
in School Age Children

submitted by Kathleen M. Moran

in partial fulfillment of the requirements for the degree of
Master of Science

Gary Holtgrafer
Supervisor

Paul Hagler

Helen Gault

Date: October 12, 1989

DEDICATION

For my daughter, Elizabeth Ray

ABSTRACT

Research on the development of metaphor comprehension and analogical reasoning suggests that performance improves as a function of age. Possible relationships between these two abilities have also been queried (Nippold, Leonard, & Kail, 1984). The purpose of the present study was to assess proportional metaphor comprehension and analogical reasoning in school age children and to further investigate possible relationships between these two skills. Experimental tasks were developed by imposing a number of controls that appear to have confounded earlier studies.

Children at three grade levels (3, 5, and 7) were given both an analogical reasoning task and a proportional metaphor task. The students were assigned to the tasks in one of two orders of presentation. One group completed the analogies followed by the metaphors. The second group was given the two tasks in the reverse order. The effects of previous experience with analogies on the performance of metaphor understanding was analyzed.

All the subjects, regardless of grade level, performed extremely well on the two tasks, with the majority achieving a perfect score on either one or both tasks. Consequently, results did not demonstrate a predictable improvement in the development of either analogical reasoning or metaphor comprehension as a function of grade. There was a significant difference in metaphor comprehension only between the grade 5 and grade 7 students. The better performance of the seventh graders seemed to have is discussed in relation to cognitive

theories. On the analogical reasoning task, there was no significant difference in the performance between any of the grade levels. Overall, performance on the metaphor comprehension task was significantly better than on the analogical reasoning task. No significant effect for order was found on either of the tasks. No correlation was found between the two tasks. These results are discussed in the context of three issues which seemed to underly the results obtained in the present research. These are the controls introduced into the stimulus items, the linguistic cues provided by the stimuli and subject variables. Implications for remediation are also considered.

ACKNOWLEDGEMENTS

My sincerest appreciation to my advisor, Gary Holdgrafer, whose unconditional support and active contributions made this journey an educational and delightful one.

Gratitude also to my committee members, Paul Hagler and Helen Ilott, for their patience and participation.

Many thanks to the staff of the Department of Speech Pathology and Audiology, who provided continual comraderie and encouragement.

A very special thank you to my parents, Mr. and Mrs. Moran, and my grandparents, Mr. and Mrs. R. E. Russell, who were the first to help set me on a path that would one day find me here.

I would also like to extend my deepest gratitude to my dear friends, Mary, Trish, and Denise whose timely and practical support allowed me to see this project to fruition.

Thank you also to my employer, H.O.M.E.S. and especially to my immediate supervisor, Deborah Breakenridge, whose respect and support for my educational aspirations helped to make this dream a reality.

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CHAPTER 1

Introduction

Figurative Language: its prevalence and importance

Language contains both literal and nonliteral forms. Nonliteral forms are commonly referred to as figures of speech. The realm of figurative language includes expressions such as "don't count your chickens before they're hatched" (proverbial), "you're pulling my leg" (idiomatic), and "his muscles were as hard as rocks" (metaphorical). The ability to extract the appropriate meaning of a nonliteral form of language is essential to comprehending the overall meaning of the utterance in which it is embedded. When figurative language is taken literally, it leads to an incorrect interpretation of the meaning intended by the speaker or a construance that is anomalous and unresolvable.

Figurative language occurs frequently in conversational speech and written material (Nippold & Fey, 1983). Researchers have even found significant numbers of figuratives in gradeschool textbooks (Arlin, 1978) and fictional books (Lockhart, 1972). Because of its presence in the language of instruction, comprehension of nonliteral forms is an essential component to understanding the content of material presented to children in their classrooms.

The focus of this investigation was on the study of metaphors. There were three reasons for this choice. First, metaphors comprise a unique subset among figurative forms. Unlike idioms and proverbs, which tend to have fixed or static meanings, metaphors tend to be novel utterances. They are created by the speaker and dependent on the context in which they take place. Because of the large number of novel metaphors that one is likely to encounter, it is important for a listener to have a strategy that allows processing the message for its nonliteral intent.

Second, certain populations have been identified as being at risk for having difficulties with metaphoric language (Wiig & Semel, 1980). Recent research has documented delayed comprehension of metaphors in "preadolescents having a history of language acquisition difficulties" (Nippold and Fey, 1983) and learning disabled children (Seidenberg and Berstein, 1986). Children who exhibit deficits in processing metaphoric types are undoubtedly at a disadvantage, both educationally and socially. It is important that professionals dealing with these children be aware of the implications of such a deficit and be equipped to suggest effective remediation. Unfortunately, very little is available in the literature on empirically tested intervention procedures. The identification of a strategy for decoding metaphors may have clinical implications for facilitating comprehension of metaphors.

Third, studies by Reynolds and Ortony (1980) and Seidenberg and Berstein (1986) have shed light on possible

facilitators to the comprehension of metaphoric statements. These studies have implied that metaphors that are made more direct or explicit are easier to understand. Both studies use the simile as a direct form of the metaphor. A simile is metaphor in which words "like" or "as" are included to lexically signal that a comparison is being made. The metaphor "The baby was a loaf of bread with no wrapper" becomes a simile when the word "like" is inserted so that the comparative statement reads "The baby was <u>like</u> a loaf of bread with no wrapper".

One might assume that any surface structure which states a metaphoric comparison more directly could facilitate understanding. Typical analogy problems, like similes, state metaphoric comparisons more directly or explicitly. Verbrugge and McCarrell (1977) stated that whereas in a metaphor, ". . . a resemblance is communicated by forms that assert or presuppose an *identity*. . . similes and analogies . . . directly assert a relation of similarity" (p. 495). More specifically, analogies have been likened to a particular type of metaphor, the propc .tional metaphor (i.e., "The house was a cake that didn't have frosting."). Analogies state a proportional metaphor more directly (i.e., cake is to frosting as a house is to paint). We might predict that analogies, like similes, would be easier to understand than metaphors. Nippold, Leonard, & Kail (1984) have suggested that a relationship may exist between metaphor comprehension and analogical reasoning ability. They stated that "...children's ability to perform certain reasoning tasks resembling the reasoning involved in understanding various

types of metaphoric sentences could be compared with their metaphoric abilities. For example, a task of analogical reasoning ". . . seems to resemble analyzing the underlying structure of proportional metaphors" (p. 202). The purpose of this study was to evaluate the potential relationship between the proportional metaphor and the analogy.

Purpose of the Study

The intent of this study was threefold. The first objective was to examine the development of proportional metaphor comprehension and analogical reasoning of children at three grade levels. The second goal of this study was to determine if there was a relationship between the tasks used to assess verbal analogical reasoning and proportional metaphor comprehension as suggested by Nippold et al. (1984). Results of a recent study by Nippold and Sullivan (1987) did not find a significant correlation between their tasks of verbal analogical reasoning and proportional metaphor comprehension. It is possible, however, that their results may be accounted for by methodological factors. The third purpose was to analyze the effects of previous experience with analogies on the performance of metaphor understanding. Children at three grade levels were given both an analogical reasoning task and a proportional metaphor task. The students were assigned to the tasks in one of two orders of presentation. One group completed the analogies followed by the metaphors. The second group was given the two tasks in the reverse order. It was hypothesized

that the group that had previous exposure to the more explicit form of comparison, namely the analogies, would perform better on the metaphor task than the group who received the metaphor task first. A finding of this nature would have significant implications for remediation. Analogies could be used as a formula or strategy for decoding metaphoric comparisons. This strategy could be incorporated to faciliate the comprehension of metaphors.

CHAPTER 2

Review of the literature

Towards a Definition of Metaphor

A standard definition of metaphor remains an elusive objective. There seem to be as many definitions of a metaphor as there are studies of its nature and development. MacCormac (1985) explained the metaphor as "an unusual juxtaposition of the familiar and the unfamiliar"(p. 9). Gardner, Winner, Bechhofer and Wolf (1978) defined a metaphor as "a figure of speech in which one term (usually called the tenor or topic) is described or illuminated in terms of another element (usually called the vehicle)" (p. 5). They added that a comparison between these two elements is founded on the basis of some common property, usually referred to as the grounds. Smith (1981) described a metaphor as "a figure of speech in which the meaning of a term or phrase is transferred from the object it ordinarily designates to another object so as to provide new insight or perspective on the latter" (p. 52).

A simple way to characterize a metaphor is "as a comparison statement with parts left out" (Miller, 1979, p.226). More specifically, metaphors seem to include some combination of certain basic components. These include:

1) two terms (or sets) from apparently dissimilar domains, which are called the topic and the vehicle,
2) a juxtaposition of these two terms (or sets) within the same utterance, which can be stated explicitly or implicitly
3) an active comparison of the two terms (or sets) between which some relationship is found; a process that has been likened to that of solving an analogy (Gentner, 1977; Nippold, Leonard & Kail, 1984; Billow, 1975).
4) the resulting establishment of the grounds, which exists as the intended relationship and, serves to allow the vehicle to highlight some specific aspect of the topic.

An example of a metaphor that illustrates these components is as follows: "The giraffe (topic) was a flagpole (vehicle) living at the zoo". In this example, the feature of tallness that is shared (the grounds) by the giraffe and the flagpole is left unstated. More generally, metaphors are readily recognizable when they succeed in making a comparison of two or more things (the giraffe and the flagpole) that are widely different, but share some aspect (tallness) which is highlighted through the descriptive image.

There are a variety of specific types of metaphors. Metaphors have been differentiated according to the types of domains that are being compared in the statement. Gallagher and Wright (1979) distinguish between the concrete and the abstract whereas Nippold et al. (1984) make a distinction between perceptual versus psychological. Metaphoric

statements have also been differentiated in terms of the number of elements used in the surface structure to make the comparison. For example, the predicative metaphor has only one topic and one vehicle (eg. His hair was spaghetti.), whereas the proportional metaphor is usually comprised of three elements stated explicitly in the statement, two aspects of the vehicle and one aspect of the topic. The focus of the present study is on the proportional metaphor, which has been likened to an analogical comparison.

Arlin (1978) described a proportional metaphor as one in which, "...four or more elements in the communication must be compared, not directly (as in a simile), but proportionally" (p. 6). Her definition of the proportional metaphor was derived from Aristotle's definition of analogy in which the second element relates to the first as the fourth element to the third. For example, in "My head is an apple without any core, the three stated elements must be complemented by an implied fourth to form the proportion: (head: apple :: brain : core)" (Billow, 1975, p.415). This specific type of metaphor uses the same type of comparative structure as does an analogy (i.e., A:B::C:D). Proportional metaphors and analogies convey the same type of comparison, albeit with different linguistic representations. The semantic similarity between these forms was one of the working premises for the ensuing thesis.

Development of Metaphoric Understanding

Man's interest in the nature of metaphors dates back to the time of Aristotle (Ortony, Reynolds & Arter, 1978). The very earliest analyses of metaphoric language were primarily theoretical in nature. Philosphers developed models to accomodate the unique nature of metaphors and other forms of figurative language. In Gardner & Winner (1978), these early developmental analyses were referred to as "little more than mental exercises by evolutionary minded scholars" (p.125). It is only within the last two decades that metaphors have come under the harsh eye of empirical research.

Among all the forms of figurative language, none rivals the metaphor for the current attention it seems to be receiving from researchers in language and psychology. Although there has been some indagation of adult comprehension and production of metaphors (Verbrugge & McCarrell, 1977), the majority of studies have probed the abilities of normal developing children to comprehend and produce metaphors (Arlin, 1978; Billow, 1975; Cometa & Eson, 1978; Cicone, Gardner & Winner, 1981; Dent, 1984; Gardner, Kircher, Winner, & Perkins, 1975; Gardner & Winner, 1978; Nippold et al., 1984; Nippold & Sullivan, 1987; Reynolds & Ortony, 1980; Winner, 1979; Winner, Rosensteil & Gardner, 1976).

Several researchers have investigated stages of metaphoric comprehension. Reynolds and Ortony (1980) describe these developmental studies as "attempting to establish that there are distinguishable levels of metaphoric understanding progressing

toward fully mature comprehension in early adolescence" (p. 1110). Unfortunately, the studies done thus far fail to elucidate these levels. Any significant synthesis or unitization of these studies is hampered by the fact that most of these investigations have tapped distinctly different competencies with a variety of comprehension (Seidenberg & Bernstein, 1986), production (Winner, 1979), and metalinguistic tasks (Billow, 1975). Other researchers have investigated differences in the comprehension of specific types of metaphors (e.g., predicative vs. proportional, cross-sensory vs. psychological) (Cicone, Gardner, and Winner, 1981; Nippold, Leonard & Kail, 1984) or factors that may affect performance on tasks involving metaphor comprehension (e.g., memory, reading ability, vocabulary level) (Reynolds & Ortony, 1980). Still others have used nonlanguage modes in the presentation of a metaphor comprehension task (Dent, 1984).

Almost all the research seems to clearly indicate an increased proficiency in understanding metaphoric language as a function of age. It also seems apparent that performance on tasks of comprehension may be dependent on several variables. These include the directness with which the metaphor is stated in the surface structure (Seidenberg & Bernstein,1986), the type of metaphor (Nippold, Leonard & Kail,1984), and the explicitness of the terms (Arlin, 1978).

The following review of research on metaphor is confined to developmental studies that are pertinent to the comprehension of metaphoric forms. It also focuses more specifically on studies

that provide information that might be valuable in the formulation of a remediative approach.

There is evidence in the research to suggest that some preschool children possess a genuine metaphoric capacity (Gentner, 1977; Winner, 1979; Gardner et al, 1975; and Dent, 1984). It appears, however, that a child's developmental level sets limits on the types of metaphors that the child will be able to understand beyond the most literal level. These studies of young preschoolers indicate that their understanding and production of more mature and transparent metaphoric forms may be limited by their linguistic and cognitive levels. Even at the elementary grade level, most researchers maintain that children tend to be highly concrete and literal in their approach to metaphors. Studies by Gardner, Kircher, Winner, and Perkins (1979) and Winner, Rosensteil, and Gardner (1976) illustrate this point.

Gardner et al. (1979) included subjects from the widest age range of any research on metaphor comprehension or production. They analyzed the metaphoric preferences (on a multiple choice task) and productions (elicited by open-ended sentences) of children between the ages of 3 and 19 years old. Their results indicated that the youngest children's preferences were more often literal or conventional whereas the older subjects were more likely to favor novel metaphoric endings. In the production portion of the testing, endings generated by the subjects at any age indicated an overall trend to respond with conventional endings. The older subjects' conventional endings,

however, became increasingly embellished and vivid. Their responses were relatively effective linguistic expressions in comparison to the " . . . hackneyed formulas characteristic of most younger children" (p. 139). Even so, Gardner et al. still viewed the older subjects' productions as "transitional" in that they still could be - and should be - differentiated from appropriate metaphors. Their interpretation of the results implied that there is a gradual growth in metaphor appreciation, reflected in the qualitative differences in the responses chosen and generated by children in the age groups they studied. One might speculate that metaphoric competence develops even further in children beyond the age of nineteen. Studies by Winner (1976) and Dent (1984) also provide evidence that competence in metaphor understanding improves as a function of age.

Winner et al. (1976) studied the development of metaphor understanding in children 6 to 14 years of age. The span of subjects' ages serves to exemplify gradual improvement in metaphor comprehension. The tasks chosen to assess the children's ability to interpret metaphoric statements were explication or a selection of one of four offered paraphrases (magical, metonymic, primitive metaphoric, genuine metaphoric). The alternatives for the multiple choice task were formulated to represent three steps preceding the attainment of mature comprehension. These steps were derived from the "stage theory" of metaphoric understanding (Billow, 1975; Gardner et al., 1975). In the multiple choice task, the genuine metaphoric

interpretation was selected as early as six years of age, but did not comprise the majority of the paraphrases chosen until 10 years of age. The proportion of genuine metaphoric choices continued to increase with age. By the age of 14, this sophisticated type of responding comprised 92 percent of the choices made. Although the explication task showed a pattern of responding similar to that for the multiple-choice task, the percentages of explanations that were judged as genuine metaphoric fell well below the numbers obtained in the multiple choice task. In summary, refined understanding of metaphors, which includes the ability to recognize, paraphrase, and explicate the multitude of metaphoric forms that can occur, is a relatively late attainment (Nippold & Fey, 1983; Gardner et al., 1979). Developmental literature reveals that children move through qualitative changes in the types of metaphors they comprehend and produce, finally culminating in the comprehension and use of mature forms.

The development of metaphoric comprehension has also been compared to comprehension of other figurative forms. Similes resemble metaphors in that they too make comparisons between literally disparate concepts or domains. Similes, unlike metaphors however, state the comparison more explicitly.

The Relationship of Metaphors to Similes

Metaphoric relationships can be made more direct by lexically marking, in the surface structure of an utterance, that a comparison is being made. This is accomplished by adding the

words "like" or "as" to form a simile. For example, the metaphor, "The man's nose was a pickle" can be made more direct or explicit by adding the word "like". The resulting simile, "The man's nose was like a pickle" should be easier to understand. Both Reynolds and Ortony (1980) and Seidenberg and Berstein (1986) found that comprehension was better for similes than for metaphors.

Reynolds and Ortony (1980) studied metaphoric competencies in elementary school children between the ages of 8;2 and 12;4. Each student was asked to choose an ending to stories that were read to them. The stories were supplied with four alternative completions from which to choose. The younger children were able to select the correct ending more often when the choices were stated as similes than when they were in the form of a metaphor. Reynolds and Ortony concluded that because there was no difference in the semantic content of the metaphors and the similes, "the difference in performance must have been due to the difference in the surface structure of the comparisons" (p.1115). As age increased, there was a reduction in this advantage of similes over metaphors. At each successive grade, there was also a subsequent increase in the number of correct responses made.

Seidenberg and Berstein (1986) tested both learning-disabled and nonlearning disabled for their understanding of metaphors and similes. When the proficiency of the two groups on the two metaphoric types was compared, they found a difference in performance in the learning disabled (L.D.) group

that was not present for the nonlearning disabled group. The L. D. students performed significantly better for the simile condition. Seidenberg and Berstein concluded that "Because there was no difference in the semantic content of the two metaphoric types, their better performance on the simile condition appeared to be due to the explicitness of the comparison signaled by the grammatical surface structure of the simile" (p. 219).

These two studies seem to imply that metaphors that are made more direct or explicit tend to be easier to understand. Vosniadou (1987) reinforced this concept in her statement that both "...the explicitness of the metaphoric comparison, and the explicitness of the metaphorical grounds, can facilitate metaphor comprehension considerably" (p. 879). Verbrugge and McCarrell (1977) stated that metaphoric language communicates a resemblance through linguistic forms that *assert* or *presuppose* an identity. They differentiate metaphors from similes and analogies which they describe as *directly asserting* a relation of similarity. In as much as analogies, like similes, can state a proportional metaphor more directly, children should perform better when the proportional metaphor is represented in the form of an analogy. The notion of directness might be applicable to remediation as well. It may be that prior experience with analogies might facilitate the comprehension of proportional metaphors.

Development of Analogical Reasoning

Analogical reasoning occurs when an individual draws upon familiar experiences to understand new experiences more fully (Sternberg, 1982). Levinson and Carpenter (1974) provided a more expanded explanation of analogical reasoning. They quoted Willner (1964) as having said that true analogical reasoning requires the "extraction of a relationship in one realm, construction of a closely equivalent relationship in another realm, and a careful inspection to see that both relationships are closely matched." (Levinson & Carpenter, 1974, p. 857). Moreover, they propose that "true analogical reasoning involves an understanding of proportional relationships" (p. 857). Analogical reasoning has been assessed in a variety of ways (e.g., perceptual mapping, perceptual analogies), but most commonly through the use of verbal analogies. Verbal analogies consist of four terms, in which the first two are related to one another in the same way as the third term is to the fourth (A is to B as C is to D); for example, "bird is to air as fish is to water".

Developmental studies on analogical reasoning typically demonstrate the capacity for analogical reasoning increases with age (Nippold & Sullivan, 1984; Levinson & Carpenter, 1974). There are several factors which have been found to affect performance on tasks of analogical reasoning. A number of them were considered in the design of the present study. These are listed below.

A) The complexity of the analogical form (i.e., quasi versus true analogies)

B) The semantic or vocabulary level of the words used to express the analogy. Auditory comprehension level may confound performance on a test of analogical reasoning. If there are terms in the analogy which are unfamiliar, an accurate interpretation of the relationship between the terms is thwarted.

C) The associative strength of the third term alone to elicit the fourth term. Younger children have shown a proclivity towards responding associatively (Gallagher & Wright, 1979; Sternberg & Nigro, 1980; Goldman, Pelligrino, Parseghia & Sallis, 1982). On a multiple choice task, children tend to choose the word that is most closely associated with the third term rather than basing the response on any analysis of the relationship between terms.

D) The type of relationship expressed between the two sets of terms (e.g., part-whole versus action-object, perceptual versus verbal). Wiig and Semel (1976) have given some guidelines on which analogy types are more difficult than others. The sequence they suggest has been abstracted from knowledge of cognitive developments (i.e., previous success in establishing semantic classification and transformation). For example, they have suggested that whole-part analogies are easier than part-whole analogies, sequential relationships are easier than temporal or spatial relationships.

E) The type of task used to assess analogical reasoning. For example, a sentence completion or generation task has been

found to be more difficult than a multiple choice task (Goldman et al., 1982).

The two studies reviewed below illustrate the effects of some of these variables on subject performance.

Nippold and Sullivan (1987) studied the comprehension of verbal analogies and perceptual proportional analogies in children aged 5, 6, and 7 years. Perceptual proportional analogy problems were described as consisting of "various visual patterns or geometric designs such as a small circle (A) and a large circle (B) paired with a small square (C) and an empty slot (D)" which would be correctly completed with a large square (p, 367). "An example of a verbal proportional analogy problem sound be "Five is to number as black is to _____' ..." (p. 367). Both analogical tasks used pictured items expressing the relationship between the terms. In the verbal task, the relationship between the terms was a semantic one. The relationship in the perceptual task was cued by visual features that the two terms shared. Proficiency increased with age on both tasks of analogical reasoning. Although, "...children within each age group showed a wide-ranging ability to perform each of the (two) tasks" (p. 372), significant differences in performance were found between each of the age groups. For all age groups, the scores on the verbal task were consistently higher than for the perceptual task.

Levinson and Carpenter (1974) made a distinction between quasi and true analogies. They stated that the structure of true analogies parallels a mathematical proportion [e.g., 3 (A) is to 15

(B) as 4 (C) is to 20 (D) (A:B::C:D)] such that the relationship between all four terms can be permutated into seven additional arrangements (i.e., A:C::B:D, B:A::D:C, C:D::A:B, ...) (Miller, 1979). Quasi analogies, on the other hand, cannot be permutated since they include a grammatical structure which establishes "the relationship between the first two stimulus words, thus eliminating the necessity for deducing the relationship" (Levinson & Carpenter, 1974, p. 857). An example of a quasi analogy would be "A bird uses air; a fish uses ___ (water)" (p. 857).

Levinson and Carpenter tested 9, 12, and 15 year olds using these quasi and true analogies. Their study yielded the following results.

1) There was a significant difference between the scores obtained by the 9- and 12-year old subjects, but not between the 12- and the 15-year-olds. They concluded that the

> 9-year-old subjects appeared to have an emerging ability to reason analogically, (but that) this ability apparently was not developed to the extent that it was in the 12- and 15-year-old subjects" (p. 859).

2) The 9-year-olds performed better on the quasi analogies than they did for the true analogies. This may have occurred because the quasi analogies stated the relationship between the terms more explictly in the surface structure. A similar trend can be seen in the improved performance found for similes over metaphors in Reynolds and Ortony (1980) and Seidenberg and Bernstein (1986).

3) The above difference was not observed in the two older groups (12- and 15-year-olds). Again a parallel can be drawn between these results and those found in the studies comparing performance on simile vs. metaphor comprehension tasks. Both Reynolds and Ortony (1980) and Seidenberg and Bernstein (1986) found the advantage in simile comprehension diminished in the older children.

4) There was a significant effect for the order in which the children received the analogies. This effect "suggested that information provided by the quasi analogies improved (subsequent) performance on the true analogies" (Levinson & Carpenter, 1974, p. 860).

The research of cognitive theorists has contributed findings that may help to establish a relationship between cognitive ability of analogical reasoning with language skill of metaphoric understanding. Billow (1975) and Arlin (1978) are two authors that have initiated inquiry into some plausible propositions. Their research goes beyond indicating what types of metaphoric language develop at various ages to investigate how and why these qualitative differences change over time.

Cognitive Ability and Metaphoric Competence

A number of studies have attempted to specify the developmental stages of metaphoric language in terms of cognitive levels of abilities (Billow, 1975; Nippold & Fey, 1983; Cometa & Eson, 1978; Arlin, 1978). Cognitive tasks that have been related theoretically to specific phases of metaphor

comprehension include combinatorial reasoning (Cometa & Eson, 1978; Billow, 1975; Arlin, 1978), conservation (Arlin, 1978; Cometa & Eson, 1978) and classification (Nippold & Fey, 1983; Cometa & Eson, 1978; Nippold et al., 1984; Billow, 1975). These investigators seem to be working under the same premise as Arlin (1978). She asserted that the understanding of metaphors may be related to cognitive abilities. Arlin stated that "A look at some of the studies on cognition and metaphoric language seems to show that not just age, but also operational level may be one predictor of a child's ability to comprehend metaphors" (p. 40). She explained further of a "theory that predicts that the similarity metaphor is the metaphor type appropriate to concrete operational thought" (1978, p. 37). Her study, in 1978, attempted to correlate the comprehension of proportional and similarity metaphors with three different Piagetian tasks: classification, conservation, and formal tasks (combinatorial and proportional reasoning). For all of the comprehension items, operational level was a strong predictor of metaphor comprehension. With specific regard to the similarity metaphor, she judged her findings as being consistent with the aforementioned theory. Supportive evidence is provided by Cometa and Eson (1978), Nippold and Fey (1983) and Billow (1975).

Billow (1975) tested young boys within each of five age ranges (five through fourteen) on their comprehension of metaphors and cognitive ability. In the first 'phase', each subject was asked the meaning of similarity metaphors (i.e., "Hair is

spaghetti" (p. 415)) in a sentence context. This was followed by questions of class inclusion that were considered a measure of concrete operations. In the second "phase", the three oldest groups were also given "proportional" metaphors (i.e., "My head is an apple without any core" (p.415)) and proverbs for their explication, which was succeeded by a test of combinatorial reasoning. The latter was given to ascertain the availability of the mechanisms of formal operations. There was a strong age effect on proportional metaphor performance across the 9 to 13-year-old groups. Billow has used these findings to infer that the comprehension of the proportional metaphor is in some way related to the acquisition of formal operations. Nippold, Leonard, and Kail (1984) speculated that these proportional metaphors may be more difficult because they may involve a type of reasoning ability that develops more slowly than that involved in understanding predicative or similarity metaphors.

In summary, the current research seems to substantiate that cognitive level may explain qualitative changes that occur in the comprehension and production of metaphoric forms.

> "Changes in children's cognitive structures may be accompanied by changes in their ability to understand specific metaphor forms. Conversely, developmental limitations on children's capacities for various forms of logical thought or their ability to engage in highly complex classificatory activity may represent as well limitations on their capacity for understanding specific metaphor forms" (Arlin, 1978, p.4).

In other words, the more complex and abstract the basis of the comparison in the metaphor, the more sophisticted the cognitive

processes necessary for identifying these comparisons. In the following section, a potential relationship between yet another cognitive ability, namely, analogical reasoning and metaphoric comprehension, will be explored. Nippold et al. (1984) speculated that a relationship may exist between metaphor comprehension and analogical reasoning ability.They stated that

> "... children's ability to perform certain reasoning tasks resembling the reasoning involved in understanding various types of metaphoric sentences could be compared with their metaphoric abilities. For example, a task of analogical reasoning ...seems to resemble analyzing the underlying structure of proportional metaphors" (p. 202).

Analogical Reasoning and Comprehension of Proportional Metaphors

The metaphor is considered "analogical in nature and seems to require the same processes to comprehend as does an analogy" (Sternberg, Tourangeau & Nigro, 1979, p. 339). This theory of analogical reasoning seems to be the most appropriate to proportional metaphors. Ortony defined proportional metaphors as ones that compare four or more elements in a communication indirectly and have been likened to implicit analogies. This type of metaphor expresses the analogy in an indirect fashion by leaving out certain of its components. Both analogies and proportional metaphors require proportional thinking, with analogies being the more direct form that the proportional comparison can take (Ortony, 1979).

When comparing cognitive competences with metaphoric ability, Nippold, Leonard and Kail (1984) suggested that the

reasoning task used to assess a child's cognitive ability should resemble the reasoning involved in understanding the various types of metaphoric sentences. As previously mentioned, the reasoning tasks that have been utilized thus far have included combinatorial reasoning, conservation and classification. Analogical reasoning is another cognitive ability that should be explored. Thus far, only Nippold & Sullivan (1987) have investigated this relationship. They compared two types of analogical reasoning and proportional metaphor comprehension in five-, six-, and seven-year old children. Each of the children were presented with three tasks: Verbal Analogical Reasoning, Perceptual Analogical Reasoning, and Proportional Metaphor Comprehension. They obtained significant, but low correlation coefficients between Verbal and Perceptual Analogical Reasoning and between Perceptual Analogical Reasoning and Proportional Metaphor Comprehension. Although they also "expected that verbal analogical reasoning would also be related proportional metaphor comprehension, and indeed be more closely related than perceptual analogical reasoning, . . . the results did not support that prediction" (p. 374). Although they found no correlation between their tasks of verbal analogical reasoning and metaphor understanding, it is believed that the stimuli chosen to represent the metaphor comprehension task may have confounded their results. In the present study this confounder has been eliminated and will subsequently be discussed at greater length in the methodology section. The authors emphasized the importance of their other findings and stated

that their study was " the first to document a significant relationship between analogical reasoning and proportional metaphor comprehension in children of any age, a finding that had been predicted because of the similarities in logical structure between proportional analogy problems and proportional metaphoric sentences" (p. 374).

The research described in the following chapters explores the development of analogical reasoning and metaphor comprehension in gradeschool children and the relationship that may exist between these two abilities.

CHAPTER 3

Rationale and Research Questions

As has already been stated, children are constantly exposed to figurative language. It is important that they understand the nonliteral intention of figurative phrases to benefit fully from the language in which it is embedded.

It is not extraordinary to find figurative language used in classroom textbooks, recommended fictional reading books and the instructional language of teachers. Figurative forms are often used to convey a new idea to students. Impaired comprehension of figurative forms could inhibit a child's learning of many common forms that language takes; for example riddles, idioms, metaphors. Children who are not able to extract the correct interpretation from a figure of speech are at a distinct disadvantage in learning the material presented using the medium of figurative language.

Among the disadvantaged are the language disordered and learning disabled. They have been identified as having considerable difficulty in comprehending figurative language. It is important for educators and remediative staff to be aware of the implications of such a deficit. These children need to be identified and provided with remediation so they too can benefit from the broader range of language forms.

Literature on figurative language has flourished within the last two decades. Unfortunately, very little of the research addresses the issue of remediation. Because the formulation of possible remediative procedures is dependent on a thorough understanding of the process(es) involved in the comprehension of figurative forms, it is imperative that we study how children acquire figurative language and explore strategies that might facilitate mature comprehension. An increased focus on remediation may lead to the formulation of a possible remediative strategy that would facilitate the understanding of figurative language.

It is proposed that the cognitive ability of analogical reasoning may exist as a prerequisite to metaphor comprehension. Furthermore, it may be that the ability to complete verbal analogies can actually facilitate the decoding of some metaphoric forms, namely proportional metaphors. If the latter is true, analogical reasoning tasks could potentially be used in the remediation of poor metaphor comprehension.

To support the hypothesis that analogical reasoning tasks and metaphoric comprehension may require the same underlying ability and that analogical reasoning may be a prerequisite for mature metaphor comprehension, this study will investigate the relationship between analogical reasoning and metaphoric comprehension, and explore the use of analogies as possible facilitators to metaphoric understanding. The findings should also concatenate with the composite of research on

metaphor development. These objectives will be met by asking four pertinent questions:

1) Will performance on the metaphor comprehension task improve as a function of grade level?

   Results from this study are expected to support the findings of the multitude of research that has shown that metaphor understanding continues to develop as age increases.

2) Will performance on the analogical reasoning task improve as a function of grade level?

   Most research to date supports the notion that performance on tasks of analogical reasoning steadily improves as a function of age (Nippold and Sullivan, 1987; Levinson and Carpenter, 1974). The investigator believes that these findings will be substantiated in the present study and that this corroboration will lend validity to the tasks that the investigator has generated to measure analogical reasoning ability.

3) Will childrens' performance on a test of analogical reasoning correlate with their performance on a test of metaphoric understanding?

   Billow (1975) found a relationship between operational level and the capacity to understand specific types of metaphors. More specifically, Billow states that . . .

> "The strong age effect on porportional metaphor performance across the 9-13-year-old group suggested that the comprehension of the proportional

metpahor is in some way related to the acquisition of formal operations" (p. 421).

This same age effect was noted by Levinson and Carpenter (1974) in their study on the performance of 9-, 12- , and 15-year-olds on tests of analogical reasoning. They implied that performance differences they obtained between the 9-year-olds and the two older groups "...suggested that the two older groups had an ability which contributed to their facility to solve verbal analogies which was more developed than that of the 9-year-old subjects" (p. 859). It would appear plausible that this age distinction may be attributed to the same cognitive variable considered by Billow (1975). The ability to demonstrate competence within the formal operational level may also affect one's ability to complete true analogies.

4) Will performance on the metaphor task be better when they are preceded, rather than followed by, the analogy items?

or

5) Will performance on the analogy task be better when they are preceded, rather than followed by, the metaphor items?

Levinson and Carpenter found that previous experience with quasi analogies was facilitative of performance with the true analogies. This facilitative effect may be attributed to the directness with which the quasi analogies are stated. In as much as analogies state a comparison more directly than metaphors, previous experience with the analogies may

facilitate performance on a metaphor understanding task. If this were found to be the case, analogies might be used as a remediative strategy for students who are having difficulty with metaphor comprehension.

CHAPTER 4

Methodology

Subject Selection

All subjects were selected from the Edmonton Public and Separate school systems and were considered by their teachers to be of average academic ability. To be eligible to participate in the study, each student was required to meet the following criteria:

(a) assignment to a regular classroom,

(b) demonstration of average reading ability as judged by the classroom teacher,

(c) absence of reports of emotional or learning problems,

(d) absence of hearing and vision impairments as reported by their classroom teachers,

(e) English as the first language,

(f) not considered to be low acheivers by their teachers,

(g) verbal I.Q. within one standard deviation of the group mean,

(h) parental consent (Appendix A).

The above criteria were met by taking the following steps. First, cooperating teachers were given a letter which explained their role in the selection process (Appendix B). The teacher used specific criteria with which they made a preliminary list of

students who could be considered for inclusion in the study. Second, with the permission of the school's principal, access to each of the student's cumulative files was obtained. The following information was extracted where available: 1] sex, 2] birthdates 3] Verbal I. Q. scores, 4] Reading Achievement scores, 5] general ratings of students' performances in school subjects (e.g., report cards), and 6] pertinent history of sensory impairment, special academic support (e.g., resource room), and/or special assessments (e.g., reading ability, speech-language,...) that were recommended or provided. Items 4 through 6 were checked for corroboration with the information given by the teacher. If any of this information in the student file conflicted with the teacher report, the student was considered ineligible.

Obtaining verbal I.Q. scores for all of the students was not possible. For the Grade 5 and 7 students, specific verbal I. Q. scores on the Canadian Cognitive Abilities Test (CCAT) (Thorndike & Hagen,1974) were available in the student cumulative files. For each CCAT score, a group mean was also given. For the Grade 3 students, I. Q. scores were usually available, but the testing instrument , the type of I. Q. score (i.e., verbal quantitative, nonverbal) and group means were not specified.

There were twenty grade seven students, seven males and 13 females. Their I.Q. scores ranged from 94 to 115 with a mean score of 103.8. They ranged in age from 12 years, 2 months to

thirteen years, 3 months with a mean of approximately 12 years, 9 months.

There were originally twenty-one grade five students. Two were excluded because they were not able to correctly answer screening practice items. Of the 19 remaining students, 6 were male and 13 were female. Their I.Q. scores ranged from 96 to 118 with an average of 107.2. They ranged in age from10 years, 5 months to 11 years, 8 months with a mean of10 years 2.5 months.

There were originally sixteen grade three students. Four students were excluded because they failed to pass the necessary screening practice items. Of the remaining 12 students, six were females and six were males. I. Q. scores were available for only 9 of the 12 students. Their I.Q. scores ranged from 110 to 120 with an average of 114.9. It was not clear from the student files that these scores represented verbal I.Q.s. The group mean for that particular testing was not available. The grade three students ranged in age from 8 years, 5 months to 9 years, 8 months, with a mean of 9 years.

A listing of each individual student's I.Q. score and chronological age at the time of testing is shown in Tables 3, 4, and 5.

Stimulus Items

Examination of a relationship between analogical reasoning and metaphoric comprehension required accurate measurement of each ability. There are no separate standardized instruments for measuring these abilities. Subtests are available, but these cannot be scored irrespective of the tests from which they were derived. Therefore, this investigator developed measurements to establish levels of metaphoric understanding and analogical reasoning. Two types of stimulus items were constructed: proportional metaphors and 'true' analogies (Levinson & Carpenter, 1974) which are illustrated below.

Metaphor

The bird's nest was a piggybank that had no coins.
That means the bird's nest:
a- had no eggs
b- had no twigs
c- had no food

Analogy

A piggybank is to coins as a bird's nest is to_____.
a - eggs
b - feathers
c - trees

Proportional metaphors. A formula implemented by Nippold et al. (1984) was used to generate the proportional sentences. All metaphoric stimuli contained a four-part analogy, V-1: V-2 :: T-1: T-2 and had the following surface structure: T-1 was a V-1 + a relative clause which will contain V-2 (i.e., "The **bird's nest** was a **piggybank** that had no **coins**"). Each metaphor was accompanied by three alternative interpretations that completed the phrase 'This means that _____". The students

were required to select one of three choices offered. Twelve metaphors were used in the experimental task. Alternatives offered as answers to each item were generated according to the guidelines used by Nippold and Sullivan (1987). The correct choice was always closely related to T- 2, whereas the foils were always related to T - 1. In addition, because Gardner, Kircher, Winner, and Perkins (1975) found that young children seemed to prefer literal interpretations, no literal interpretations were included among the foils.

True analogies. The analogies were constructed using the same comparisons and vocabulary as in the metaphor sentences. They were represented in the following format: A is to B as C is to ____. Students were asked to complete each analogy by choosing from among three alternatives supplied by the experimenter. Most of the alternatives that were offered in the multiple choice array had been selected from a pool of open-ended responses supplied by University students to these same analogies. The analogical reasoning task was comprised of twelve analogies.

Construction of all stimuli was guided by "item-writing rules" in W.J. Popham's Criterion Referenced Measurement (pp. 57-62). The rules applied were as follows:

1) Each alternative was grammatically consistent with the item's stem.
2) Attempts were made to maintain similarity in the length of the alternatives offered as anwers to any one item.
3) Each alternative position for correct answers was used randomly in approximately equal numbers.

In addition, the metaphors and analogies were matched for vocabulary and semantic content. That is to say, each metaphor had a corresponding analogy that used similar or identical

vocabulary to express the same proportional comparison. The examples already provided illustrate the relationship between items in the analogy and metaphor tasks. A complete list of the stimuli used in this study is provided in Appendix C.

Reynolds and Ortony (1980) claimed that "measures of metaphor comprehension tend to be confused with measures of other, theoretically unrelated, performance factors" (p. 1115). Because subsequent research in the area of metaphor comprehension has given credence to this claim, it was crucial that the present study include controls for possible confounding variables that may contaminate the validity of the two measures. Therefore, apriori criteria were established for all the stimulus items. These criteria addressed the following potentially confounding variables:

a) vocabulary level,
b) reading level,
c) syntactic structure (i.e., comprehension of grammar of the surface structure),
d) the internal validity of the stimulus items,
e) response association,
f) literal interpretation,

Vocabulary and reading level. The lexical items within the stimuli were restricted to the Grade three level. These levels were assessed by having 10 third graders, who did not participate in the main study, read the stimulus items aloud to the experimenter. The children were asked to indicate if any of the words were difficult to read or understand. If more than one child had difficulty decoding or understanding any word in a stimulus item, it was eliminated from the pool of stimuli being assessed. This was done to ensure that the students' semantic competency or reading ability would not confound their performance on the tasks.

Syntactic structure. Relative clauses were embedded in the surface structure of the metaphor sentences. Therefore a

screening was conducted to insure that students at grades three and above could comprehend the specific type of relative clause present in the metaphors. Fourteen grade three children participated. They were not involved in the main study. The screening tool that was used was made up of 4 items. Each item consisted of a stimulus sentence containing a relative clause and a question to assess their understanding of the sentence. The four items were as follows.

1] "The car pulled up in front of the house that was red. What was red?"

2] "Johnny bought a teddy that was wearing a hat. Who was wearing the hat?"

3] "All the dolls had on shoes that were dirty. What was dirty?"

4] "The horse licked the puppy that was black. What was black?"

An overall percentage of 84 was obtained by the group. Almost all students had either 75 percent (3 out of 4) or 100 percent (4 out of 4) correct. The error that predominated was on the first item. The error rate on this first item could have been due to a confusion over the low probability that a house would be red or a warm-up to the task since there were no practice items. One student who erred on 2 of the 4 items was reported as low average by the classroom teacher.

Internal validitiy of the stimulus items. In order to provide internal validity, the metaphors and analogies constructed were piloted on University students. Each stimulus item was retained only if at least 95% of the pilot subjects selected the same alternative from among the multiple responses offered. This criterion was taken from the study by Nippold et al. (1984). Although it was used only for the screening of metaphor items they constructed, it was used as a criterion level for both the metaphor and analogy items by this investigator.

Response association. Nippold (1986) reported that younger

children were more likely to give an associative response than analyze the relationship between the first two terms to correctly complete an analogy.

If an analogy was completed by word association alone, the analogy task would not be representative of the child's true ability for analogical reasoning and, therefore, an invalid measure. To decrease the probability of correct responding based on associative strength alone, all analogies were screened. This was done by administering a written free association exercise to a group of University students. Any analogy items whose fourth term arose as a response to the third term in a free association task more than 8% of the time, were not used in this study. An example of an analogy that could be answered correctly based on the associative strength of one of the alternatives is as follows.

"tennis ball is to fuzz as head is to _____

a - comb
b - whiskers
c - hair".

In the free association task, the correct answer to the above analogy (hair) arose as an associate of the third item (head) 34 percent of the time. Therefore, it was determined that the likelihood that the item would be answered correctly based on associative strength alone was strong and the item was excluded from the pool of stimuli that were screened.

Literal interpretation. Gardner, Kircher, Winner and Perkins (1979) reported that the children in their study had a tendency to choose a literal interpretation over other types of responses (i.e., conventional, metaphoric). To eliminate the opportunity for this type of bias in responding to occur, no literal interpretations were offered among the multiple choices given.

Design

Originally the study was designed to be a two by three two factor between groups design. Three grade levels and two orders of task presentation were designated as the independent variables. The dependent variables were performance on tests of analogical reasoning and metaphor comprehension. The type of data that arose from this study, however, contraindicated the use of an ANOVA as will be discussed in the Results chapter. Therefore, the design of the study followed that of two between groups designs.

Three grade levels were tested for their performance on a test of metaphor understanding and analogical reasoning. The table below illustrates the final subject distribution within each grade level.

TABLE 1. Number of Subjects Within Each Grade Level

Grade 3	Grade 5	Grade 7
12	19	20

All the students were randomly assigned to one of two orders of task presentation. In the first order of presentation (Order I), the subjects received 12 analogies to complete followed by 12 metaphors to interpret. In the second order of presentation (Order II), the metaphors preceded the analogies. The order in which the items within each task were presented was randomized. This was done in an attempt to control for any possible item order effects between the tasks (analogies and metaphors). The table below illustrates the final subject distribution to experimental conditions.

TABLE 2. Number of Subjects Assigned to Each Order.

Order I	Order II
27	24

Procedures

The tasks were administered to the children in small groups of two to six students in an available classroom in their respective schools. All the items were typed on worksheets that were handed out to each child. An undergraduate student from the Department of Speech Pathology and Audiology assisted the investigator so that all the students could be monitored. Her presence allowed the investigator to ensure that all the students were following along and filling out their answer sheets properly.

Every participant was given the following instructions:

"Thank you very much for giving your time to fill out these papers for me. I will be handing each of you worksheets. Please listen to me first before you begin to do anything. Do not put your name on your papers.

You will be completing two different worksheets. We will have a chance to practice each together before you begin on your own. The answers you provide will stay with me. They will be part of a study that I am doing for a class I have at the

University. Your names will not be mentioned in anything that I report. That is to say, that you will remain anonymous.

Each of you should have a worksheet, this white one (a sample was held up for display) and an answer sheet (a sample was held up for display) in front of you. Before we get started, I need you to put some things at the top left hand corner of the white sheet. Please turn your sheet over and listen to me."

The children were then instructed on how to code their white sheets. These codes were later transfered onto the answer sheets by the experimenter or the undergraduate assistant.

All the children were also given specific instructions for both the metaphor and analogical reasoning tasks (Appendix D). Instructions for each task were given just prior to its administration. The order in which these instructions were given, however, was dependent upon the condition in which the child was placed. These instructions included directions which were applicable to both tasks and ones that were specific to each task. The general instructions required that the students listen and read along silently as the experimenter read each item. This instruction was given to provide an extra measure to ensure that neither reading ability nor memory would interfere with their performance on the task. They were also told how to indicate their answers. Answers to the practice items were marked on the stimuli worksheets. Answers to the experimental items were recorded on optical score sheets.

Prior to the experimental items, students were given four practice items. These acquainted the children with the nature of each of the response types that would be required of them. The practice items consisted of four analogies and four metaphors in the same syntactic form as those in the stimulus items. Both the sentences and the offered choices in these practice items, however, were literal or polysemous as opposed to figurative. Two of the practice items were done as a group and the students were provided with the correct answer. The last two practice items were completed by the students without any feedback on their answers. For students who did not independently complete the last two examples of each set of practice items accurately, their responses on test items were excluded from any formal analyses. As previously mentioned, two of the fifth graders and four third graders did not pass the practice items so their scores on the two experimental tasks were excluded from statistical calculations.

Answers to the experimental items were coded by the students on optical score sheets provided by the experimenter. All response sheets were subjected to an item analysis using GPSOR and ITEMANAL on the University of Alberta's mainframe computer. This was done in order to obtain a distribution of responses and each item's level of difficulty.

CHAPTER 5

Results

Descriptive statistics for the metaphor and analogy tasks are given in Table 6. The range of scores on both tasks was fairly narrow. This was more predominant for the metaphor task than for the analogy task, where all subjects obtained a score of between eight and twelve. Histograms of all scores for each the metaphor comprehension and analogical reasoning tasks are represented in Figures 1 and 2 respectively. Most subjects scored high, with the majority of students in the seventh grade achieving a ceiling on both tasks. This high end performance trend resulted in a distribution of scores on both tasks that were negatively skewed and leptokurtic. This leptokurtic pattern is especially notable for the scores on the metaphor task.

Because of the negatively skewed distribution and leptokurtic pattern of scores, the use of a parametric ANOVA was questionable. Kirk (1968) outlined assumptions that need to be met before parametric statistics using the F distribution can be used. These are as follows.

The assumption of a normally distributed population. Kirk stated that a moderate departure from the normal distribution [in terms of skewness and kurtosis] can be tolerated provided ". . . the k populations are homogeneous" (p. 61). Because no

specific guidelines were given regarding the amount of kurtosis that could be tolerated, a test for homogeneity of variance was done. The test used was one that was proposed by Cochran (1941) and described by Kirk (1968). The variances were determined to be heterogeneous (p= .05).

The assumption of homogeneity of population-error variances. Kirk stated that this assumption may be violated " . . . provided the number of observations in the samples is equal" (p.61). This was not the case in this study's sampling. Experimental cells varied in number from five to ten subjects.

Because the samples were neither homogeneous nor equal in size, parametric statistics could not be used. Therefore, nonparametric statistical tests were used to analyze the results. A computerized statistical program developed by Feldman, Hofmann, Gagnon, and Simpson (1988), StatView SE + Graphics, was used to perform the analyses required to answer the experimental questions.

Metaphor Comprehension as a Function of Grade

Figure 5 shows the mean scores obtained on the metaphor task at each successive grade level. The numbers were taken from Tables 7 through 9, which also provide descriptive statistics on group performance on the two tasks at each grade level. Visual inspection of Figure 5 show that performance on metaphors improved at each successive grade.

A Kruskal-Wallis one-way analysis of variance (Feldman et al., 1988) was used to analyze the data. There was a significant difference in performance on the metaphor task as a function of grade level ($H = 9.206$, $p = .01$). Table 11 outlines the specific outcomes of the Kruskal-Wallis. The multiple comparisons procedure advocated by Conover (1980) was used as a post hoc test to determine which grade levels differed significantly in their performance. There were significant differences between the grade three and the grade seven students ($p < .002$) and between the grade five and grade seven students (p approximated at .0214). There was no significant difference between the grade three and grade five students' scores (p approximated at .2846).

Analogical Reasoning as a Function of Grade

Figure 5 shows the mean scores obtained on the analogy task at each successive grade level. As with the metaphors, there appears to be an improvement as grade level increases. Visual inspection of the mean scores seems to show that the differences between grade levels was less marked for the analogy scores than for the metaphor scores.

A Kruskal-Wallis one-way analysis of variance (Feldman et al., 1988) was used to analyze the data from the analogical reasoning task. The differences obtained on the analogies task did not prove to be significant ($p = .1686$) among any of the grade levels. Table 12 provides the specific figures obtained.

Correlation of Analogical Reasoning with Metaphor Comprehension

Because both analogical reasoning ability and metaphor comprehension seem to be developing under similar cognitive constraints, it was hypothesized that the results of this study would show a relationship between the development of these two skills. Paired scores on the analogical reasoning and metaphor comprehension tasks were subjected to a Spearman Rank-Order Correlation. Because there was an inordinate number of tied observations, a correction factor had to be incorporated into the computation of Z (Seigel, 1956). Table 13 gives both the uncorrected and corrected calculations of Z, along with their respective p values. There was a significant correlation for the uncorrected calculations. When Z was corrected for ties, however, there was a significant drop in the p value, such that the correlation between the two tasks was not found to be statistically significant ($p = .1069$).

Order Effects on the Metaphor Comprehension and Analogical Reasoning Tasks

A Mann-Whitney U-Test was used to determine if there were differences in performance as a function of the order in which the tasks were administered. These analyses were completed using StatView SE + Graphics (Feldman, Hofmann, Gagnon and Simpson,1988). No significant differences were

found for order. Tables 14 and 15 supply the p values obtained for both metaphor and analogy performance as a function of the order of presentation of the tasks.

Although the difference between the performances on the metaphor comprehension and analogical reasoning tasks as a function of order was not statistically significant, performance on the analogical reasoning task was always slightly better when preceded by the metaphor task (Order I). Figure 4 illustrates that this advantage seemed to increase at each successive grade level.

A different trend was noted for performance on the metaphor task (Figure 3). The pattern varied between grades, with grade 3 and 5 students performing differently than the grade 7 students. The mean scores obtained by the subjects in grades three and five seemed to show that previous experience with the comparison in the analogy format (Order II) did not improve subsequent performance on the metaphor task. The grade seven students, however, appear to have performed slightly better on the metaphor task when it was preceded by the analogy task.

The mean of all combined scores on each the analogical reasoning task and metaphor comprehension task showed that, overall, the students performed better on the metaphor comprehension task (Figure 5) than on the analogical reasoning task. Because this was an unexpected, but substantive finding, a Mann-Whitney U Test was used to determine if the difference

between the scores on the two tasks was a statistically significant one. The analyses demonstrated that the difference between the two tasks was significant ($p = .0174$).

Individual Subject Data

Figures 6, 7, and 8 show paired scores for each individual subject on both the analogical reasoning and metaphor comprehension tasks. At every grade level, there were more subjects who performed better on the metaphor task (26) than subjects who performed better on the analogy task (10). For grade five and seven subjects who performed better on the metaphor task, the difference between the subjects' paired scores on the two tasks was more conspicuous (differing two or more points) than the differences found between the paired scores obtained by the grade three students.

Chapter 6

DISCUSSION

As is evident from histograms of the scores obtained on the analogical reasoning and metaphor comprehension task, there was a prominent negative skewness in distribution of scores. This trend was more conspicuous at the fifth and seventh grades. The propensity of subjects to do well on the two tasks could have been the result of the stringent controls imposed on the stimuli in this study. Both Vosniadou (1987) and Reynolds and Ortony (1980) asserted that there are numerous uncontrolled variables that have confounded the performance of subjects on tasks of metaphor comprehension. Reynolds and Ortony stated that

> "... measures of children's ability to understand metaphorical language can all too easily be confounded with measures of other general language variables that have no particular connection to metaphorical language" (p. 1117).

In studies where measures have been taken to minimize the effect of extraneous variables on metaphor comprehension, even very young children have exhibited the ability to think metaphorically (Dent, 1984; Gardner, Kircher,Winner & Perkins, 1975; Gentner 1977; Nippold,

Leonard, and Kail,1984). Nippold, Leonard, and Kail (1984) were the first to demonstrate that children younger than 11 years of age could comprehend proportional metaphors. In their study, children as young as 7 years old performed well on their task of metaphor comprehension. They attribute this to the fact that they controlled for the effects of memory and attention, sentence length, semantics, and novelty. The present study also attempted to control for a large number of factors that have been shown to affect performance on metaphor comprehension and analogical reasoning (e.g., vocabulary level, syntactic structure). Children as young as 9 years of age obtained high scores on the tasks of metaphor understanding. In addition, there were minimal differences in performance between grade levels.

The students in this study also performed exceptionally well on the test of analogical reasoning. Most of the children, even those in the youngest group, answered the analogical problems with 75 percent accuracy or better and an average of 84 percent. This is in contrast to the results reported by Levinson and Carpenter (1974), where the mean raw score on the true analogies was 8.00 (out of a total of 16 problems).

Performance on the metaphor comprehension task was significantly better than on the analogical reasoning task. This finding refutes the hypothesis of this investigator, that the analogical reasoning task would be easier for the students than the metaphor comprehension task. That hypothesis was based on two assumptions. First, it was believed that the comparison in an analogical problem, like that in a simile, was stated more directly and secondly, that a more direct comparison would result in improved performance. Seidenberg and Berstein (1986) found simile performance to be better than metaphor performance and attributed this to the explicitness of the comparison signaled by the surface structure of the simile. This difference was statistically significant only for the learning-disabled children in their study. There was no significant difference between tasks for the normally developing children. Seidenberg and Berstein concluded that this ". . . linguistic variable is an important factor for both younger and older learning-disabled children" (p. 226).

Reynolds and Ortony found more correct responding in their simile condition than in their metaphor condition with normally developing children, but the advantage of similes over metaphors was reduced for the older children. The assumption that the analogy, like the simile, somehow represented a more direct comparison may be erroneous. In actual fact, the reverse may be more plausible. The proportional metaphor may be the more explicit statement when compared against the verbal

analogy. Additional linguistic cues supplied in the surface structure of the metaphors may be more efficient at signaling that a comparison should be made. The semantic content of the metaphors may function like that found in quasi analogies. Levinson and Carpenter (1974) stated that ". . . the quasi analogy appears to reveal the relationship between the first two stimulus words, thus eliminating the necessity for deducing the relationship" (p. 857). The parallel between the quasi analogy and the metaphor can best be made by giving an example of each, as follows:

"A piggy bank is to coins as a bird's nest is to____."
(true analogy)

"A piggy bank <u>has</u> coins, a bird's nest <u>has</u> ____."
(quasi analogy)

"The bird's nest was a piggy bank that <u>had</u> no coins."
(proportional metaphor)

Each of the items above represents the same comparisons, albeit implicitly. The last two items, however, contain additional linguistic information (underlined in the examples) in the surface structure that helps to indicate the relationship (spatial and purpose) between the terms. It is possible that the additional word(s) in the proportional metaphors provided a linguitic signal that helped to reveal the relationship between the terms in the metaphors. Further more, the multiple choice answers for the metaphors included a repetition of this linguistic cue for the students (e.g., "This means that the bird's nest . . . <u>had</u>

no eggs) which was not part of the answers offered for the analogies. This explicitness may account for the higher scores on the metaphor task.

The Effect of Grade Level on Task Performance

The main effect for grade on metaphor comprehension corroborates with numerous other studies of the development of this ability (Reynolds and Ortony, 1980; Seidenberg and Bernstein, 1986; Nippold, Leonard & Kail, 1984). The grade seven students' performance on the metaphor comprehension task was significantly better than the performance of both the grade three and grade five students, whereas there was no significant difference found between the performances of the grade three and grade five students. The advantage that the seventh graders seemed to have could be accounted for by the ability to assess the mechanisms of formal operations. The age span between the fifth and seventh graders coincides with the emergence of formal operations, which begins at approximately 11 to12 years of age (Billow, 1975; Levinson & Carpenter, 1974). Billow proposed that there may be a relationship between the proportional metaphor and formal operational thinking. The finding in this study lends support for this theory.

The Relationship Between Performance on the Metaphor Comprehension and Analogical Reasoning Tasks

The findings of this study support those of Nippold and

Sullivan (1987) in which no correlation was found between Verbal Analogical Reasoning and Proportional Metaphor Comprehension. In the present study, no significant correlation was found between the analogical reasoning task and the metaphor comprehension task. This was especially surprising, since this study took some added measures that would be expected to positively affect a correlation (i.e.,the analogies and metaphors were matched for semantic content). There is a possibility that the number of tied scores could have obscured finding a correlation between these two skills. In the statistical analyses, the p value for Z was at a significant level (.0314) when left uncorrected for the occurrences of tied values. Only when the Z was corrected for ties did the p value drop below an acceptable significance level.

The Effect of Order on the Task Performance

Although no significant differences were found for order, some interesting patterns emerged as the mean scores were plotted (Figures 3 and 4). Firstly, performance on the verbal analogies was slightly better when preceded by the metaphor task (Figure 4). This may have been the result of additional linguistic cues supplied within the metaphor statements. These could have acted to enhance processing of the corresponding analogy problems. Levinson and Carpenter (1974) found that their 9-year-old subjects performed better on "quasi analogies" than on "true analogies". The quasi analogies provided

additional linguistic cues which revealed the relationship between the first two stimulus words [i.e., "A bird uses air; a fish uses ___" (water)]. When the metaphor task preceded the analogy task, the linguistic cues provided within the metaphors may have acted to reveal the relationship between the terms in the analogies.

Secondly, figure 3 shows an interesting trend in performance on the metaphor task. Grade seven students showed an overall, albeit minimal, improvement on the metaphor task when it was preceded by the analogies. This same improvement was not evidenced by the third and fifth grade students. It could be that the older students had some ability (possibly access to formal operations) which allowed them to recognize the similarity between the two tasks and draw on that similarity to improve their performance on the metaphor task.

Conclusions

Three issues appear to underly the results obtained in the present research. These are the controls introduced into the stimulus items, the linguistic cues and the subject variable.

Stimulus variables. Scrupulous measures were taken in generating and screening the stimuli used in this study. The controls introduced into the stimulus items minimized the influence of confounding variables on subject performance and may account for the findings that contradict those of previous

developmental research. Future researchers should be aware of the extent to which extraneous variables can taint their results and take the necessary steps to minimize their influence.

Linguistic variables. Between the two tasks completed by the subjects in this study, the analogical reasoning task was the more difficult one. One explanation for this may be that verbal analogies are inherently more difficult for children to comprehend than proportional metaphors. The more likely explanation is that the paucity of language supports within the surface structure of the analogy make its comparisons less explicit than those made in a metaphor and therefore more semantically obscure. Although the analogy may be more direct in asserting *that* a comparison is being made, the metaphor may provide semantic information to reveal *what* the relationship is. Additional linguistic cues within the metaphors could account for better performance on the metaphor comprehension task in comparison to the analogical reasoning task.

Another plausible explanation for the better performance on the metaphor comprehension task lies within the subjects' familiarity with each of the language forms. Between analogies and metaphors, it is likely that metaphors are the more "natural" language form. Within the context of informal conversational exchanges, children are, undoubtly, exposed to these forms at a very young age On the other hand, the verbal analogies used in the present study are rather contrived linguistic forms. Children are unlikely to experience 'true' analogies until they reach school

age. It is possible that an increased familiarity with metaphors contributed to the subjects' better performance on the metaphor comprehension task.

Subject variables. Seidenberg and Bernstein (1986) compared learning disabled and nonlearning disabled children's performance on comprehension of similes and metaphors. They found that "...only the learning-disabled children's performance on the two conditions differed significantly" (p. 226). They concluded that the learning disabled student's abilities to comprehend metaphors are somehow masked by the indirect form that the metaphor takes. It was believed that results of the present research would parallel those in studies by Seidenberg and Bernstein (1986) and Reynolds and Ortony (1980) with the analogy being analogous to the simile in their studies. The fact that the present study used normally developing subjects could account for findings that differed from those found in Seidenberg and Bernstein's study (1986) of metaphor and simile comprehension with learning disabled subjects. Unfortunately this study does not provide sufficient evidence on its own to substantiate or disclaim this possibility. A replication of this study with matched learning disabled and normally developing samples is necessary before any conclusive statements can be made. It may be that the results found in the "normal" children of this study would not be duplicated among learning disabled subjects.

No correlation was found between comprehension of proportional metaphors and verbal analogies, two seemingly similar abilities. Although this finding seems to lend support to those of Nippold and Sullivan (1987), it still is a perplexing one, since both linguistic forms make proportional comparisons, albeit within different surface structures and with varying propositional content. In this study, the reliability of this finding is questionable. Further research is needed in order to be able to determine the definitive nature of this finding.

Comparisons of performance on tests of proportional metaphor comprehension and verbal analogical reasoning, using both true analogies and quasi analogies may shed light on the effects that surface structure and propositional content had on these results.

Anecdotal to the execution of this study was the lack of standardized measures of both metaphor comprehension and analogical reasoning ability. It would be valuable to have had standardized tests of these two abilities available. Norms could be used to identify children who are having difficulty with these abilities so that intervention could be offered. What that intervention would entail is yet to be definitively described, but as in all problems, identification is the first step to resolution.

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APPENDIX A

PARENTAL CONSENT FORM

Parental Consent Form

The purpose of the study is to investigate children's abilities to understand metaphors (i.e., The baby was a loaf of bread that had no wrapper) and analogies (i.e., pot is to soup as swimming pool is to _____). As a participant in this study, your child will be given written tasks of metaphor and analogy comprehension. Your child will be completing these tasks individually or in small groups with other children from his/her school. It is estimated that the tasks should take around an hour to complete. Children will be scheduled in consultation with their teachers so that each child's involvement will occur at the most convenient time possible.

All your child's answers will remain anonymous. Information obtained from this study will be reported in a thesis paper that will be submitted to the University of Alberta. Results may also be presented for educational purposes to related professionals. At no time will the identity of your child be disclosed. If you should have any questions, please feel free to call me at home. My phone number is 477-7630.

Thank you for your consideration,

I understand the purpose and procedures of this study. I understand the extent of my child's participation in the study described above. I understand that my child may withdraw at any time prior to or during the tasks he/she will be asked to complete.
Withdrawal will not jeopardize your child's relationship with the school in any way.

I, hereby, give permission for my child to participate in the above study.

_____	_____
Child's name (please print)	Parent/Legal Guardian's name (please print)
_____	_____
Date	Parent/Legal Guardian's signature

Kathleen Moran, Graduate Student
Department of Speech Pathology & Audiology
University of Alberta
Tel. (Residence): 477-7630

APPENDIX B

TEACHER INPUT TO SUBJECT SELECTION

Dear _____,

I am hoping to administer my experimental tasks to some of the students in your class. Students that are eligible for inclusion in the study need to meet certain criteria. Part of the selection process requires your input as a teacher. Please list the students in your class who you feel are "average" (not exceedingly high or low) and also meet the following criteria: (a) assignment to a regular classroom, (b) demonstration of average reading ability, (c) absence of reports of emotional or learning problems, (d) absence of hearing and vision impairments, (e) English as the first language and (f) not considered to be low acheivers.

Once your input has been applied to the student selection process, a final list of the students chosen for the study will be given to you. You will also receive consent forms to be sent home and signed by the parents of these children.

I will be eagerly awaiting your invaluable input into the selection process. Thank you very much for your cooperation and time. Please feel free to call me if you have any questions or concerns. I can be reached at 477-7630.

With Sincere Gratitude,

Kathleen M. Moran
Graduate Student
Dept. of Speech Pathology & Audiology
University of Alberta

APPENDIX C

STIMULUS ITEMS

Metaphors

Practice Items:

A) The boy got caught in the rain storm.
That means the boy:
a- would be punished
b- would be warm
c- would be wet

B) The lady had a little lunch.
That means the lady:
a- ate a small amount
b- picked up her food
c- cooked her food

C) After a hard day at work, the man was really beat.
That means the man:
a- was mean
b- was tired
c- was hungry

D) The bad boy got a licking when he got home.
That means the boy:
a- got a spanking
b- got kissed by his dog
c- got a sucker

Experimental Items:

1) The cook was a floor that needed a mop.
That means the cook:
a- was busy
b- was dirty
c- was funny

2) Mary's face was a cookie that had chocolate chips.
That means her face:
a- was round
b- was wrinkled
c- was freckled

3) The little girl was a doll that stayed in a toy chest.
That means the little girl:
a- was very small for her age
b- always wore pretty dresses
c- never went out to play

4) The desk was a jacket that had no pockets.
That means the desk:
a- had no chairs
b- had no drawers
c- had no legs

5) The yard was a room that had no door.
That means the yard:
a- had no gate
b- had no grass
c- had no fence

6) The chair was a bed that had a good mattress.
That means the chair:
a- was very big
b- had arms on it
c- had a soft cushion

7) The animal was a piece of fruit to be peeled.
That means the animal:
a- was hungry
b- was skinned
c- was small

8) The plane was a flying bus that had no driver.
That means the plane:
a- had no wings
b- had no pilot
c- had no passengers

9) The boy's head was an apple that had no core.
That means the boy:
a- had no thoughts
b- had no hair
c- had no heart

10) The house was a box that had no lid.
That means the house:
a- had no furniture
b- had no people
c- had no roof

11) The house was a cake that didn't have frosting.
That means the house:
a- didn't have any paint
b- didn't have any windows
c- didn't have a door

12) Santa Claus was a chicken that didn't have eggs.
That means Santa Claus:
a- forgot to bring his toys
b- forgot to take his sleigh
c- forgot to feed his reindeer

Some of the above metaphors have been taken directly from a study by Nippold and Sullivan (1987) or have been adapted from a study by Nippold, Leonard, and Kail (1984).

Analogies

Practice Items:

A) hammer is to pounding as scissors are to _____
   a- sharp
   b- cutting
   c- metal

B) a rug is to the floor as a blanket is to a _____
   a- pillow
   b- chair
   c- bed

C) a dozen is to twelve as a pair is to _____
   a- two
   b- shoes
   c- several

D) sad is to frown as happy is to _____
   a- smile
   b- tickle
   c- glad

Experimental Items:

1) bed is to mattress as chair is to _____
   a- cushion
   b- legs
   c- couch

2) a floor is to a mop as a person is to _____
   a- a bathtub
   b- a washcloth
   c- a vacuum

3) box is to lid as house is to _____
   a- furniture
   b- people
   c- roof

4) apple is to core as head is to _____
   a- brain
   b- heart
   c- hair

5) cake is to frosting as house is to _____
   a- windows
   b- people
   c- paint

6) chicken is to eggs as Santa Claus is to _____
   a- sleigh
   b- toys
   c- reindeer
7) room is to door as yard is to _____
   a- gate
   b- fence
   c- grass
8) fruit is to peel as animal is to _____
   a- hunt
   b- skin
   c- brush
9) cookie is to chocolate chips as a girl's face is to _____
   a- freckles
   b- hair
   c- wrinkles
10) bus is to driver as plane is to _____
   a- wings
   b- passengers
   c- pilot
11) jacket is to pockets as desk is to _____
   a- legs
   b- chairs
   c- drawers
12) doll is to toy chest as a little girl is to a _____
   a- mom
   b- house
   c- chair

APPENDIX D

INSTRUCTIONS

(A) Metaphors:

"Each of you should have a worksheet and an answer sheet in front of you. This is a sentence understanding test. There are 12 sentences. I will be reading each of the sentences and the choices aloud. You should read each one silently along with me. When we are finished reading each sentence and the answers, you will be choosing the answer that best explains the real meaning of the sentence. Let's try some together first.

Please look at sentence A at the top of your sheet. This is an example that we will do together. First I'm going to read the sentence aloud as you read along silently. (Read A aloud). Now circle the circle the letter on the white sheet you think best explains the sentence. The answer is c. Is there anyone who does not understand? Now let's try B together. Listen and read silently along with me. (Read B aloud) Now circle the answer you think best explains the sentence. The answer is a. Are there any questions? Now let's do the next two, C and D. Remember to read silently as I read them aloud. Then circle the answer you think is best.

Listen and read along silently. (Read through C and D). Now circle your answer on the white sheet (repeated after each one).

Now we are finished with the practice ones. We will do all the others in the same way except that now you'll be using this answer sheet (optical score sheet held up) to put down your answers. Once you have chosen your answer, you should darken

the circle that goes with that answer on your answer sheet. For example, if the answer was a, then you would darken the circle under the letter a. Be sure to stay inside the lines and do not make any other marks on these answer sheets. Is there anyone who does not understand?

Now we will begin with the numbered sentences. Again, I will be reading each one aloud as you read along silently. Remember to wait for me to finish reading. Then you can mark your answer. You should choose the answer you think best explains the sentence. Remember to fill in the answer space that goes with the letter for the answer you choose.
When you are done with each one, stop and wait until we all go on to the next one together.

(Name of assistant) will be walking around to help make sure I don't go on too fast and to help us fill out the answer sheets correctly.

Point to number 1. Listen and read along silently. (Read first item). Now choose your answer and darken in the circle that matches it on your answer sheet.
Number 2. Listen and read along. (Read second item). Choose your answer and darken a circle."

(B) Analogies:

"Each of you should have a worksheet and an answer sheet in front of you. In this test, you are given a phrase that is not complete. Below the phrase, there are three words. You need to choose the word which best finishes the phrase. There are 12 of these incomplete phrases. I will be reading each of the phrases and the choices aloud. You must read each one silently along with me. When we are finished reading the phrases and the answers, you will be choosing the word that best finishes the phrase. Let's try some together first.

Please look at phrase A at the top of your sheet. This is an example that we will do together. First I'm going to read the phrase aloud as you read along silently. (Read A aloud). Now circle the letter on the white sheet you think best finishes the phrase. The answer is b. Is there anyone who does not understand? Now let's try B together. Listen and read silently along with me. (Read B aloud) Now circle the answer you think best finishes the phrase. The answer is c. Are there any questions? Now let's do the next two, C and D. Remember to read silently as I read them aloud. Then circle the answer you think is best.

Listen and read along silently. (Read through C and D). Now circle your answer on the white sheet (repeated after each one).

Now we are finished with the practice ones. We will do all the others in the same way except that now you'll be using this

answer sheet (optical score sheet held up) to put down your answers. Once you have chosen your answer, you should darken the circle that goes with that answer on your answer sheet. For example, if the answer was b, then you would darken the circle under the letter b. Be sure to stay inside the lines and do not make any other marks on these answer sheets. Is there anyone who does not understand?

Now we will begin with the numbered phrases. I will be reading each one aloud as you read along silently. Remember to wait for me to finish reading. Then you can mark your answer. You should choose the answer you think best finishes the phrase. Remember to fill in the answer space that goes with the letter for the answer you choose.

When you are done with each one, stop and wait until we all go on to the next one together.

(Name of assistant) will be walking around to help make sure I don't go on too fast and to help us fill out the answer sheets correctly.

Point to number 1. Listen and read along silently. (Read first item). Now choose your answer and darken in the circle that matches it on your answer sheet.

Number 2. Listen and read along. (Read second item). Choose your answer and darken a circle."

APPENDIX E

TABLES

Table 3. Student Characteristics - Grade 3

Student	C.A.	I.Q. Score
AMM	9;8	?
BLA	9;3	?
DEL	9;2	114
FGT	9;2	112
HAG	9;2	110
LHA	8;11	110
MAM	8;10	118
MJD	8;8	114
NCA	8;11	120
PWR	8;9	116
RCM	9;1	120
SNS	8;5	?

Table 4. Student Characteristics - Grade 5

Student	C.A.	I.Q. Score
SBT	11;2	115
MAD	10;3	110
HKB	10;6	106
AYS	10;6	105
AAB	11;1	112
GCC	11;0	99
LAM	11;0	97
LW	10;5	112
TJEM	10;11	108
WWJS	11;1	106
DJ	10;11	98
FC	11;8	96
KK	10;6	100
LD	10;9	116
MC	?	103
SJ	10;4	116
GNA	10;5	111
MEC	10;5	109
WBR	11;0	118

Table 5. Student Characteristics - Grade 7

Student	C.A.	I.Q. Score
ALK	12;9	100
CJ	12;10	101
DCH	12;11	110
DJE	12;8	115
LRL	12;3	105
NSR	13;3	97
ST	13;1	108
TTA	12;9	94
BTL	13;0	96
DTD	12;11	104
LDJ	12;8	103
PRA	12;11	104
TE	12;9	94
WTF	12;3	110
LJA	12;9	115
SST	12;5	114
PV	12;8	97
SJM	12;2	111
SAD	13;1	97
TLA	12;5	101

Table 6. Descriptive Statistics for the Composite of Scores on the Analogical Reasoning and Metaphor Comprehension Tasks.

A. Analogical reasoning task.

Mean	Std. Dev.	Std. Error	Count
10.471	1.419	.199	51

Minimum	Maximum	Range	# Missing
6	12	6	0

B. Metaphor comprehension task.

Mean	Std. Dev.	Std. Error	Count
11.098	1.1	.154	51

Minimum	Maximum	Range	# Missing
8	12	4	0

Table 7. Descriptive Statistics of Grade 3 Students' Scores.

A. Analogical reasoning task.

Mean	Std. Dev.	Std. Error	Count
10.083	1.379	.398	12

Minimum	Maximum	Range	# Missing
8	12	4	0

B. Metaphor comprehension task.

Mean	Std. Dev.	Std. Error	Count
10.5	1.243	.359	12

Minimum	Maximum	Range	# Missing
8	12	4	0

Table 8. Descriptive Statistics of Grade 5 Students' Scores

A. Analogical reasoning task.

Mean	Std. Dev.	Std. Error	Count
10.316	1.376	.316	19

Minimum	Maximum	Range	# Missing
6	12	6	0

B. Metaphor comprehension task.

Mean	Std. Dev.	Std. Error	Count
10.895	1.197	.275	19

Minimum	Maximum	Range	# Missing
8	12	4	0

Table 9. Descriptive Statistics of Grade 7 Students' Scores.

A. Analogical reasoning task.

Mean	Std. Dev.	Std. Error	Count
10.85	1.461	.327	20

Minimum	Maximum	Range	# Missing
7	12	5	0

B. Metaphor comprehension task.

Mean	Std. Dev.	Std. Error	Count
11.65	.587	.131	20

Minimum	Maximum	Range	# Missing
10	12	2	0

Table 10. Difference Between Scores on the Metaphor Comprehension and Analogical Reasoning Tasks (Mann-Whitney U Test).

	Number:	Σ Rank:	Mean Rank:
m	51	2966	58.15
a	51	2287	44.84

U	96	
U-prime	164	
Z	-2.272	p = .0231
Z corrected for ties	-2.379	p = .0174
# tied groups	5	

Table 11. Difference in Performance on the Metaphor Comprehension Task as a Function of Grade (Kruskal-Wallis).

Group:	# Cases:		
GRADE 3	19		
GRADE 5	12		
GRADE 7	20		
DF		2	
# Groups		3	
# Cases		51	
H		7.934	p = .0189
H corrected for ties		9.206	p = .01
# tied groups		5	

Table 12. Difference in Performance on Analogical Reasoning Task as a Function of Grade (Kruskal-Wallis).

Group:	# Cases		
GRADE 3	12		
GRADE 5	19		
GRADE 7	20		
DF		2	
# Groups		3	
# Cases		51	
H		3.346	p = .1876
H corrected for ties		3.561	p = .1686
# tied groups		4	

Table 13. Correlation Between Analogical Reasoning and Metaphor Comprehension (Spearman Correlation Coefficient).

N	5
ΣD^2	15374
Rho	.304
Z	2.152 p = .0314
Rho corrected for ties	.228
Z corrected for ties	1.612 p = .1069
#X tied groups: 4	#Y tied groups: 5

Table 14. Difference in Performance on the Metaphor Comprehension Task as a Function of Order (Mann-Whitney).

	Number	Σ Rank	Mean Rank
I	27	663	24.556
II	24	663	27.625

U	285	
U-prime	363	
Z	-.736	p = .4617
Z corrected for ties	-.793	p = .4279
# tied groups	5	

Table 15. Difference Between Performance on the Analogical Reasoning Task as a Function of Order (Mann-Whitney U Test).

	Number	Σ Rank	Mean Rank
I	27	768.5	28.463
II	24	557.5	23.229

U	257.5	
U-prime	390.5	
Z	-1.255	p = .2095
Z corrected for ties	-1.294	p = .1955
# tied groups	4	

APPENDIX F

FIGURES

Figure 1. Frequency Distribution of Scores on the Metaphor Comprehension Task.

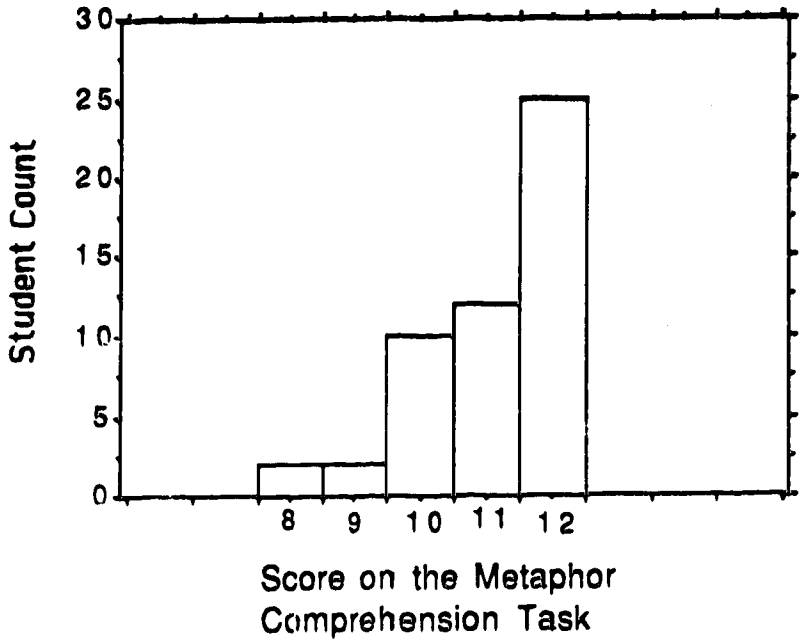

Figure 2. Frequency Distribution of Scores on the Analogical Reasoning Task.

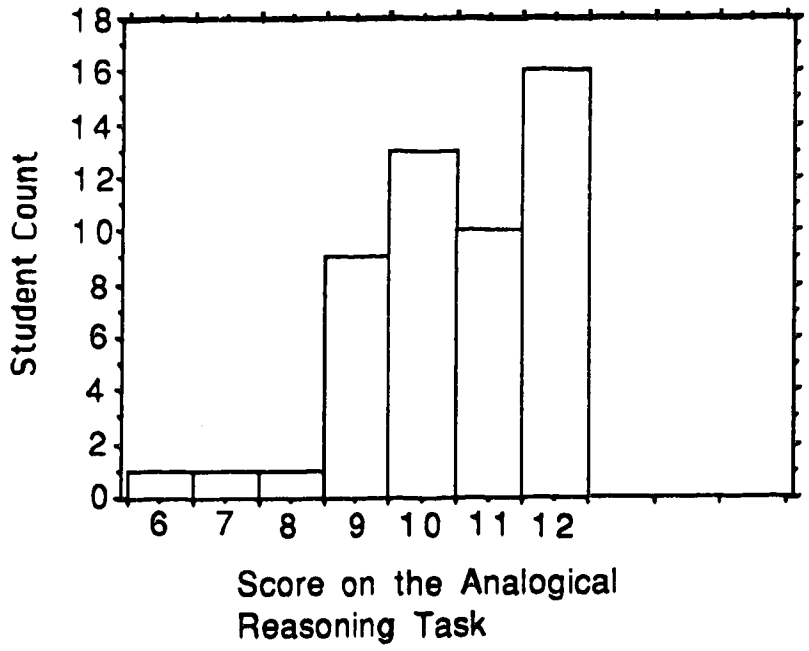

Figure 3. Mean Scores at Each Grade Level as a Function of Order on the Metaphor Comprehension Task.

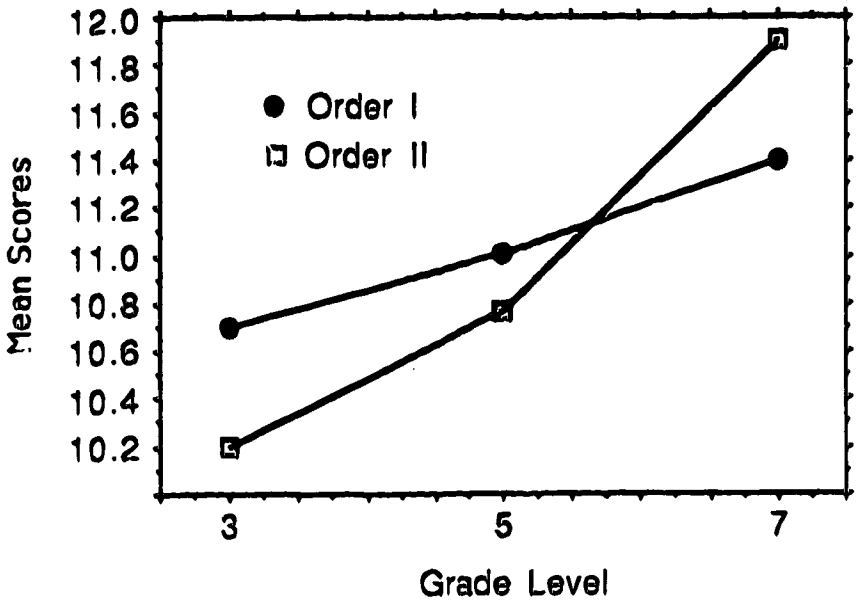

Figure 4. Mean Scores at Each Grade Level as a Function of Order on the Analogical Reasoning Task.

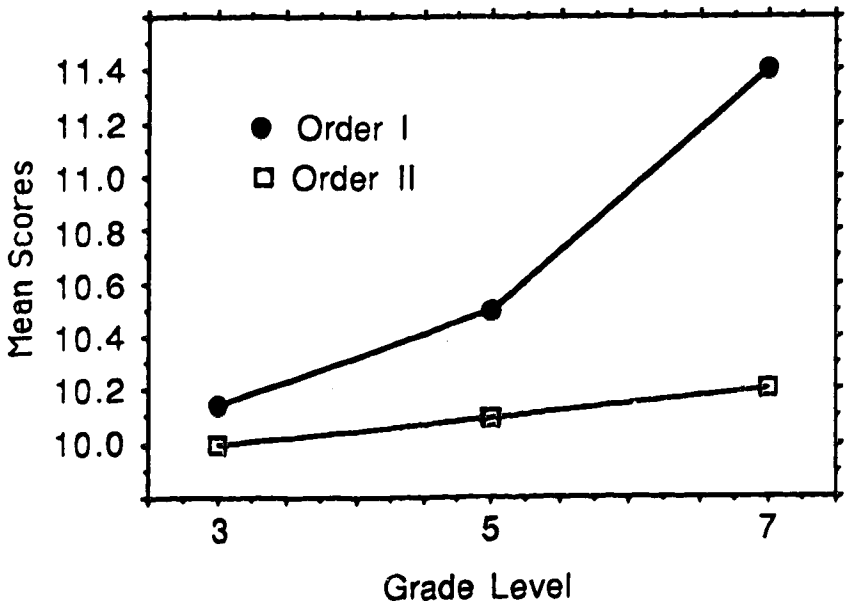

Figure 5. Mean Scores at Each Grade Level for the Metaphor Comprehension (MC) and Analogical Reasoning (AR) Tasks.

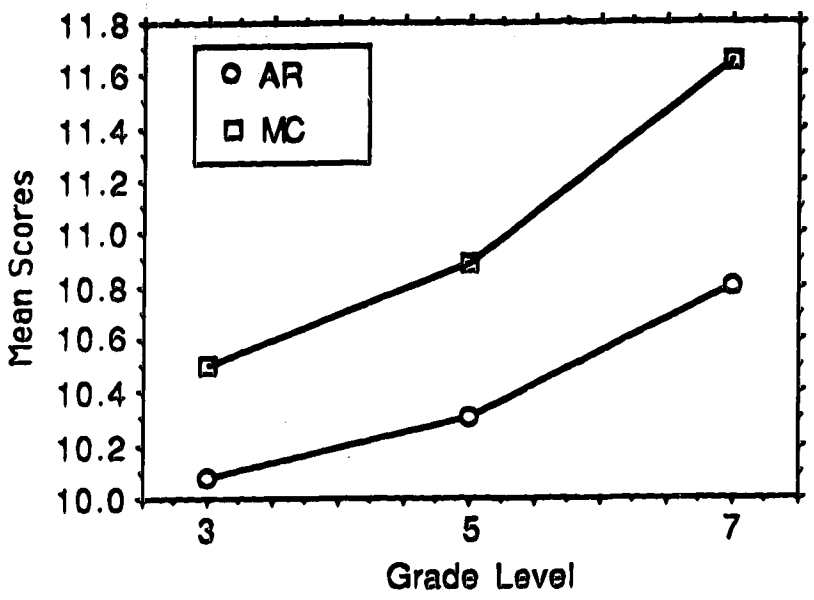

Figure 6. Paired Scores for Individual Subjects in Grade Three.

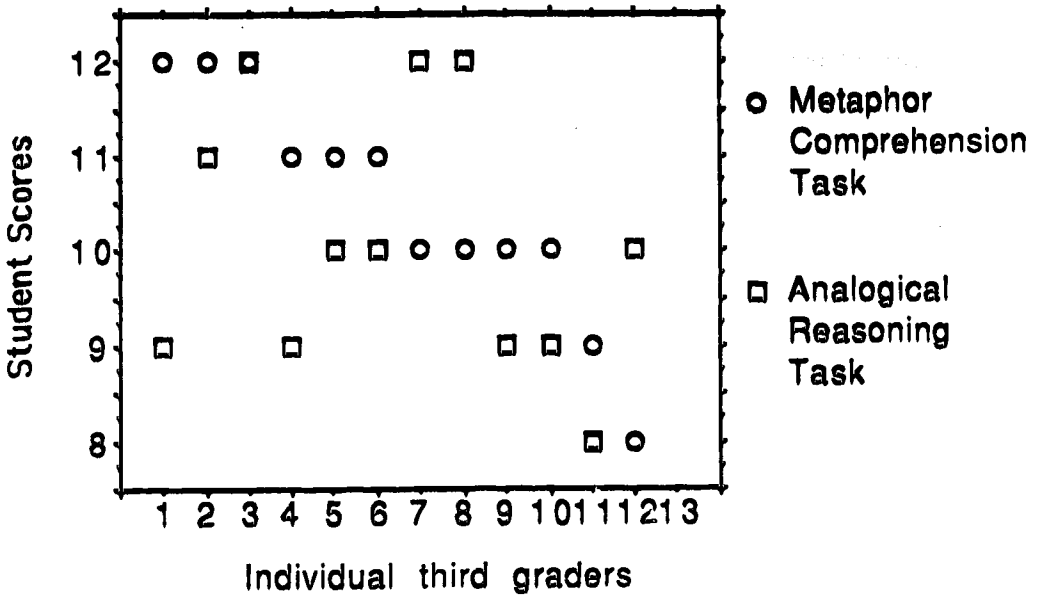

Figure 7. Paired Scores for Individual Subjects in Grade Five.

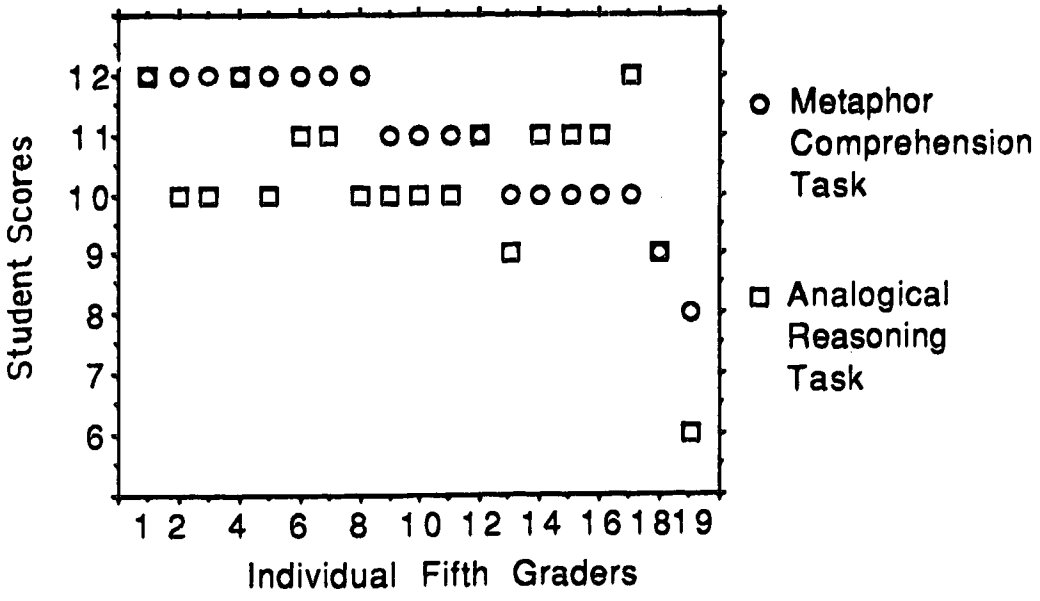

Figure 8. Paired Scores for Individual Subjects in Grade Seven.