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# Survey of children's analogical abilities for ages 2-15

Denyse Claire DuBrucq, 1937-

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UNIVERSITY OF NORTHERN COLORADO

Greeley, Colorado

The Graduate School

A SURVEY OF CHILDREN'S ANALOGICAL ABILITIES

FOR AGES 2 - 15

A Dissertation Submitted in Partial Fulfillment  
of the Requirement for the Degree of  
Doctor of Education

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Summer Quarter, 1977

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## ABSTRACT

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Problems - The problems are three: What are children's analogical abilities? How do they vary with age and sex? And, how do they relate one to another? These interrelated problems cannot be separately studied.

Procedures - An instrument of seven activities was developed and presented in individual tape recorded interviews of twenty to thirty minute duration to 140 children. Ten children of each age from two through fifteen years were interviewed. To randomize the sample, only those children having birthdays during the month of the interview were interviewed. This procedure gave age specificity for data analysis. The tapes were transcribed onto data forms according to prescribed evaluation procedures.

Instrument activities include:

- a. interpreting verbal analogy problems,
- b. interpreting figurative analogy problems,
- c. stating the reasoning leading to the  
solution to verbal analogy problems,

- d. stating the reasoning leading to the solution to figurative analogy problems,
- e. selecting pictures of analogous events for a story concept,
- f. speaking and writing with analogies, and
- g. recognizing analogies in context while listening or reading.

An interrater reliability check on the survey instrument gave an 85% level of agreement for all tasks. Statistical reliability for activities a - d was 0.894 as determined using the Kuder Richardson (formula 20) procedure.

Data analysis techniques employed were: performance averages and ranges by age for the activities, significant score patterns, mean and standard deviation based on three year age spans, correlations, and analysis of variance.

Results - There is no significant relationship between:

- 1. age and performance on individual analogy activities. Accepted for activities e and f. Rejected for activities a - d, and g.
- 2. the sex of the child and performance on individual analogy activities. Accepted for activities a - d, and g. Rejected for activities e and f.
- 3. performance on verbal and figurative activities. Accepted.

4. performance on different analogy activities.

Accepted.

5. identification and use of analogies in speech and writing. Accepted for both types of analogies (personal, direct, symbolic, and fantasy) and grammatical classes (simile and metaphor).

Conclusions - Based on these results, the outstanding data in figures and tables, the phenomena reported on activities f and g, and with respect to the limitations inherent in this study, the following conclusions are warranted:

1. Many abilities comprise children's analogical thought. Their analogical abilities include at least those exhibited in the seven activities in this survey.
2. Children develop the abilities of interpreting both verbal and figurative analogy problems and of speaking and writing using analogies gradually.
3. Children develop the abilities inherent in activities c, d, e, and g immediately upon concept awareness.
4. Children as early as four years old exhibit analogical abilities inherent in activities b, e, and f.
5. By the intermediate grades, children exhibit all analogical abilities identified in this study.

6. Children's abilities to write and speak with analogies differ from their abilities to recognize analogies as they listen or read.

7. Children speak and write with analogies freely when analogy use is acceptable and encouraged.

8. During pre-adolescence, children's abilities on activities a and b are greater than on activities c and d. Adolescents perform verbal activities (a and c) with equal ability; for figurative problems, their ability to state the reasoning leading to the solution exceeds their ability to interpret the problems.

9. The expressive activities (e and f) are not age dependent.

10. Sex is related to abilities for the expressive activities (e and f). Girls exhibit greater ability on activity e. Boys exhibit greater abilities speaking with analogies during preschool years; girls exhibit greater abilities during elementary years; and both sexes exhibit equal abilities during adolescence.

Recommendations - How these ability patterns relate to J. Piaget's model of learning, L. S. Vygotsky's stages, and change with W. J. J. Gordon's synectics activities needs investigation.



## ACKNOWLEDGEMENTS

"Mind, governing all, must be acknowledged as supreme." (427-24) "Human language can repeat only an infinitesimal part of what exists." (520-5) writes Mary Baker Eddy in Science and Health with Key to the Scriptures.

Daily readings and observing youngsters handle both scientific and religious concepts described in figurative language initiated a fascination with analogies.

Creative experiences in classes under Robert B. Sund and topic searching discussions with Robert Pavlik helped bring the design of this study into focus.

The reviews of literature by Rene V. Dawes and Luis T. Siojo and Janet Emig more than encouraged this pursuit, they demanded it.

With assistance in understanding the characteristics of metaphor provided by Sharon Wilson and patient listening of Dudley W. Smith, the proposal and instrument took shape.

The fine cooperation by the Weld County District Six Public Schools facilitated by James B. Elliott enabled the interviews to be made smoothly.

Data processing by Lawrence M. Rudner, Gallaudet College, Washington DC, and proofing the copy by Beverly Ferguson aided the completion of this study.

The able and patient help in perfecting the presentation by Robert Pavlik brought the study in focus for the reader.

During my entire graduate program at the University of Northern Colorado, I have been able to pursue areas in and out of science education which were of vital interest to me. Leslie W. Trowbridge, my major professor, has been hallmark in my studies. His work with this study has given the needed clarity and simplicity in the many aspects of its development.

Finally, I am grateful to Douglas P. McNutt who encouraged my graduate study and facilitated my work in Greeley; and to my four loving children, Jill, Lynn, Ross, and Todd, who patiently accepted a graduate student mother.

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## CHAPTER 1

### DESCRIPTION OF THE STUDY

"An analogy is something that when you get near, you sneeze," offered a seven year old during an interview. Though his definition missed, his explanation hit one major use of analogy, to fill in where a word does not exist in the child's vocabulary. Taking another approach, it could be humor, making fun using a near homonym. One can understand what is meant by a word or word group which expresses an idea for a specific purpose or creates a particular mood. This is what analogy is all about.

The analogical abilities of children ages two through fifteen years were surveyed for this study using individual interviews. Tapes of the interviews were transcribed and data tabulated to determine whether the array of analogical activities are a single ability or separate traits or talents, and whether abilities on these tasks vary with age and sex of the child.

Analogies pair items which in the originator's mind share a concept, clarify ideas, and extend the imagination. Analogy usage demonstrates to others both intelligence (Aristotle, Thorndike, and Burk in Dawis and Siojo, 1972) and creativity (Gordon, 1966; Torrance, 1971;

and Khatena, 1975a). Within the limits of language, sometimes only an analogy can bridge two ideas being compared thus enabling understanding where words alone would not suffice. An example is the word 'love' with its multitude of meanings.

Children demonstrated facile use of this form of verbal imagery in their expression and in their understanding of children's literature according to findings reported in Emig (1972). But to what extent they understand analogies and what they choose for analogies in their own expressions has not been profiled for children in an age range encompassing initial verbal expression through adolescence.

Not only could defined analogical abilities of children guide authors and educators to prepare curriculum materials more appropriately for children of the included age groups, but also this type survey could reveal analogy's role in the child's developmental patterns of thought and expression (Schaefer, 1975; Vernon, 1967; and Bruner and Vygotsky in Vygotsky, 1962).

### Statement of the Problems

The problems are three:

1. What are children's analogical abilities?
2. How do they vary with age and sex?
3. How do they relate one to another?

These interrelated problems cannot be separately studied.

### Definition of Terms

To clarify the specific meanings of certain words as they are used in this dissertation, the following terms are defined:

Analogy - a relationship of likenesses between two things or one phenomenon with another consisting of the resemblance not of the things themselves, but of two or more attributes, circumstances, or effects. Forms of the analogy include metaphor, simile, and allegory. This type of parallel expression is referred to as figurative language.

Analogies are classified in several ways. Those considered in this study are:

Types of Analogy (Khatena, 1972)

Personal analogy - an individual is identified with an object or concept as a means of expressing an idea as, "I am moss covered rocks."

Direct analogy - the relationship of one thing to another is used to express a meaning beyond that of either term as, "History stands to other sciences as experimental science stands to abstract science." (Tolstoy, 1869, p. 690b)

Symbolic analogy - one item is set to represent another to expand or imply a specific meaning as, "The analogy is the spearhead that puts the point across." (Schwartz, 1976)

Fantasy analogy - an impossibility used to imply meaning as, "Stupidity is brief and artless, while intelligence wriggles and hides itself." (Dostoevsky, 1880, p. 121a)

Frequency of Use (H. R. Pollio, 1973)

Cliché - a figure of speech heard or used previously and then reused in a new situation as, "He's a pain in the neck."

Novel analogy - a figure of speech created for the moment. Here the reader can create one.

Experience Base of the Subject (C. S. Lewis in Emig, 1972)

Master's analogy - an expressed comparison which was chosen from several different possibilities to express an idea.

Pupil's analogy - a comparison used as an only means of expressing an idea.

Degree of Emotional Interaction (Richards in Schiller, 1969)

Symbolic analogy - a likeness expressed between two items to convey comparison or description as, "She sat like a cup on a saucer."

Emotive I analogy - a conveyance of feeling related to the object discussed through likeness to another item as, "It was red as a screaming siren."

Emotive II analogy - a means to initiate a feeling or reaction on the part of the listener or reader through use of figurative language as, "Let not education shackle the mind, but free the soul."

#### Grammatical Classification

Metaphor - a form of analogy in which a word or phrase literally denoting one kind of object or idea is used in place of another by way of suggesting likeness between them as, "The book had me in its jaws."

Simile - a figure of speech by which one thing is likened or explicitly compared, often with the words 'as' or 'like', to something of different

kind or quality (Schaefer, 1975, p. 143) as,  
"I feel like I'm drowning in work."

Survey - inspection by interview of a sample of children of each age included in the study, two to fifteen years, regarding their analogical abilities.

Children - for the purpose of stating the research subjects, the word 'children' indicates groups of ten (10) youngsters for each age level, two through fifteen years, who were interviewed during their birthday month. For example, those born in May were interviewed in May.

Response - the reaction of the child to a question or event during the interview. Types of response follow:

Demonstrated - nonverbal reaction as pointing or facial expression.

Figurative - the choice of illustration to express the reply.

Verbal - a spoken answer or reply.

Written - a recorded answer using language conveyed on paper.

Free Form - expression with no particular cadence or format of word placement. Choice and order of words is determined by the desired meaning.

Poem - a literary form which in units expresses a linguistic whole often incorporating rhythm and rhyme.

Cinquain - a five line literary form with each line having the number of words indicated by the line number. The role of each line is specific. Line one is the title. Line two describes the title. Line three expresses action. Line four expresses feeling. Line five gives another word for the title and expands on it.

(Torrance, 1971) An example of a cinquain is:

jam	1
lumpy jelly	2
jiggles on bread	3
slithers between the fingers	4
preserves psyches when goin's rough.	5

Interpretation of analogy problems - to have sufficient understanding of three components of a four component analogy problem (A:B::C:\_\_) that a correct response is given for that fourth component.

Problems are:

Verbal - problem components are words.

Figurative - problem components are diagrams or pictures.

Explanation of analogy problems - to identify the combining characteristics between the first and second components which are duplicated by the third and fourth.

Use of figurative illustration - to express what is discerned from a passage of literature by a picture which expresses an analogical event to the major concept.

Use of analogies - to react to events or respond to requests verbally with inclusions of recognizable figurative language.

Identification of analogies - to recognize and point out figurative language used in a passage from literature.

Task - any one of the five preceding activities.

Attitude - the child's opinion as expressed in answer to the question, "Are analogies important in communication?"

Heritage - the family experience of a child from birth to present. Types of heritage include:

Anglo-Saxon - American English speaking using traditions of European origin.

Chicano - Mexican Spanish speaking using traditions of Mexican or South American native origin.

Concept related performance - scoring representing abilities which have low scores and very high scores with few midrange scores. It is described as developing an ability immediately upon concept awareness.

Language development related performance - scoring representing a building of ability on a task with age or experience. It is described as gradual ability development.



### Need for the Study

Two recent extensive research reviews have presented studies, applications, and theoretical interpretations of analogy use and its prerequisites and requirements. In the conclusions of both reviews, the need for further study on many questions was defined.

Dawis and Siojo's (1972) concluding statements are:

Most of the empirical studies found in the literature have been concerned with the usefulness of analogy tests as measures of 'intelligence' or as predictors of school or job success. It is apparent that analogical reasoning per se needs much more study. (p. 19)

Certainly, if the philosophers (and some psychologists) are to be believed . . . that reasoning by analogy constitutes one of the most important modes of human thinking . . . this field bears cultivating. (p. 20)

Emig (1972), whose review is more child centered, finds many areas of analogy research needing investigation.

But as yet no one has connected the work on the metaphor from such disciplines (philosophy, psychology, and linguistics) with speculations and studies about how children deal with metaphor. (p. 164)

Difference in comprehending and creating the metaphor should be carefully observed. (p. 171)

Of the following questions, the first two were investigated in this study, the second only partially.

When can a child produce metaphor?

When can he describe what he is doing as he produces or comprehends metaphor?

When can he analyse how his own and others' metaphors work within oral and written discourse?

About stages Emig (1972) states:

If Piaget's model of learning - indeed, if any developmental hypothesis about learning - is valid:

Are there characteristic and predictable ways children at various cognitive stages deal with metaphor?

If a developmental timetable is observed, what are the milestones or stages? For example, are there stages and ages when metaphor is an essential feature of discourse? others, at which it is an optional feature? (p. 174)

Are there actual - in this context, cognitive - differences between the comprehension and the production of a metaphor and of a simile?

Concluding, Emig asks:

If our ability to comprehend and to create metaphor is a valid mark of our cognitive, emotional, and moral development, should we not set about immediately to study so crucial, so central, so revelatory a phenomenon? (p. 175)

These statements and questions included in the reviews of Dawes and Siojo (1972) and Emig (1972) served as a guide in the design of this study.

### Purpose of the Study

The purpose of this study was to identify children's analogical abilities, to determine how these abilities relate to one another, and to describe how these abilities vary with age and sex.

### Limitations of the Study

To understand the parameters of this survey study, the following limitations are noted:

1. One hundred forty (140) children were interviewed to provide a sample of ten youngsters randomly chosen to fill each age category from two years through fifteen years. These interviewees had their birthdays during the month that the interview was conducted and were interviewed in the City of Greeley, Colorado.
2. Only the information obtained from the interview is available on these children. No estimate of intelligence, creativity, or experience levels is available.
3. Probing the child's analogical reasoning terminated with the child's explanation as to why he chose the fourth component of the analogy problems.
4. Proof as to the number of traits or talents involved in performance on survey tasks came only from consistencies and inconsistencies in children's scores on the included tasks of the survey.
5. A single twenty to thirty minute session with each child was the time allotted to complete the survey. This, or the limit of his attention span during that time, was the entire exposure of the interviewer to the child.

### Assumptions

In this study it was assumed that:

1. The children interviewed can understand and use the English language.
2. The random sampling technique used in selection of the children provided a cross-section of children in the age groups sampled.
3. The children's language skills and analogy usage are stable. No influence by factors such as time in relation to the school year was considered.
4. Interviewer influence is negligible. That is, race, sex, and other factors are assumed to have no effect.
5. Performance on survey activities is indicative of analogical abilities.

### Hypotheses

These five statements provide the structure for the survey design and data analysis.

Hypothesis 1: There is no significant relationship between the age of the child and his performance on individual analogy tasks.

Hypothesis 2: There is no significant relationship between the sex of the child and his performance on individual analogy tasks.

Hypothesis 3: There is no significant relationship between performance on verbal and figurative activities.

Hypothesis 4: There is no significant relationship between performance on different analogy tasks.

Hypothesis 5: There is no significant relationship between identification and use of analogies in speech and writing.

An analogy is a work of art in verbal form,  
it paints a picture on the mind. (author)

## Chapter 2

### REVIEW OF LITERATURE AND RESEARCH

#### Introduction

Analogy and metaphor have assumed a multifaceted and contested role in both application and research. To explore this role fully, both definition and classification of the metaphor and significant uses of analogy in scientific thought, literature, and children's writings initiate the discussion. Studies of analogy applications, training procedures and their effectiveness for increased use of analogy in expression and problem solving, and evaluation for intelligence, competency, creativity, and divergent thinking are analysed. Finally, an attempt is made to understand the role of analogy in the development of thought and language in man.

#### What is Metaphor?

Metaphor, analogy, is the comparison of words, ideas, or concepts which through their paired likenesses

express meaning often beyond that normally implied in their use. Differences in these items flavor the meaning.

Three uses of metaphor are indicated by literary critic, I. A. Richards (Schiller, 1969, p. 83-7). They are:

1. The 'symbolic' or 'prosaic' metaphor (which may be illustrative or diagrammatical) is the use of one reference to a group of things between which a given relation holds for the purpose of facilitating the discrimination of an analogous relation to another group. (The Meaning of Meaning, Richards, 1923 p. 343)

2. The first 'emotive' type metaphor is founded on the similarity between the feelings aroused by the objects referred to by the terms of the metaphor. (Practical Criticism, ibid., 1929, p. 221)

3. The second 'emotive' type metaphor is identified by its effects on the attitudes of (the listener or) the reader, such as those achieved by the "contrast, conflict, harmony, interanimation, and equilibrium" of the terms of the metaphor. (The Meaning of Meaning, ibid., 1923, p. 378)

Though Richards attributes the first to scientific literature and prose, and the two 'emotive' types to poetry, with increased involvement in the affective domain areas by educators today, application of all three metaphor types can be noted in studies of researchers as E. Paul Torrence (1971), W. J. J. Gordon (1966), and Joe Khatena (1972-5b).

'Anatomy of the metaphor' of Richards (Rhetoric, 1936) has two elements, the 'tenor' which is the object of discussion and the 'vehicle' which is likened to it. He notes that it is the similarity between the tenor and the

vehicle which constitutes the ground of all metaphor. But, he adds:

In general, there are very few metaphors in which disparities between tenor and vehicle are not as much operative as the similarities . . . The peculiar modification of the tenor which the vehicle brings about is even more the work of the unlikeness than of their likenesses. (Rhetoric, 1936, p. 127)

Philosophers, linguists, psychologists, and educators have all posed category schemes for the metaphor. Some of their schemes follow:

Max Black's distinction is between trivial 'comparison' and 'substitution' metaphors and 'interaction' metaphors. Interpretation of interaction metaphors puts special demands on the perspicacity of the reader. (Tomkins, 1968)

Creative analogies are placed in four categories by Joe Khatena (1975b): personal, direct, symbolic, and fantasy. These are based on Gordon's early work and are defined in Chapter 1, pp. 3-4.

Gordon (1966) later modified his categories to include: direct analogy, a simple comparison of two objects or concepts (p. 18); personal analogy, a description of how it feels to identify with a person, concept, or plant, animal, or non-living thing (p. 21); and compressed conflict, a poetic, two-word description on a high level of generality where two words do not seem to fit and



sometimes actually contradict each other (p. 25).

Compressed conflict, Gordon states:

is developed by a process that is essentially analytical. Almost everything in the world contains certain paradoxical traits that provide the material needed for the internal conflict of a compressed conflict. (pp. 27-8)

Some examples include: "safe attack: used by Pasteur to describe rabies virus production of hydrophobia and "protoplasmic kiss", Cajal's description of the interaction between nerve cells.

Frequency of use in a society determines whether an analogy is 'frozen' or 'novel' as used by H. R. Pollio (1973). The frozen analogy is a saying, an idiom type expression, or cliché learned as one would learn normal vocabulary. The novel analogy is new and original, created for the situation.

Originator motives define the categories of S. C. Pepper (Emig, 1972). The root metaphor encapsulates a whole system of knowledge into one likeness as Watson and Crick's double helix model for DNA. A metaphor to be wary of, as the "domino theory of Southeast Asia", is a tool for persuasion. Behavioral models express an interaction as "the learner is clay to be molded by the teacher" or as later discussed, Grote's "teaching and the sex act" (1972). Ornamental analogy is Pepper's fourth category.

The experience base of the originator defines C. S. Lewis's two categories. For the 'masters' metaphor, full understanding of the matter allows the expression to be optional, one of many such verbal expressions appropriate to the circumstances. The 'pupil' metaphor, on the other hand, is necessary as a way of expressing a concept representing limited comprehension of the subject.

For the young child first comprehending and creating metaphor, metaphor may well be a constitutive form of language, an absolutely necessary feature of discourse. (Emig, 1972, p. 171)

Historical development of analogy as described by Dawis and Siojo, (1972, pp. 2-4) indicated a beginning perhaps with Pythagoras employing three mathematical forms each supplying three components to the relationship. They are: the harmonic form,  $[3:4::4:6, (\text{proportional})]$ ; the arithmetic form,  $[3:4::4:5, (\text{equal intervals})]$ ; and the geometric form,  $[1:\sqrt{2}::\sqrt{2}:2, (\text{ratio of intervals})]$ . Plato used verbal analogies in this three component style.

By the time of Aristotle, the four component analogy was devised as a proportionality, giving the relationship of one pair of items to a second pair. This type expression can be represented as:  $\frac{a}{b} = \frac{c}{d}$ ,  $a:b::c:d$ , or  $a \rightarrow b:c \rightarrow d$ . An analogy question gives  $a$ ,  $b$ , and  $c$ , with  $d$  to be found. Present day tests of Woodcock (1973), Thorndike et. al. (1968-72), and Miller (1926) have these

correlations in verbal and figurative forms to indicate reading or word comprehension, intelligence, and job competency respectively.

### Use of Analogy in Scientific Thought, Literature, and Children's Writings

The unseen becomes comprehensible in science because of the metaphor. Simple writing becomes a kaleidoscope through metaphorical interpretation. The metaphor is the way a child's fantastic ideas are expressed when his vocabulary is limited. A review of applications follows.

#### Scientific Thought

Instances of analogy-based pioneering thought in the sciences are distributed throughout The Metaphorical Way of Learning and Knowing (Gordon, 1966) from Einstein to Pasteur and Darwin to Cajal.

Development of Rutherford's atomic model, the atom is not an electric cloud, but has structure, is based on two metaphors: the solar system for the atoms making the target and the artillery shell for the helium particles shot at the thin film target and passed through the material. Electrons circle the nucleus at quite large distances as planets do the sun.

"The metaphors are as much a part of Rutherford's

personality as is the idea of the experiment."

(Bronowski, 1952, p. 105)

Feynman's (1963) use of analogy is master quality.

In "The Physiology of the Eye", he states,

The retina is really like the surface of the brain. The lens is like an onion, except that it is all transparent, and has an index of 1.40 in the middle and 1.38 at the outside.

Richards used as the vehicle for critical evaluation of poetry, the model of the mind of biologist Sherrington. He reminds us, however, that one must realize the dangers that arise from being overly committed to one critical metaphor or model or to what Coleridge (English Poet, 1772-1834) calls a 'speculative instrument' for the mind, as quoted in Russo, (1971, p. 133)

. . . as most thinkers have agreed, in no way other than by metaphor can one consider what the mind really is.

Metaphor is predominant in the style of William James. (Gilmore, 1971) Turning directly to James (1890), in "Habit" he states:

Habit is the flywheel of society, its most precious conservative unit. (p. 79)

The great thing then, in all education, is to make our nervous system our ally instead of our enemy. For this we must make automatic and habitual, as early as possible, as many useful actions as we can. (p. 80)

## Literature

From the parables of Christ and the deep political allegories of Lewis Carroll to the light hearted World of Pooh of A. A. Milne and nonsense of Dr. Seuss, analogies are a major conveyor of inner meanings. Surface meanings can be fun; however, depth of contemplated relationships gives layered interpretations making these works ageless and stageless.

Analogy and metaphor dominate much of literature. Shakespeare was a master of analogy Richards found (Schiller, 1969). One could contemplate what the analogical implications are of the title, "Fiddler on the Roof".

"Tobermory", a moral fable by SAKI (H. H. Munro, 1930) has powerful deep meaning wherein the surface cat takes on the characteristics of Christ as one probes more deeply.

In speech, metaphor gives strong emphasis to a point as shown in the words of Terry Herndon, NEA Executive Director, "Standardized tests are like a lock on the mind, a guard at the factory gates." ("The Schools", AAAS, 1976)

## Children's Writings

Common usage of analogy in children's compositions are reported by Britton, McNeill, and Cazden (Emig, 1972).

As examples, five of the seven poems by youngsters ages 7 - 11 years published in Ranger Rick (February, 1975, p. 15) have analogies serving as a major means to convey their ideas.

### Research on Analogy

Creativity and intelligence are two major aspects of metaphor research. The creativity work centers on increasing abilities in divergent thinking and originality. The intelligence work applies as a means to sort individuals according to intelligence, job competency, and comprehension. Studies of application of analogy and instructional and evaluation techniques are discussed here.

### Studies of Analogy Use

A survey of analogy use in science writings for children (Beeler, 1954) in four periods between 1800 and 1952 indicates no discernable trends. The summary of uses reveals an average of 41 analogies per book and one analogy for each 835 words. About 67% of the analogies were judged to have reference to either universal or common experiences and 20% more referred to infrequent experiences of children.

Single or direct analogies accounted for 83% of the analogies. Major purposes for their use include:

63.3% for process composition; 26.4% for appearance and magnitude; with other purposes considered being physical property, emotion, humor, and general purpose.

Curtis's (1938) investigations of language usage in textbooks did not consider figurative language in attempting to determine readability characteristics of science texts. Only reading difficulty of individual words was considered.

More attention should be placed on patterns inherent in the English language to enhance reading comprehension and critical reading skills, claims Miller (1974).

Drastic revision of texts to conform to the modern theories of metaphor is recommended by Tomkins (1968) in her dissertation surveying Canadian high school English texts. Samples of metaphorical instructional formats to supplant present material are included. She adds,

As teacher and pupil strengthen their grasp on a theory of metaphor, they become better equipped to deal with problems relating more generally to poetry and composition.

The persuasive effectiveness of metaphor (Jordan, 1972) is accounted for in Richard's Emotive II definition, i.e. it achieves evaluative responses on the part of the listener.

Reinsch (1972) tried to explain this type of

effectiveness using Osborn's model for the psychological reaction to metaphor which is: error (shock, finding the statement not literally true), recoil (tension caused by the rejection of the literal interpretation), and resolution (insight into the figurative nature of the expression). This discovery includes personal and sometimes emotional involvement. It may be questioned whether this earned understanding will increase retention on the part of the listener or reader.

Seabrook (1972) claims the language of the British middle class is dead because it is derivative and unoriginal and relies heavily on an imagery that stems from obsolete popular speech such as clichés.

Metaphorical descriptors of social interaction can be a basis for understanding institutional interactions (Ruchkin, 1974) and educational theory (Grote, 1972). Analogical statements, "Teaching and Acting", "Teaching and the Sex Act", "Teaching/Healing", and "Education and the Aesthetic Process" are used to increase understanding of the teaching role.

Types of analogy produced by 8 - 19 year olds selected for high originality (Khatena, 1975b) are tabulated in Table 1, Column 1. Simple and complex analogies in the four types are tabulated in Column 2 and 3 respectively for highly creative college students (1972).



Column 4 contains the researcher's computations of percentages of each type analogy used by the college students in this study so it could easily be compared with that of the 8 - 19 year olds.

TABLE 1  
KHATENA DATA COMBINED FOR AGE RANGE COMPARISONS

age	8 - 19 yrs.	college		
Type data	percent	analogy frequencies	percent	
Analogy type		simple	complex	
personal	3.3%	18	16	0.6%
direct	93.6	4,969	576	98.6
symbolic	0.0	16	7	0.4
fantasy	3.0%	17	21	0.7%

Khatena (1975b) discusses data for 8 - 19 year olds stating:

Highly original children appear to use direct analogy as a main thinking operation.

Piaget's theory of cognitive development will support in part the absence of symbolic analogies; however, it does not account for the infrequent use of personal and fantasy analogies. It may also be the result of insufficient exercise of these thinking operations, inadequate reinforcement and over emphasis on objectivity in dealing with the environment. (p. 314)

Finding more simple analogies produced at all age levels, Khatena notes that complex analogies are used the least at age 9 years for boys and 8 for girls, and most at age 12 for boys and 13 for girls. A slump in

verbal image production was noted for yougnsters 9 - 10 years. (Khatena, 1975b)

Comparing verbal images of deaf and hearing children between ages 10 and 19 years, Johnson and Khatena (1975) found hearing subjects produced more original verbal images than deaf subjects, and the deaf show significant improvement with age while hearing subjects showed no noticeable change.

### Instructional Techniques

Jones (1967) states

A gifted teacher will rush to an analogy like a shortstop to a slow rolling grounder because it happens to be good practice. (p. 215)

In the following quotation Aristotle (384-22 BC) pp. 694-5) discusses metaphor. Only the second paragraph is often quoted; however, his relating the metaphor to the riddle, oratory, and iambic verse make it appropriate here.

. . . Diction becomes distinguished and nonprosaic by use of unfamiliar terms, ie strange words, metaphors, lengthened forms, and everything that deviates from ordinary modes of speech. But a whole statement in such terms will be either a riddle or a barbarism, a riddle if made up of words . . . These will save the language from seeming mean and prosaic, while ordinary words in it will secure requisite clearness.

But the greatest thing by far is to be a master of metaphor. It is the one thing that cannot be learnt from others; and it is also a sign of genius, since a good metaphor implies intuitive perception of the similarity of dissimilars.

In iambic verse, which models itself as far as possible on spoken language, only those kinds of words are in place which are allowable also in an oration, ie the ordinary word, the metaphor, and the ornamental equivalent.

Searching for solutions to problems by playing with analogies is one of the six ways Torrance (1971) used to increase creativity. (p. 37)

Producing multiple analogies and combining the insights gained from their use is one of five strategies to gain divergent insight into a problem. (p. 37)

Having youngsters make up their own analogies and demonstrate and defend them is believed by Stevenson (1971) to be the best demonstration of thinking skill development.

Gordon states in his Metaphorical Ways of Learning and Knowing (1966):

Good teaching has always made ingenious use of the metaphor and analogy to help students visualize the internal working of substantive material. (p. 59)

A student's grasp of substantive information is judged by his capacity to develop his own analogies to describe phenomena. (p. 64)

The metaphorical instructional techniques for making the strange familiar are:

1. Present substantive information.
2. Supply a relevant metaphor and have students find the connection.

3. Ask the student to supply his own metaphor and show its connection with the substantive material.
4. Indicate contradictions or 'non-fits' in the analogy.
5. Apply the analogy to the strange situation to see how the parts fit. (p.89)

Gordon's findings from applying these techniques

are:

Metaphors work not only with the intelligent, but even with non-achievers.

Metaphor is based on student ideas and feelings.

Analogies must not be viewed as exact parallels of the scientific state of affairs. Rather they should be intuitive tools for developing an emotional, empathic understanding. Analytical comparison of analogies with phenomena will reveal discrepancies, non-fitting aspects, that highlight the truth. (p. 85)

Including connectives as the word 'like' can help students more easily master the more committed analogical language. (p. 21)

Comparing his advice for the personal and direct analogy, explicit use of personal analogy is appropriate for elementary grades. It is not only a valid introduction of the metaphor, but is all that a student of this age can absorb at first. Conversely, it is best to keep the learning style of the direct analogy implicit. (p. 21)

In the upper grades this skill can be made more explicit (use of direct analogy) because older students are not thrown off by learning the whys and wherefors that underlie their instinctive thought processes. (p. 19)

At this stage, students should be encouraged to reach for more poetic use of personal analogy.

'Comparative' and 'being' situations with the metaphors in fourth grade instruction induce innovative thinking. (Holstein, 1972). She found originality, elaboration, fluency, flexibility, and coherence improved significantly in writing, but only elaboration improved in speaking. Also, more use of direct analogy occurred spontaneously in speaking.

Children use figures of speech, both novel and frozen, in their compositions as early as the third grade. Novel usage seems to decrease over the grade levels, finds M. Pollio (1973) in study pretests. The experimental program using "Making it Strange" increased the frequency of occurrences of novel figurative usage by the children exposed to this series is shown by posttest compositions. Use of frozen analogies increased with length of composition thereby suggesting that frozen figures might be considered simply as learned vocabulary items. Training had little influence in increasing novel figures used by third graders, but gave marked effects for fourth and fifth graders. He believes that it is better to have children speak their composition rather than write them when there is no grade factor involved. (p. 13)

Marilyn Pollio (1971) has composition data that agrees with the above data, but finds it a poor task for figurative language compared to multiple uses tasks, a comparison exercise. With this third graders use fewer frozen and novel figures of speech. Her data suggest that children are able to use figurative language well before they are able to explain the exact nature of the relationship linking the elements of the figure. In Piagetian terms, this may mean that children are probably not able to explain such usage until much later; perhaps not until the stage of formal operations.

Various socioeconomic and achievement backgrounds showed varying effects resulting from "Making It Strange" experiences. Contrasting its effect to that of lesson plans, M. Pollio (1973) found increased production of novel figurative language occurs in all but the low income, low achievement school where no difference was found. Frozen figures are greater for the experimental groups only in the lower middle income school which was slightly below average.

The art of thinking in analogies circumvents boredom and enhances learning according to Jimenez (1975) who cites many experiences of practice teachers from Middlebury College, Vermont. Using Synectics Education Systems (SES), a style of thinking, this deliberate

manipulation of metaphor increases insight into many situations.

Means of enhancing children's production of creative analogies are explained by Khatena (1975d):

We use words with their objective meanings and emotional connotations to convey to others our ideas, feelings, and perceptions about the world. Often we find ourselves trying to communicate thoughts, feelings, or experiences that do not lend themselves to easy expression: We cannot explain or describe what we have in mind; so we search for some familiar situation to which our thought-feeling complex can be related -- a process of making the strange familiar; sometimes by reversing this process whereby we make the familiar strange we allow ourselves insights into relations hitherto concealed to us. Both these mechanisms are operations involved in the making of creative analogies and have been presented to us in the Synectics approach to creative problem solving. (p. 2)

Some things teachers can bear in mind in order to encourage children and adolescents to use their imagination more fully and so enhance their creative development include:

1. Primary analogy use by giving examples of the use of different kinds of analogy and image complexity prior to tasks of creative expression can maximize the quality of imaginative expression.

2. Timing limitations for creative assignments have varying effects on specific age and creativity level of individuals. For instance, if the time interval is fixed, adults need considerable warmup; yet, children and

adolescents are rapidly sensitized. If the time interval varies, moderate deadlines give best production of verbal images for adults and children; however, adolescents function best when given as much time as needed.

3. Peak effectiveness periods are greatest from preschool through grade 1. (This correlates with the Montessori (1936) sensitive period for language). Though training does not seem to alleviate slumps in creativity noted for boys in grade 4 and girls in grade 2 and tendencies for such in upper elementary grades and grade 10, remedial measures may help to some extent. (Khatena, 1975d)

4. For individual and student centered work, Khatena (1973, p. 156) recommends that nurturing procedures designed to increase productivity should not be of constant intensity throughout every stage of children's lives. Training may not bring about increased productivity. Nurturing specifically where and when it is needed may be one answer to the problem of maintaining and possibly increasing the creative performance of children.

Khatena found curriculum and methodological change incorporating principles of creative mental functioning are conceived as necessary in an all or nothing way. These changes should also be initiated as specific to needs. In this way children who need help can be given it at once.



### Evaluation Techniques Employing Analogy

Discrimination of intelligence, competency, comprehension, operational thought, and creativity levels is accomplished using analogy test items with both high reliability and validity. How analogy functions in all these areas so effectively is a concern of the reviewers.

#### Intelligence Tests

Dawis and Siojo (1972) report the following:

1. The first application of analogy in intelligence testing occurred in 1911 when both Burt in England and Engle, Woodworth, and Wills in the U. S. designed tests using Aristotle's format of:  
Eating:drinking::hungry:\_\_\_\_\_.

2. Analogy is the sole component of five tests, the most famous being the Miller Analogies Test (1926). It is a major tool in ten other tests including the presently used Armed Forces Test and Service Academy Test (Turner, 1965, 67).

3. Reliability on analogy tests is highest for the age group 11 1/2 to 12 1/2 years on a test-retest situation at the .92 level using a 100 item test. Wyatts results testing girls 10 to 13 years old shows the highest reliability level at 12 years also.

4. Validity for this age group, grades 4 - 8, using the Otis test compares at the .97 level with the composite and mental ages obtained using the Stanford Binet Test. The next highest category occurs at the second year in college with validity at .79 here employing Otis, Form A.

5. Validity of analogy tests correlates with various indications of intelligence such as teachers' estimates, IQ, and vocabulary tests; other verbal test forms such as completion, opposites, and vocabulary; but only slightly with numerical ability, perceptual speed, and perceptual accuracy.

6. The Miller Analogies Test (MAT) has reliabilities of above .92 for internal tests and above .83 for equivalent forms. Though the average validity of one test with another is given as being between .35 - .55, validity of MAT with the Graduate Record Exam (GRE) is .80 and the Ohio State University Psychology Exam is .82.

In specific studies concerning MAT, Hochberg finds the variables most responsible for group differences of successful and unsuccessful graduate students are the MAT results and undergraduate grade points. No high scores on MAT are recorded for the unsuccessful group. The MAT was found to function equally well for all three divisions of Fordham University's School of Education. (Hochberg, 1972)

Testing to see if MAT is 'field specific', Doppelt (1951) discovered that science majors do best on science items. They do as well as others on non-science items. Perception of the relationships are what is crucial to the solution and recognition of function of analogy items.

Applications of analogy formats to test situations include:

1. Figurative and verbal four component analogy problems comprise a large portion of three tests by R. L. Thorndike, Lorge, and Hagen (1964, 1968, and 1972). These multilevel tests are for grades K-12 and 3-13. Questions 4 - 7 (Appendix A) in this study are figurative analogies.

2. The entire word comprehension section of the Woodcock Reading Mastery Test, Form A (1973) for ages 6 through 12 years is verbal analogies. Questions 1 - 3 (Appendix A) in this study are verbal analogy problems in this form.

The National Assessment of Educational Progress (NAEP) exercises, however, contain no analogy items according to Hal Wilson, Director, (1976) because they test for achievement, not intelligence.

### Piagetian Formal Operational Thought Indicators

To discriminate between students at the concrete operational and formal operational levels of thought, Burney (1974) based on work by Tisher (1971) found

that verbal analogies and certain paper and pencil items similar to Piagetian tasks can be used to measure formal thought with a fairly high degree of accuracy. (p. v)

Of the six analogies included in the 42 items question pool, all six were retained for his final questionnaire. These six were among those items that appeared to be most successful in measuring formal thought. (p. 56)

Burney's multiple-choice form of analogy item is illustrated by the following example:

1. a. brain		e. spring		i. bedpost
b. eye	is to <u>head</u> as	f. blanket	is to	j. ticking
c. hat		g. caster		k. bed
d. ear		h. pillow		l. summer

### Creativity

In distinguishing poets from nonpoets, the simile and metaphor discriminate most effectively (Stumberg, 1928). Question styles used are illustrated by the following:

Simile: "The other was a softer voice, as soft as \_\_\_\_"

Metaphor: Find all symbols or metaphors for words as 'sadness'. Example: 'rainy day'.

Each question can be answered with as many words as the respondent thinks appropriate.

Stumberg encountered difficulty deciding which of the comparisons were real metaphors and similes. Rejected answers were either of a descriptive nature or did not contain a real element of similarity between the two items compared.

In the study poets' answers averaged over 26 analogies to nonpoets' average of just over 10. Those scoring over 22 correct answers per question were all poets and those scoring under 8 were all nonpoets. All participants were University of Chicago students.

"Abilities to handle figures of speech are the most striking and significant fact of all." claims Stumberg. (p. 233)

To determine creativity in literary production of children and adolescents, Schaefer (1975) employed a test similar to Stumberg's simile question. He provided ten situations of sensation or feeling as the tenors and required three vehicles to be provided by the respondent.

Schaefer found scoring difficulties were more than offset by the respondents' freedom in answering.

In contrast to the open ended format, the Similes Preference Inventory (Pearson and Maddi, 1966) is a multiple choice test assessing the "intensity of active,

introceptive tendencies toward variety". Its question format is:

<u>Tenor</u>	<u>Answer selection</u>	<u>Type response</u>
Tough as	a. nails	usual
	b. a brick	substitutive
	c. a teamster	remote
	d. a noodle	opposite
	e. a tulip	nonsense.

### The Interview and Its Interpretation

An individualized type of evaluation of children's thought processes was used by Piaget following the pattern of the medical interview. Piaget's definition of a good interviewer is, according to Harding and Jones (1972),

- He must
- know how to observe,
  - let the child talk freely without checking or sidetracking his utterances,
  - be alert for something definite at every moment, and
  - have some working hypothesis, some theory (true or false) which he is seeking to check.

Palfrey (1972) criticized this type of interview saying:

The questions Piaget has put to children during his research are either ambiguous or tendentious. Consequently the answers received do not necessarily follow from the child's conception of the kind of answer required.

Preservice work with elementary education majors included child interviews for Cohen (1971). He classified

responses as:

1. answer at random (Child is not interested)
2. 'romancing' (Child does not believe answer)
3. 'suggestive conviction' (Child tries to please interviewer)
4. 'liberated conviction' (Child's answer is independent of interviewer)
5. spontaneous conviction (Child knows the answer from previous experience).

Techniques of coding transcriptions, taped interviews with 96 preadults, appeared in Fitzpatrick (1974).

The reaction to the interviewer by the interviewee is a major concern in interview style studies. Harding and Jones (1972) found that responses of elementary children changed little, if at all, depending on whether the interviewer was a business man, a clergyman, or a man on the telephone. Fitzpatrick, (1974) in his study of political attitudes of students generally matched the interviewee and interviewer by race and was concerned about the reliability of the few interviews that crossed race lines.

#### Development of Thought, Language, and Analogy

There must be a time in the development of man when recognition of similarities has application to actions, thought, and words. To discover when this phenomenon occurs pinpoints the onset of metaphorical thought.

In his "Genetic Epistemology", Piaget (1969)

states:

This, in fact, is my hypothesis: that the roots of logical thought are not to be found in language alone, even though language coordinations are important. Rather, the roots of logic are to be found more generally in the coordinations of actions which are the basis of reflective abstraction.

Following this line of thought, it is found that many thought analogies occur in the very early experiences of the child. Montessori (1936) states:

There is a long sensitive period, lasting almost to the age of five, which gives the child a truly prodigious capacity of possessing itself of the images of its environment. (p. 63)

Soon after this follows an observed action analogy similar to Aristotle's style of analogy:

There was a baby seven months old, who was sitting on the floor playing with a cushion. On the cushion were printed flowers and children. The little girl with evident delight, smelled the flowers and kissed the children. (p. 65)  
[children:kiss::flowers:smell]

Certain actions that receive positive reinforcement form an analogous group. Such activities often are tried until the fun is gone or the reinforcement stops. One could contemplate how, without the ability to analogize, the child can know the correct manner to climb a new staircase.

To recognize a real figure as a giraffe from a cartoon style drawing in a story book is probably analogous



to metaphor. (McNutt, 1975, p. 35)

To move into language from a firm base of thought, Richards states:

A word is normally a substitute for not one discrete past impression but a combination of general aspects. Now that is itself a summary account of the principle of metaphor. (Schiller, 1969, p. 86)

Applying this idea, the child who uses 'daddy' for any number of persons is an example of metaphorical thought. A mental noting of similarity has occurred classifying 'daddy' as a man and thus including many men in the 'daddy' category.

Montessori (1936) finds language supplemental and innate in her statement:

What exists (in the child) is a predisposition to construct a language. And something of the same holds (true) in respect (to) the whole psycholigocal complexus of which language is the outward manifestation. (p. 34) [parentheses include the researcher's words to increase readability of the translation, yet preserve its meaning.]

With reason to determine relationships of environmental factors, the mind of the child is ready for identification of analogous items. With the added factor, a sensitive period for language, naming items is a prime concern for the preschooler. Thus both original analogies based on applied meaning often prompted by insufficient vocabulary (Britton in Emig, 1972) and a

facility to internalize figurative language of persons speaking in the child's environment enable the preschooler to speak with both novel analogies of a pupil type, using analogies to compensate for vocabulary deficiencies, and frozen analogies as clichés and idioms.

These two types of analogies fit in the Guilford Model as follows: Cognition of Semantic Relationship (CMR) inspires novel analogy (Meeker, 1969, p. 43). Memory of Semantic Relationships (MMR) allows for recalled analogies, the frozen analogy or cliché (p. 59). Both are classed as Convergent Production.

Convergent Production is a process category explaining an ability that permits children to learn from prior experience so that they do not have to approach each problem anew. (p. 19)

This might indicate that analogous tasks recognized as such can conserve both physical exertion and learning time.

In working with the deaf, Vernon (1967) surveyed results of intelligence tests of hearing and deaf individuals and concludes:

1. There is no functional relationship between verbal language and cognition or thought process.
2. Verbal language is not the mediating symbol system of thought.

3. There is no relationship between concept formation and level of verbal language.

Piaget, Montessori, and James (1890) would agree with #2, deciding that manipulative learning may be the basis of a mediating symbol system of thought. Work with the Vygotsky (1962) blocks will demonstrate #3.

Jerome Bruner states in the introduction of Vygotsky (1962, p. vii):

Having concluded that speech and thought come from different roots and that the close correspondence between thought and speech that is found in man is not present in higher animals, he (Vygotsky) plunges directly into the task of exploring the behavior of young children where there is a prelingual phase in the use of thought and a preintellectual phase in the use of speech.

Vygotsky's stages of development of thought include 'Trial and Error', 'Thinking in Complexes', and 'Concept Formation'. He categorizes their effects on language in these quotes:

Transfers of names to new objects occur through contiguity or similarity, ie on the basis of concrete bonds typical of thinking in complexes. "leg of a chair" and the "bottleneck" (traffic) are word groupings in complex-like fashion. (p. 74)

The primary word is not a straightforward symbol for a concept but rather an image, a picture, a mental sketch. In naming an object by means of such a pictorial concept, man ties it into one group with a number of other objects. In this respect the process of language creation is analogous to the process of complex formation in the intellectual development of the child . . . This thought pattern is not child-exclusive,

adults use it frequently. (p. 75)

Applying Vygotsky's word-image relation discussion above, two creativity researchers, Khatena (1975c) and Torrance (1971), find a need for multimodal activities to enhance and often enable understanding.

Generally, it was found that the visual and auditory senses or the visual-auditory senses combined, and the other sense modalities combined have important relationships with verbal processes as they relate to the imagination, and may have positive implications for learning. (Khatena, 1975d, p. 13)

Situations beyond the child's verbal expressional capabilities may best be presented by multimodal means of sounds, drawings, or acting. When this is completed, the child may have thoughts on the subject mature enough to state verbally. (Torrance, 1971)

The process of maturing has noticeable effect on learning, noted Vygotsky:

At any age, a concept embodied in a word represents an act of generalization. But word meanings evolve, a process that leads in the end to a formation of true concepts.

The development of concepts, or word meanings, presupposes the development of many intellectual functions: deliberate attention, logical memory, abstraction, the ability to compare and differentiate. These complex psychological processes cannot be mastered through the initial learning alone. (p. 83)

The analogy is an act of recognition of similarity. These likenesses indicate concept formation on the part

of the originator of analogies. Vygotsky finds:

In analysing the development of concepts of difference and likeness, we found that consciousness of likeness presupposes the formation of a generalization, or of a concept, embracing the objects that are alike; consciousness of difference requires no such generalization - it may come about in other ways. (pp. 88-9)

In regard to the transfer of concept in the Aristotlian four component analogy, Vygotsky's statement following helps relate it to thought processes.

Investigations (of children's real concepts) help to transcend this pattern (association theory) by showing that thought of a higher level is governed by relations absent from perception and memory. Transferring an object of thought from Structure A to Structure B . . . requires shifting to a plane of greater generality, to a concept subsuming and governing both A and B. (p. 115) [Parentheses are the researchers to supply references of wording in the quotation to prior dialogue].

As for the child's reported inability to identify relationships within analogous pairs until age 11 - 15 years and Burney's (1974) test correlating success on multiple component analogy problems and formal operational thought, some attention to the mental abilities necessary to do analogy problems must be made.

The high validity and reliability of analogy tests centering at 12 years of age (Dawis and Siojo, 1972) parallels the child's 'explosion; into new capabilities, that of recognizing secondary relationships, which is formal operational thought.

To elaborate, along with the initiation of a sensitive period for these secondary relationships, one would expect a learning 'explosion' (McNutt, 1975, Figure 9, p. 36), a time of intensive activity in the newly acquired ability. This could include a high frequency of application and a tendency for accuracy in the particular activity.

Uses of analogy as mechanisms of logical reasoning are explained by major psychological theorists Spearman, E. L. Thorndike, Guilford, and Piaget. (Davis, and Siojo, 1972)

Spearman's theory of intelligence is represented by the structure of the analogy,  $a:b::c:d$ .

- a. apprehension of experience
- b. eduction of relations
- c. education of correlation, and
- d. (apprehension of related phenomena)

The respondent either uses real relations -- attribution as identity, time, space, cause, objectivity, and constitution, or ideal likeness as evidence, conjunction, and intermix. (p. 6)

Thorndike's heirarchy concerning analogy skills is strictly in logical format.

Responding to relations between objects is more intellectual than responding to objects.

Responding to subjective or logical relations as likeness and difference is more intellectual than relations of space and time.

Organizing several relations to secure a certain result is more intellectual than responding to one relation at a time.

Analogical interpretation is centered in the latter statement. Analysis, synthesis, and organization are also needed. (p. 8)

Guilford's comments on questioning techniques using analogy are:

Completion type analogy would test both cognition of relations and convergent production of relations.

A multiple-choice type would 'load' less on convergent production and more on cognition.

Word analogies tap semantic relations and figural analogies test figural relations.  
(separate talents)

He concludes also that analogical reasoning constitutes only a limited portion of the domain of the intellect.

Proportionality and reciprocity are considered by Piaget in connection with his formal reasoning. Inhelder (1958) found that notions of ratio and proportion were comparatively late acquisitions (ages 13 - 15 years).

Lunzer (1970) connects Piaget's conceptualization with analogies resulting in these findings:

Applied to analogical reasoning, he found both verbal and number analogies required application of formal reasoning.

Simple analogies as well as complex ones could not be solved by a majority of the group before eleven years of age.

Most complex analogies used could not be solved by fifteen year olds.

Principal characteristics of formal reasoning were to be found in the need to elaborate second

order relationships. (Concrete operational thought only handles first order relationships)

Studies by Youniss and Furth (1964) and Karplus and Peterson (1970) support these conclusions. Youniss and Furth gave two tests to 4th and 7th graders. The first test showed equal results for both groups. A transfer of logical connectives had to occur to perform successfully on the second test and results show only 7th graders mastered the transfer.

Karplus and Peterson using the stickman problem as a class project required 4th, 7th, and 12th graders to write the number of 'smallies' paper clips they felt they needed to measure the stickman and rationalize their answers. Children did not employ proportionality reasoning until high school and then only in the suburban schools.

In summary there is evidence of a discrepancy in determining when children can use and interpret analogies. A sensitive period at age 12 years may be responsible for a change in how a child deals with analogy. Relationships recognized in prelingual thought and those expressed verbally at a young age could be attributed to analogical thought. Results of analogy research pose many questions.



### Summary

As background for the study, experiences in survey techniques (Harding and Jones, 1972; Fitzpatrick, 1974; and Cohen, 1971), interpretation of responses (Pollio, 1972,3; Stumberg, 1928; and Schaefer, 1975), types of questioning (Pollio, 1973; and Palfrey, 1972), and classification of analogy types (Emig, 1972) are abundantly available. However, real analogy and metaphor use and interpretation have not been found to be in evidence as proposed in this study. Therefore, whatever results are obtained, new information can be obtained in understanding the child's use and interpretation of analogy between the ages of 2 and 15 years.

In the interpretation of data with reference to thought and language development, the field is more or less open. As Dawis and Siojo (1972, p. 2) indicate:

For all its success as a measure of final intelligence and as a prediction of scholastic and occupational performance, reasoning by analogy failed to attract the attention of students of psychological process.

## CHAPTER 3

### METHOD OF STUDY

The purpose of this study was to identify children's analogical abilities, to determine how these abilities relate to one another, and to describe how these abilities vary with age and sex. The methods used serve this end.

This chapter describes the sampling technique; the interview; the instrument, its objectives, methods, form, administration, and evaluation of responses; panel evaluation of the instrument; instrument reliability; and data preparation and presentation.

#### Sampling Techniques

In order to test individuals ranging from initial use of language at age two years through adolescence at age fifteen, children in fourteen age categories were necessary. According to Sam Houston, Chairman, Research Statistics and Methodology, University of Northern Colorado, thirty individuals are needed for a statistically significant sample of children at each age level tested. However, a sample of ten individuals for each age category would allow sufficient statements to be made for this

survey study. This required 140 interviews for the completed study.

To achieve sharp age delineation between the fourteen categories, it was decided to test youngsters having their birthdays within the month of the interview. In this manner, ages were specific to within 1/6 of a year.

To prevent bias on the part of the researcher, random sampling was applied to youngsters at these ages for the child's sex, socio-economic classification, family, intelligence, or creativity. All children interviewed were enrolled in schools in the City of Greeley, Colorado. The sample is defined in Table 2.

For the six through fifteen year olds, arrangements were made with the Weld County District Six School Supervisors to schedule interviews at six schools during the last month and a half of the 1975-6 school year.

TABLE 2  
DESCRIPTION OF SAMPLE

Age	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Sex														
male	8	4	4	4	7	6	5	4	4	4	5	5	5	5
female	2	6	6	7	4	5	5	7	6	6	5	5	5	5
Interview location	home	preschool home park			elementary school home park						middle school		junior high	

Those schools are: elementary, Scott and Madison; middle school, Franklin and Maplewood; and junior high, John Evans and Heath.

Youngsters whose birthdays were during that month were interviewed. To illustrate, if on May 5, when the researcher entered a school, she interviewed children born between May 1 and May 31. The researcher found two through five year olds for the study by contacting day care centers, nursery schools, and churches in addition to reading birth announcements listed in the Greeley Tribune from July 1, 1974 to August 2, 1974.

As each category became complete with ten interviews, only children whose ages fit in yet incomplete categories were interviewed until all categories were complete.

### The Interview

The sole purpose of the interview was to determine the child's abilities on an array of analogy activities. A kit containing the materials for the entire session was prepared. The materials were presented in identical order for all children. The entire interview was taped. The playback of the tape allowed the researcher to code responses on the data forms, figures 18 and 19, to preserve the child's performance as data to be tabulated to determine the outcome of the study.

### The Instrument

Behavioral objectives that correlate with the hypotheses were:

1. For prereaders, given a verbally presented analogy problem, the children interpret it by giving an acceptable verbal or demonstrated response.
2. For readers, given a written analogy problem, children interpret it by giving an acceptable verbal or demonstrated response.
3. Given a figurative analogy problem, children interpret it by indicating the acceptable response from choices provided.
4. Given literature containing a major concept, children understanding the passage choose photographs that illustrate the concept directly and figuratively.
5. Given a picture, experience, feeling, and science experiment, children describe each using one or more analogies.
6. Children use analogies when creating freeform expressions, poems, and cinquains.
7. Children identify analogies in written materials.
8. Children evaluate the importance of analogies in communication.

9. Children identify the relationships between components of verbal and figurative analogy problems by telling why they chose their answers.

These behavioral objectives are keyed by number after each question or question group in the column, "The Instrument", in Table 3.

Criteria for perfecting the instrument, methods, the instrument and its administration and evaluation follow in this section.

#### Criteria for Perfecting the Instrument

The following criteria were established during the field testing of the instrument:

1. Each topic for the interview demands clarity of purpose to the interviewee and clarity so the response appears to be obvious to the individual being interviewed.
2. The tasks must be free of double meaning.
3. Ease of choice or response is necessary.
4. The interviewee must become comfortable in the interview setting.
5. A rapport of openness must be established at the onset of the interview between the researcher and the child.

The researcher believed that were the instrument tasks ordered from low participation to active involvement, the child would be more free to offer his own ideas and

perform more difficult tasks. A review of earlier tasks at the end would sum up the activities for the interviewee and retain his interest more easily than a new activity.

These criteria were met as the instrument was molded into final form. The ideas regarding the ordering of tasks were accepted based on performance in pilot interview sessions.

It was evident that there would be problems with the very young interviewees. For these situations, parts of the instrument which could be handled would be offered to the child.

### Methods

Methods employed in this interview based study were: Randomness of the population was achieved by interviewing only those youngsters at a given place who fit the stated age-birthday criteria. No rewards were offered or given. The only interaction between the researcher and the child took place at the interview. And no testing of the interviewees occurred for this study other than during the interview.

The interview included opportunities for the child to interpret and explain the relationships in both verbal and figurative analogy problems, to use both figurative illustration and analogies in context, to identify analogies in literary context, and to evaluate the importance of analogies in communication.

All interviews were carried out by the researcher. The researcher interpreted the interviews from the tapes and written materials produced by the child during the interview based on predetermined criteria for categorizing responses. To give an indication of the reliability of the instrument and scoring techniques, randomly selected tapes were interpreted by others and their results as tabulated on the data forms were compared with that of the researcher.

#### The Instrument, Its Administration and Evaluation

Table 3 was designed to convey the instrument components, their administration and their evaluation.

"The Instrument" gives a verbatim script for instrument presentation. This series can be followed in the paper and pencil form of the instrument presented in its entirety in Appendix A.

"Its Administration" completes the information needed to allow replication of the interview use of the survey instrument as employed in this study.

"Its Evaluation" instructs those using the instrument in the scoring procedures for each activity and task. This assumes that the tapes are transcribed using these criteria onto the data form in Figure 18 with the Use of Analogies statements written verbatim on another paper. These quotations are then scored using the data form shown in Figure 19. Definitions for terms in



TABLE 3

## THE INSTRUMENT, ITS ADMINISTRATION AND EVALUATION

The Instrument	Its Administration	Evaluation
<p>"Hi, I am Denny McNutt. Have a seat. Your birthday is this month. What day? How old are you?"</p>	<p>The interview room has two chairs and a table. The tape recorder is on the table and running from the start of the session.</p>	<p>The data will be taken off the tape after the interview. Coding each interview will use two digits for the age and number of the interview in the age category.</p>
<p>"Here are some statements. Can you complete them?"</p> <ol style="list-style-type: none"> <li>1. Pants are to legs as a shirt is to ____.</li> <li>2. A cow is to a calf as a bear is to a ____.</li> <li>sub. A dog is to a puppy as a cat is to a ____.</li> <li>3. A shovel is to snow as a spoon is to ____.</li> </ol> <p>(1,2)*</p>	<p>Each question is typed on a separate card. It will be read by or to the child. The response will be given verbally, thus is recorded on the tape.</p>	<p>Acceptable responses to be counted as correct are:</p> <ol style="list-style-type: none"> <li>1. arms, shoulders.</li> <li>2. cub, baby bear.</li> <li>sub. kitten, kitty, baby cat, baby.</li> <li>3. Any soft or small particle food that can be eaten with a spoon.</li> </ol>

TABLE 3 - Continued

















The Instrument	Its Administration	Evaluation
<p>"Here are some picture questions. Can you find the best figure to finish each statement?"</p> <p>4.  →  :  →</p> <p>5.  →  :  →</p> <p>6.  →  :  →</p> <p>7.  →  :  →</p> <p>(3)</p>	<p>The statement through the second arrow will appear on a card followed by the answer alternatives.</p> <p>The letter choices are indicated on the card back. Each question shapes will be in a specific color for only that question.</p>	<p>Acceptable responses are:</p> <p>4. e. </p> <p>5. b. </p> <p>6. d. </p> <p>7. a. </p>
<p>"Listen to this passage from <u>Winnie The Pooh</u> . .</p> <p>8. Which pictures do you feel fit the passage?"</p> <p>(4)</p>	<p>The passage (Milne, 1926, p. 48) is typed on a card and read by or to the child. Photo choices are arranged face up on the table. The child makes his choice by pointing or picking up the photos.</p>	<p>For straight interpretation of the passage, the photo of cumulus clouds is correct. For analogical interpretation the children on the slide or drinking from the hose are correct.</p>

TABLE 3 - Continued

The Instrument	Its Administration	Evaluation
9. "How do you feel today?" (5,6)	Researcher asks this directly and allows sufficient time for a complete answer.	The number and types of analogies used in the answer are tabulated on the data sheet from the taped answer.
"Listen to this poem by Robert Louis Stevenson (1957) called, 'My Bed is a Boat'." • • •	The poem is typed on a card and is read by or to the child.	
10. Do you ever feel like this poem describes?" (5,6)	The question is asked verbally and sufficient time for the child to answer is allowed.	The usual answer will be 'yes' or 'no'; however, if the child does not understand, it will be obvious.
11. "How would you describe your sleep?" (5,6)	Ample time is given for answering this verbal question.	The number and types of analogies used in the answer are tabulated on the data sheet from the taped answer.
"Watch this. (The candle is lit, gas bottle placed over it. When fire is out, the system is lifted. Clamp is released again and the bottle is lifted again.)	The science experiment is performed with the child's full attention.	

TABLE 3 - Continued

The Instrument	Its Administration	Evaluation
<p>12. Please describe what happened in this experiment?"</p> <p>(5,6)</p>	<p>The question is asked verbally and ample time is given for a full answer.</p>	<p>The number and types of analogies used in the answer are tabulated on the data sheet from the taped answer.</p>
<p>"I have here two special forms of writing, a poem and a Cinquain (Torrance, 1971, p. 38).</p> <p>13. Which would you like to compose?"</p> <p>"Okay, let's write it here."</p> <p>(6)</p>	<p>The poem and Cinquain are presented on separate cards and read by or to the child. The child chooses which he will compose. If the Cinquain is chosen, the poem card will be turned over to show line requirements of the Cinquain. The interviewer will write the composition from dictation if the child cannot.</p>	<p>The analogies used in this structured writing are recorded on the data sheet and classified by type. The creative products will be retained for further study.</p>
<p>"Here is a picture.</p> <p>14. Please describe this picture."</p> <p>(5,6)</p>	<p>The Escher print, "Another World" (Escher, 1947) is shown to the child. The question is asked verbally and ample time is allowed for a full answer.</p>	<p>The number and types of analogies used in the answer are tabulated on the data sheet from the taped answer.</p>

TABLE 3 - Continued

The Instrument	Its Administration	Evaluation
15. "What is it like to swing?"	These questions are asked verbally by the interviewer and ample time is allowed for each answer.	The number and types of analogies used in the answers are tabulated on the data sheet from the taped answers.
16. "What is it like to ride a bike?"		
17. "What is it like to fly?" (5,6)		
"We have been working with analogies in this interview. You have created some . . . (give examples), or We have some in this poem here as . . . (examples)."	<u>Ranger Rick</u> , December, 1975, is opened to pages 12-13. The passage is read by or to the child and he is to indicate the analogies he recognizes. Each find is recorded on the tape or, if the child prefers to mark them, a clear plastic transparency and a felt tip pen is supplied him.	The answers of the child compared with those marked on the key will be tabulated. The number of correct choices will be the numerator, the number of incorrect choices + 1 will be the denominator. The resultant quotient will serve as his score.
18. Can you find any analogies in this passage?" (7)		
19. "Do you think that analogies are useful in communication?" (8)	The question is asked verbally and ample time is allowed for the answer which is recorded.	The answer is tabulated and will be correlated with interview performance.

TABLE 3 - Continued

The Instrument	Its Administration	Evaluation
<p>"You have answered all the questions I have, but for trying to figure what the relationships are for the first seven questions.</p> <p>20. Can you tell me how each of these are related?"</p> <p>(9)*</p>	<p>The question cards 1-7 are placed on the table. The child picks one at a time and explains the relationship he finds.</p> <p>The time interval for the entire instrument presentation is 20 - 30 minutes.</p> <p>The child returns to his class or parents.</p>	<p>Correct responses include parallel statements to:</p> <ol style="list-style-type: none"> <li>1. that covered by the type of clothing.</li> <li>2. parent-offspring.</li> <li>3. tool-material.</li> <li>4. center line-out, inner figure complete.</li> <li>5. figure turned.</li> <li>6. half becomes clear, four sections show.</li> <li>7. one side less.</li> </ol>
<p>"Thank you very much for joining me for the interview. It was fun."</p>		

\* Indicates which behavioral objectives coordinate with instrument activities.

Figure 19 are in the Chapter 1 definitions section under Analogy which includes the categories of analogies judged by the researcher to be of interest to the educational researcher.

Most of the components of the survey questionnaire are derived from question designs of other researchers.

Questions 1 - 3, verbal analogy problems, represent the question formats of Miller (Dawes and Siojo, 1972), Woodcock (1973), and R. L. Thorndike, Hagen, and Lorge (1964, 68, 71).

Questions 4 - 7, figurative analogy problems, parallel those of Thorndike et. al, (1964, 68, 71).

Question 8, Use of Figurative Illustration, is an altered form of tasks used by Pearson and Maddi (1966).

Questions 9, 11 - 17, Use of Analogies, give opportunities for oral composition and written poems and cinquains as recommended by M. and H. R. Pollio (both 1973), and parallel their analyses of written compositions for analogy use.

Question 18 and 19, Identification of Analogies and evaluation of the importance of analogies in communication are original ideas of the researcher.

Question 20, Explanation of Analogy Problems, requests the child's reasoning in determining the answers to questions 1 - 7. This is an interview technique used by Piaget (1974) on his renown Piagetian tasks.

### Panel Evaluation of Questions

To insure content validity of the survey questions to probe analogy abilities of children, a panel of three was selected to evaluate the interview instrument and procedures.

Panelists included: Betty L. Lowry, PhD., University of Iowa, Professor of Elementary Education, University of Northern Colorado, and specialist in children's literature; Douglas S. Burron, EdD., University of Northern Colorado, Asst. Chairman, Elementary Education at the University of Northern Colorado, and specialist in early childhood education; and Jay K. Hackett, EdD, University of Northern Colorado, Asst. Professor of Earth Science at the University of Northern Colorado, and specialist in junior high science education.

Opinions of these panelists appear in Appendix C.

### Reliability of the Instrument

An interrater reliability check and the Kuder Richardson (formula 20) statistical reliability determination were made on the survey data.

### Interrater Reliability

Errors in transcribing the tapes and categorizing answers in scoring interview performances were possible in this survey study. To determine the degree of accuracy of



the researcher in conducting this study, interrater checks were made on the data. They were:

1. An interrater reliability test on all performance data but the Use of Analogies task by five graduate students who volunteered from Douglas Burrton's Psycholinguistics course, EDEC 648-001, taught at the University of Northern Colorado, summer, 1976.

2. A comparison of the researcher's identification and classification of the Use of Analogies responses with that of analogy researcher, Joe Khatena, Professor of Educational Foundations, Marshall University, Huntington, West Virginia.

Screening the graduate students for this task was done by interviewing the individuals using a pencil and paper version of the survey instrument (Appendix A). To be a referee, 80% was to be scored on questions 1 - 7, 18, and 20. With demonstrated difficulty on the identification of analogies in the literature passage, the Use of Analogies task scoring was allocated to Professor Khatena.

Five per cent of the data, ie seven randomly selected tapes were used by the referee panel. Random selection was made using the technique employing a table of random numbers (Edwards, 1969, pp. 129-30).

The seven tapes were made available to the referees individually along with data tabulation forms (figure 18).

Using the evaluation column in Table 3 and the "Who-o-o Knows" article (1975) with analogies underlined (figure 17), the referees interpreted the tapes. The researcher was available to answer questions regarding the coding of responses on the data form they used.

In order to retain the data from any question or question group, there need be an agreement of 80% for all interviewees with the researcher's interpretation by the five referees. All questions except the Use of Analogies task, questions 9, 11 - 17, were interpreted by these referees. ☺

For the Use of Analogies task scored by analogy researcher, Joe Khatena, the seven randomly selected tapes were sent with the poem or cinquain creations of the interviewees, transcriptions of the responses for the task, data forms (figure 19), and the Chapter 1 definitions for the included categories of analogy classification.

This selection of material to aid his scoring was sufficient since he uses the types of analogies classification in his research and is familiar with the other categories as well.

Again 80% agreement between the researcher's scoring and that of analogy researcher Khatena was considered sufficient accuracy to accept the researcher's scoring of the Use of Analogies task. It is also sufficient to accept the researcher's classification of

the analogies in the article, "Who-o-o Knows" (1975), used in the Identification of Analogies task for comparison of the analogy types and grammatical classes the child identifies with those he uses.

Table 4 presents the degree of agreement of the referees with the researcher's scorings on the survey tasks as percentages. One hundred per cent would indicate agreement in 31 scorings of the referees with that of the researcher for that task. For the Use of Analogies task, it would mean agreement of Khatena with the researcher for the seven interviewees on the eight activities in that task.

TABLE 4  
INTERRATER RELIABILITY SCORES

task	score*
Interpretation - verbal	92%
- figurative	88'
Explanation - verbal	90
- figurative	85
Number of corrected answers	61
Use of figurative illustration	85
Use of Analogies (Khatena)	86
Identification of analogies	
analogies identified	86
incorrect choices	75% **
*Appendix C contains by item scores (table 20)	
**One referee failed to tally incorrect choices.	

### Statistical Reliability

Kuder Richardson (Formula 20) internal consistency coefficients were computed for the interpretation and explanation tasks for all interviews combined. The reliability coefficient on these combined tasks was 0.894.

This high reliability coefficient is consistent with those found for this type analogy problem often used as part of intelligence tests (Dawes and Siojo, 1972); however, those reported did not include as wide an ability range as this survey, nor did 50 per cent of the data reflect the child's ability to explain why he chose his answer or explain his reasoning as he solved the problem.

### Data Preparation and Presentation

All responses were numerically interpreted for data analysis. Performance divisions used include:

1. Interpretation - correct responses for verbal analogy problems and for figurative analogy problems.
2. Explanation - correct responses for verbal analogy problems and for figurative analogy problems.
3. Use of Figurative Illustration - numbers of direct, analogous, and erroneous illustration choices.
4. Use of Analogies - the number of analogies used giving the total and subtotals per activity and per category of analogy used for types of analogies,

emotive levels, and grammatical classification.

5. Identification of Analogies - the number of analogies identified by the child, the number of incorrect choices, and the calculated scores.

The interviewee was characterized numerically as to age, sex, heritage, and attitude as demonstrated in responses to the question "Are analogies important in communication?".

This combination of factors provided the data base for analysis.

Operations applied to the data resulting in the figures and tables in Chapter 4 and Appendix D (Use and Identification of Analogies tasks results) include performance averages presented by age, significant score patterns, and statistical procedures.

#### Performance Averages Presented by Age

Performance averages and ranges of scores were plotted for each age child interviewed. Performance averages for pairs of tasks, groups of tasks or like features of task pairs were plotted. Both are presented on two axis graphs, one axis for age of the interviewees and the other for level of performance.

#### Significant Score Patterns

On stating levels of significant performance for each task, the child's performance was included in tables

giving patterns of significant performance for task groups, task pairs, and individual tasks.

### Statistical Procedures

Three techniques of data analysis brought definition to task performance by the 144 youngsters. They include mean and standard deviation data using age groups (30-32 youngsters in three year age categories), correlations, and analysis of variance.

### Summary

Procedures determined to survey analogy abilities include random sample selection by interviewing youngsters who have their birthdays during the month of the interview, instrument presentation by individual taped interview, and no testing of youngsters other than in the interview session. Ten youngsters for each age, 2 - 15 years, were interviewed giving a sample size of 140 youngsters.

The instrument was developed, evaluated by a panel of experts, and pilot tested before use in the survey. An interrater reliability check on instrument performance transcription and evaluation accuracy gave an 85% level of agreement for all tasks. Statistical reliability for the Interpretation and Explanation tasks was 0.894 as determined using the Kuder Richardson (formula 20) procedure.

Data analysis provided plotted averages and performance ranges by age, significant score patterns, and statistical procedures of mean and standard deviations for age groups of 30 youngsters, correlations, and analysis of variance.

## CHAPTER 4

### RESEARCH FINDINGS

With the purpose of this study being to identify children's analogical abilities, to determine how these abilities relate to one another, and to describe how these abilities vary with age and sex, the interview transcription information was analysed in many ways. Those techniques most clearly defining analogical abilities using the ten child samples for each age are presented in this chapter.

The hypotheses with appropriate sub-hypotheses were analysed in light of both the graphic and statistical information.

#### Data Presentation and Interpretation

Those analysis techniques included in this study are: graphed averages and performance ranges for each activity and combined activities presented by age; tabulated significant score patterns for activity groups, pairs, and individual activities; and three statistical procedures. These are mean and standard deviation, correlation, and analysis of variance. Tallies of other interesting data complete this section.



### Graphed Averages of Performance on Tasks by Age

Considering the task scores for each age by year gives averages for ten and in four cases eleven individuals. Including the ranges gives maximum and minimum performances in the group. The two axis graphs show performance levels vertically increasing upward with age horizontally. Where applicable, perfect score levels are indicated.

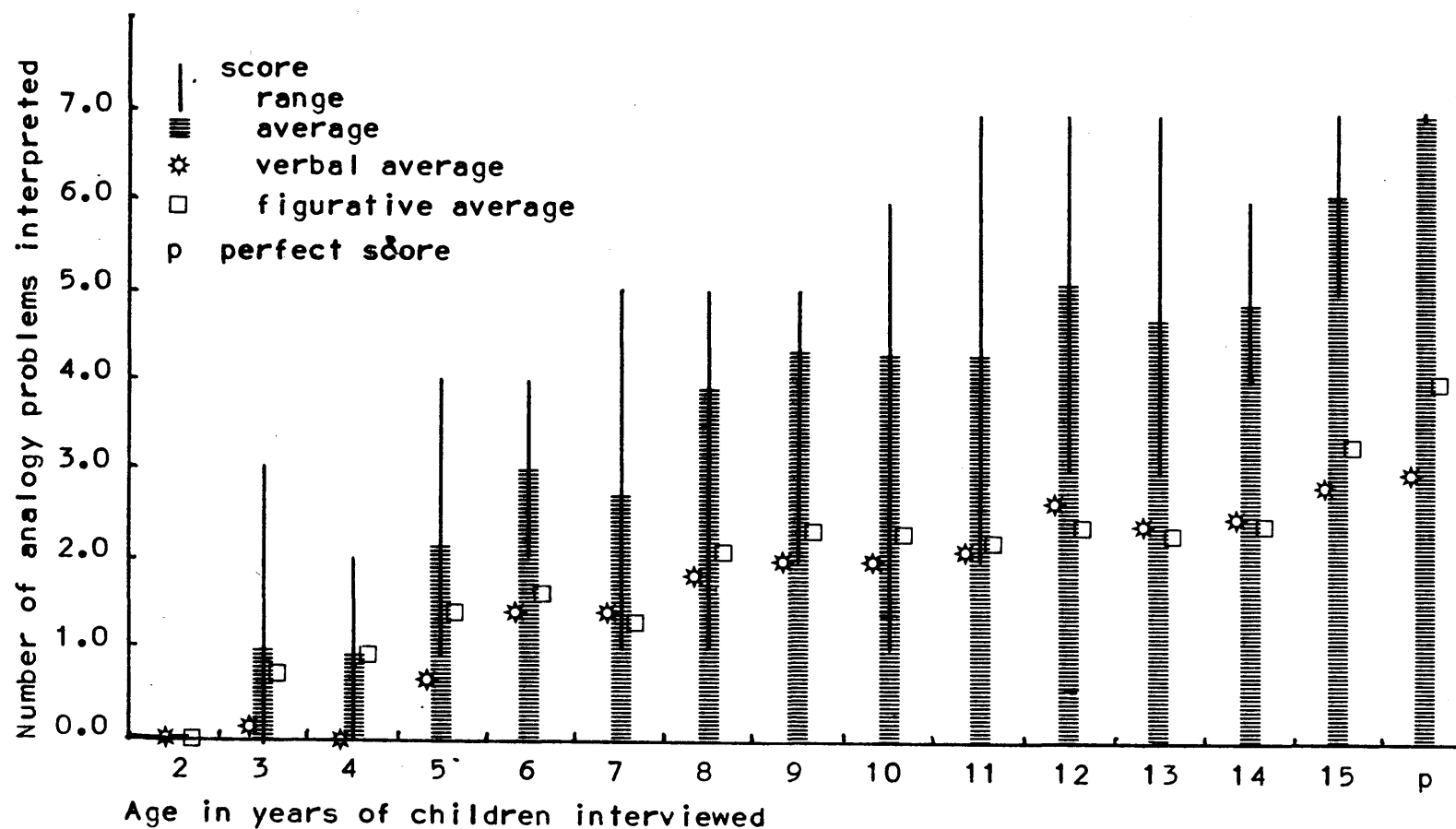
Graphs of separate activities define the ability fluctuations as children mature. Combining activity performances or defining inner aspects of the activities determines the relationship of activities one to another.

Figures 1 - 5 and table 5 provide task specific ability patterns. Figures 6 - 12 combine task performance for comparison purposes.

Figure 1 - The interpretation of analogy problem averages and range of scores are presented by age with verbal problem and figurative problem averages. Note here that initial performance is exhibited for figurative problems earlier than for verbal ones.

The data here served to define age groups used for statistical procedures as 3 - 5, 6 - 8, 9 - 11 and 12 - 14 year olds. Since this was the style analogy problem used in the Miller Analogies Test of 1926 (Dawes and Siojo, 1972) this performance pattern could be the basis of the

Fig. 1. The Interpretation of Analogy Problem Averages  
and Range of Scores Presented by Age



Averages are based on ten children per age category.

regrouping of school grades from the grades one through eight and nine through twelve to the levels of primary, intermediate, junior high and senior high as these age groupings represent.

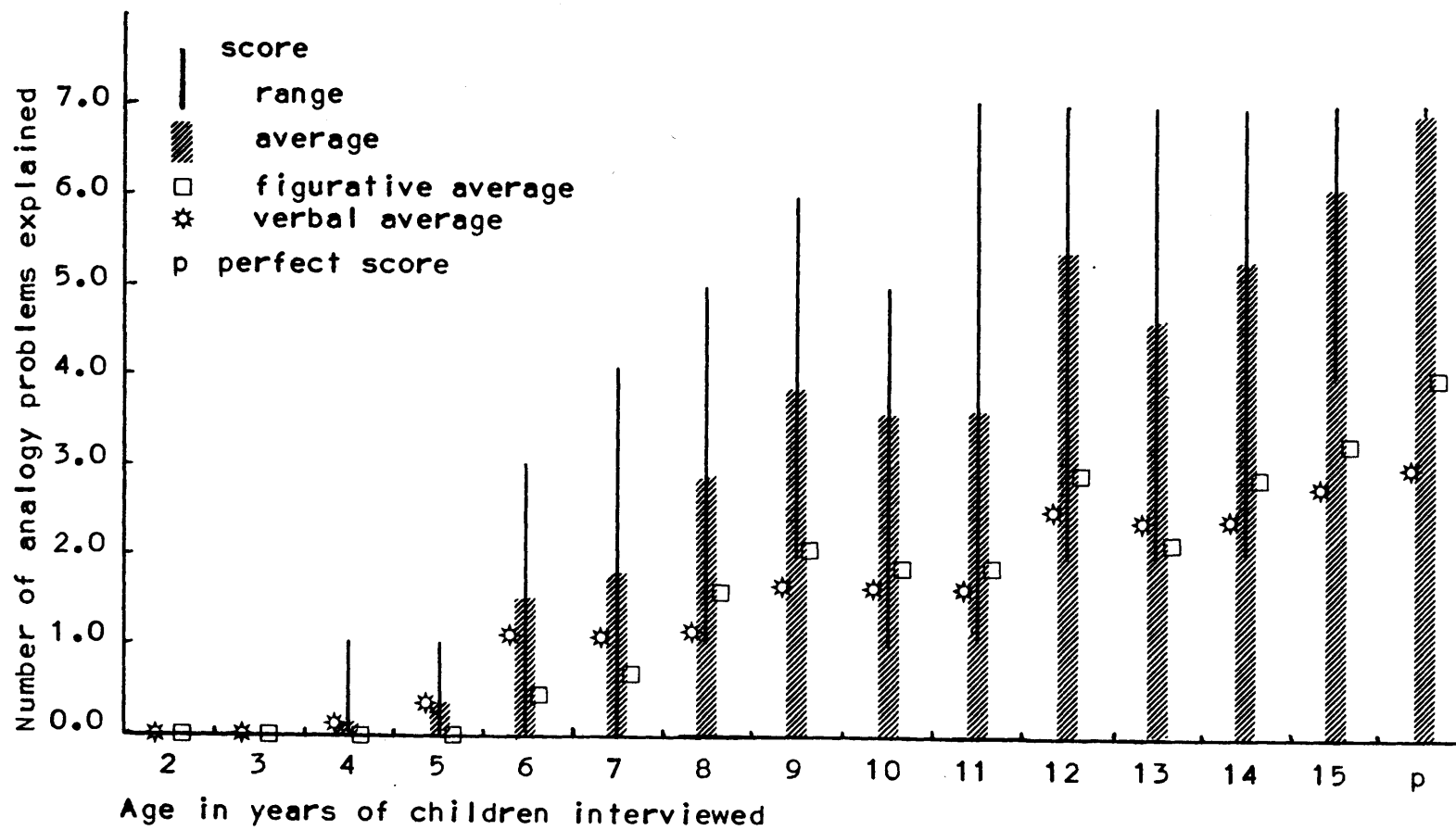
Figure 2 - The explanation of relationships in analogy problem averages and range of scores are presented by age with verbal problem and figurative problem averages. Note here that initial performance was exhibited for verbal problems earlier than for figurative. At nine years and beyond, the proportion of verbal to figurative problems explained by the children represent the proportion of these problems in the survey instrument.

Figure 3 - The use of figurative illustration score averages are graphed by age giving the straight, analogical and erroneous choice scores weighted according to the number of selections the child had for each category.

The photo directly illustrating the story was chosen nearly 100% of the time at age nine and beyond. Analogous illustration were chosen most often by the young child and erroneous choices decreased with age.

Figure 4 - The use of analogies score averages and ranges are graphed by age with averages of grammatical classes (simile and metaphor) indicated. Note here the erratic fluctuations in performance and wide ranges for each age. Also initial use of analogies is exclusively metaphor with simile dominance at age six and beyond.

Fig. 2. The Explanation of Relationships in Analogy Problems  
Averages and Range of Scores Presented by Age



Averages are based on ten children per age category.

Fig. 3. The Use of Figurative Illustration Score Averages  
Graphed by Age

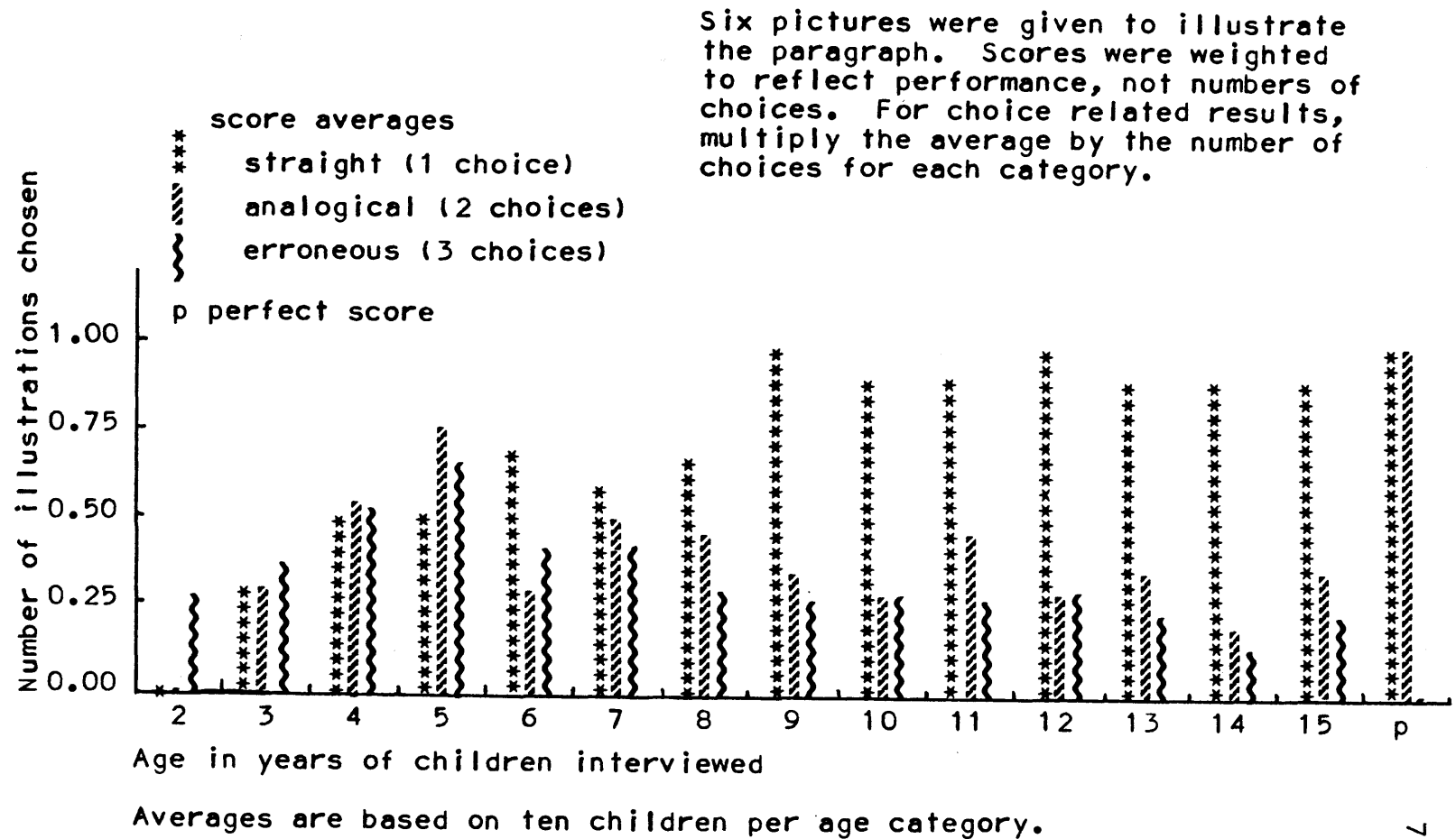
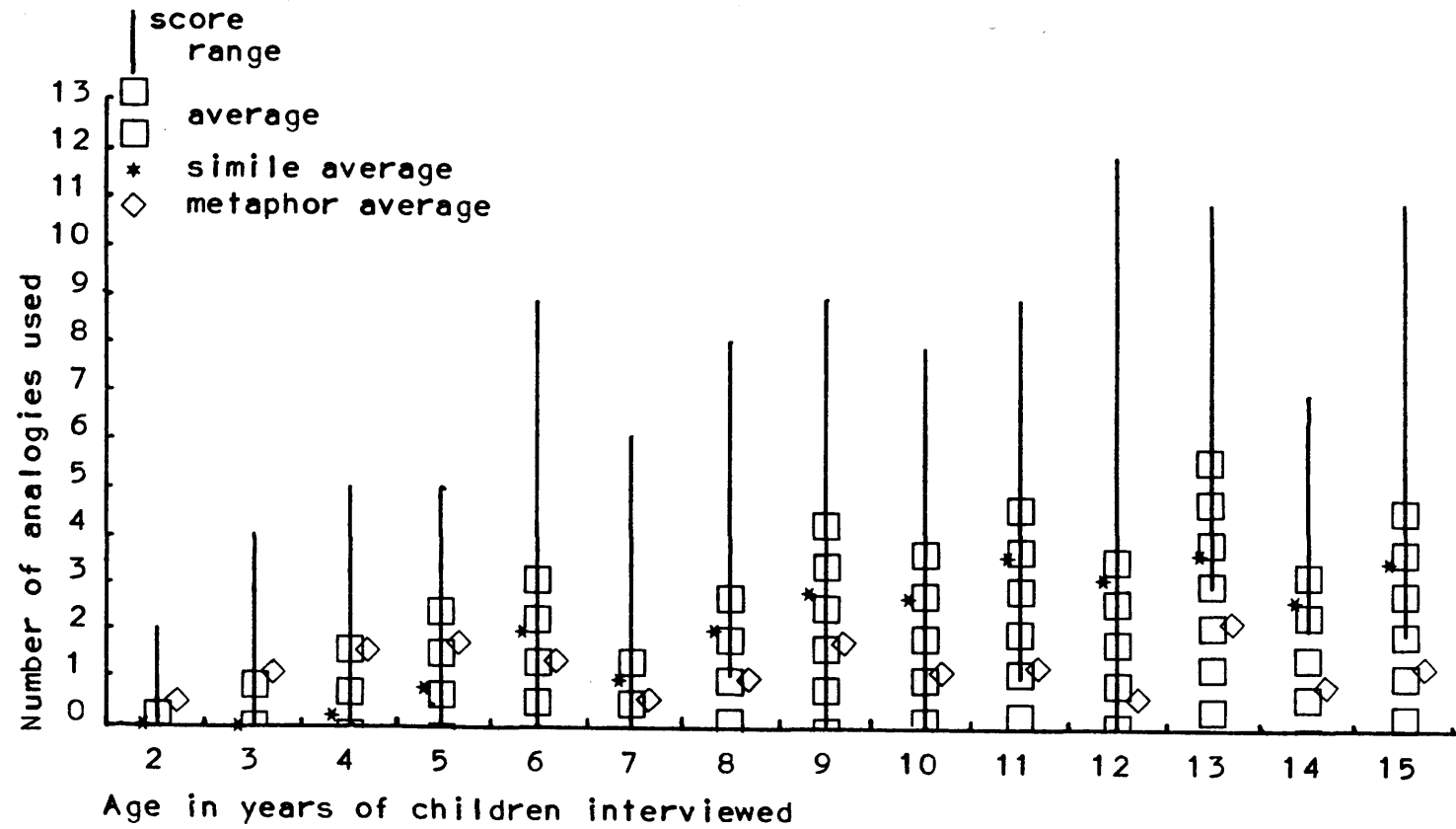


Fig. 4. The Use of Analogies Score Averages and Ranges  
Graphed by Age



Averages are based on ten children per age category.

Figure 5 - The identification of analogies score averages are graphed by age representing averages and ranges for the total of correct analogies recognized, averages for the grammatical classes (simile and metaphor) and scores. Scores in this instance are calculated by dividing the number of correct analogies indicated by the number of incorrect guesses plus one.

$$\text{Score} = \frac{\text{number of correct analogies}}{\text{number of incorrect choices} + 1}$$

Note here that after eight years old the number of analogies identified remains more or less constant but the scores tend to increase. Similes are identified initially and dominate the choices for ages through fifteen.

Table 5 - Identification task scores are calculated for age groups of ten to eleven youngsters. The highest number of correct analogies identified by each age child and averages for the age of analogies indicated, incorrect choices, and scores are tabulated for each age. A seven year old identified 13 of the 17 analogies in the text. A high degree of inaccuracy is evident at ages nine and twelve.

Figure 6 - The interpretation and explanation of verbal analogy problem score averages are graphed by age. Beginning with this figure, performance on two or more activities are compared to determine the number of abilities

Fig. 5. Identification of Analogy Score Averages

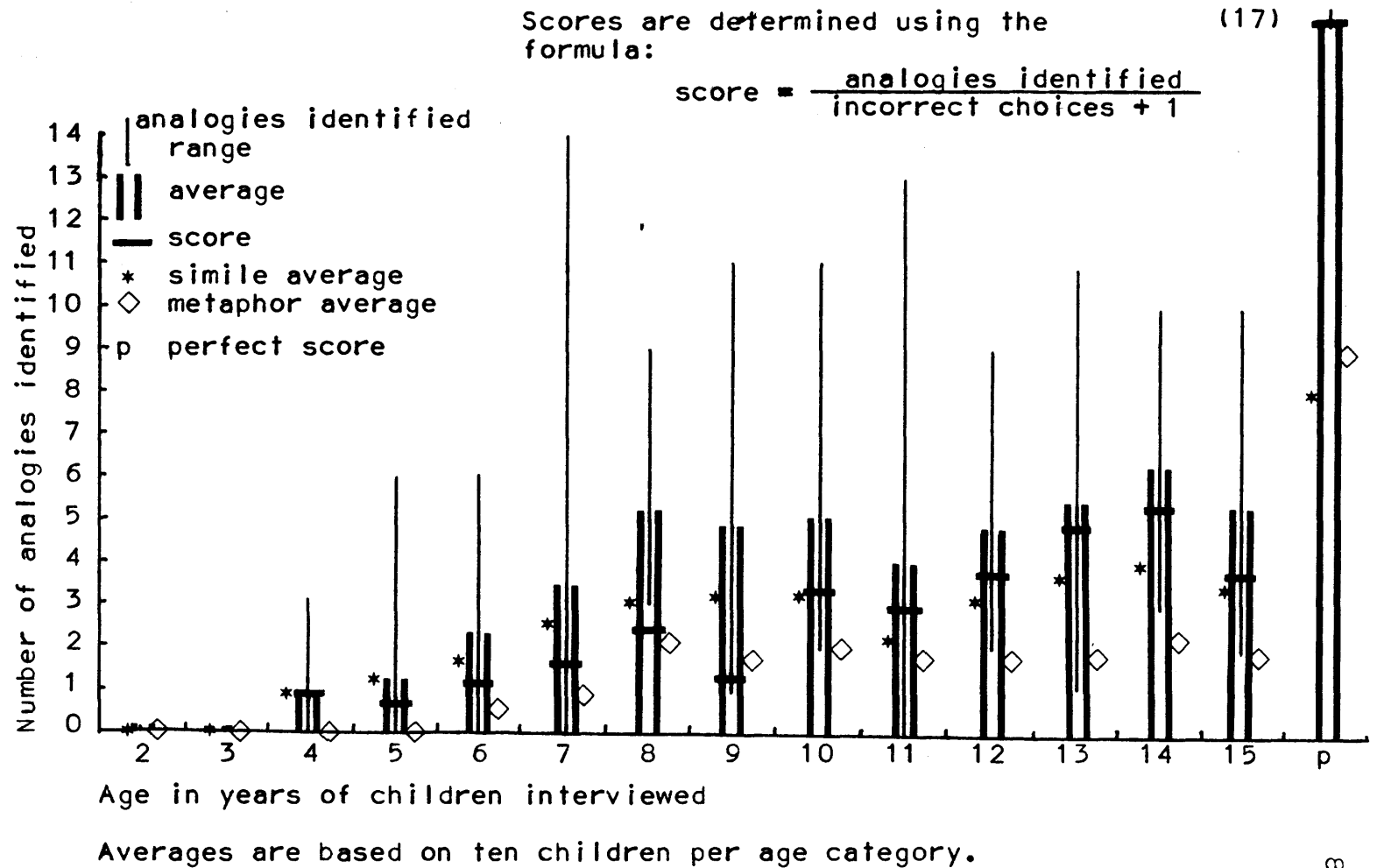




TABLE 5

IDENTIFICATION TASK SCORES FOR YOUNGSTERS  
GROUPED BY AGE

age (years)	greatest individual AI	TAI	TIC	$\frac{TAI}{TIC+1}$
2	0			
3	0			
4	3	8	0	8.0
5	6	13	5	2.2
6	6	25	13	1.8
7	13	39	12	3.0
8	9	51	16	3.0
9	10	54	37	1.4
10	11	52	12	4.0
11	11	41	7	5.1
12	9	48	13	3.4
13	11	54	3	13.5
14	9	63	5	10.5
15	10	54	6	7.7
Averages		41.8	10.8	5.2

AI - greatest number of analogies identified by an individual.

TAI - total number of analogies identified by the group.

TIC - total incorrect choices made by the group.

$\frac{TAI}{TIC+1}$  - calculated scores for the group.

inherent in the survey instrument.

Note here how the performance plateaus discussed in figure 1 are emphasized by the explanation of verbal analogy problems data. There are Piagetian implications in the data for eight and nine year olds when the transition between concrete and formal operational thought begins to take effect.

Figure 7 - Interpretation and explanation of figurative analogy problem score averages are graphed by age. Two important phenomena are exhibited: the early performance of interpreting these problems is contrasted with the late explanation abilities. Then at adolescence, the explanation abilities exceed the abilities to interpret the problem. What this means in the interview setting is that these children did not state the answer when first presented with the problem. On later review they gave the solution and from that chose the correct shape as their reasoning described.

Figure 8 - Interpretation and explanation of analogy problem score averages are graphed by age. These data show the early and gradual development of interpretive abilities and the more rapid development of the ability to state the reasoning leading to the solution of the problem.

Fig. 6. Interpretation and Explanation of Verbal Analogy  
Problem Score Averages Graphed by Age

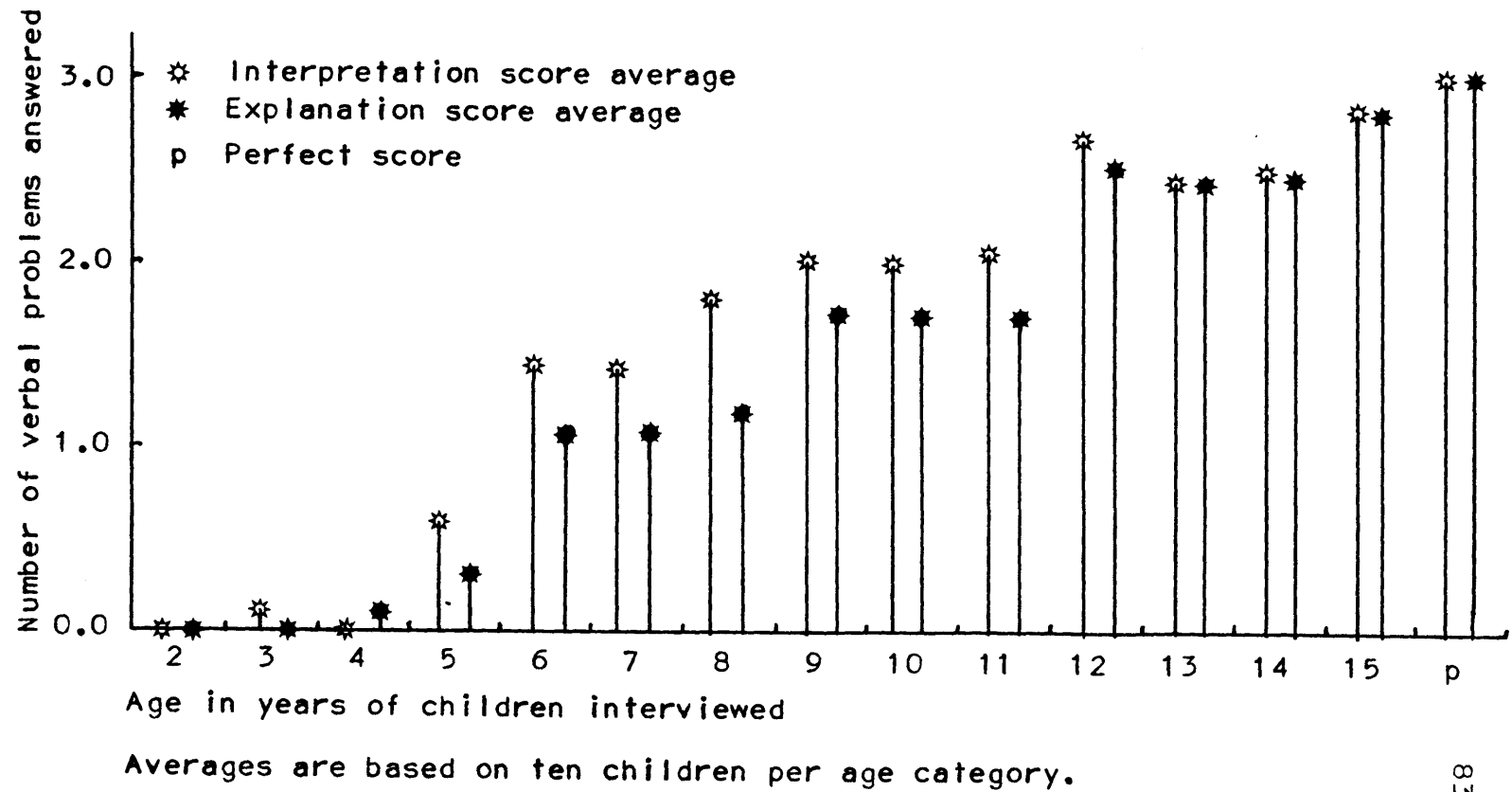
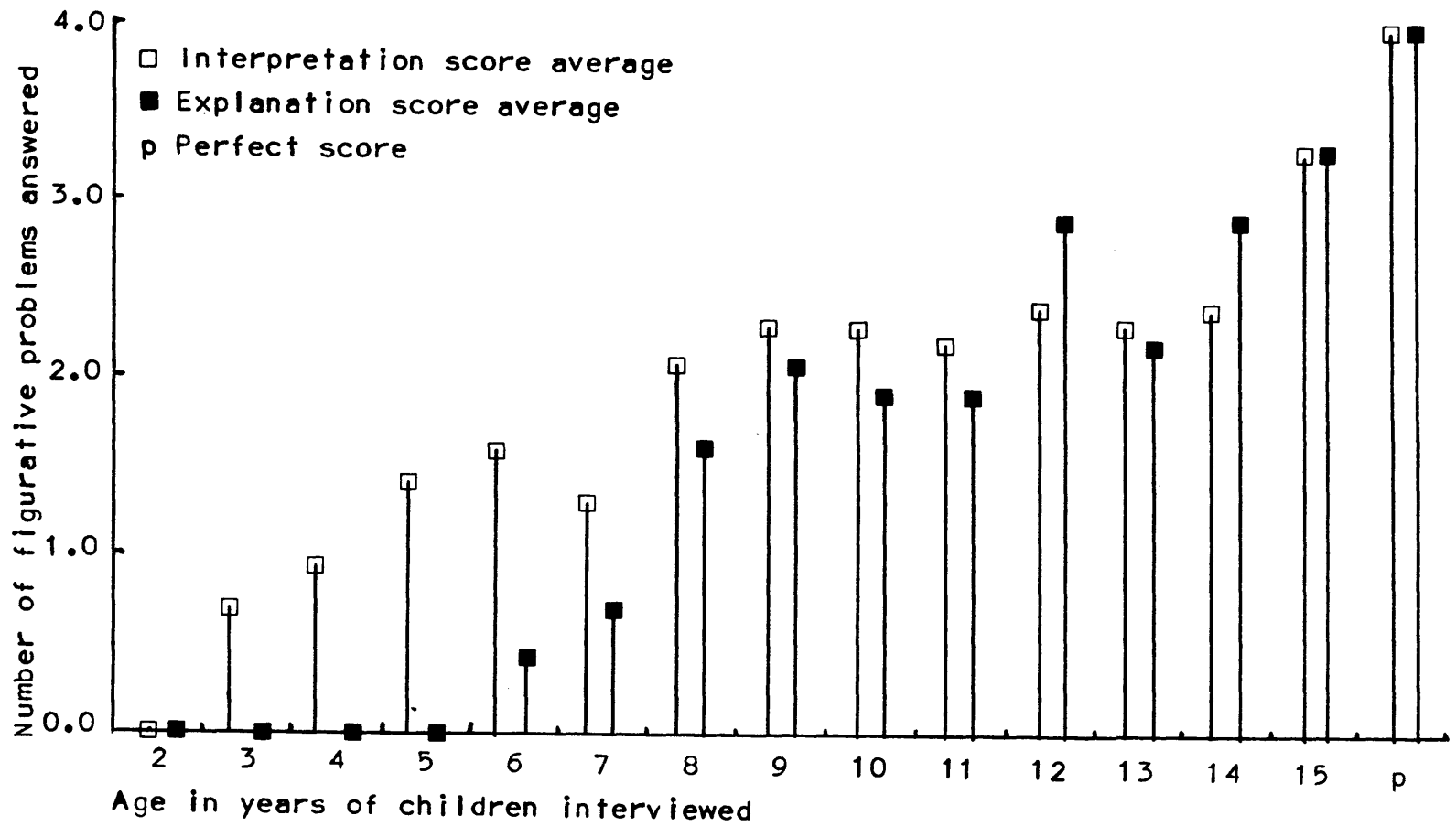
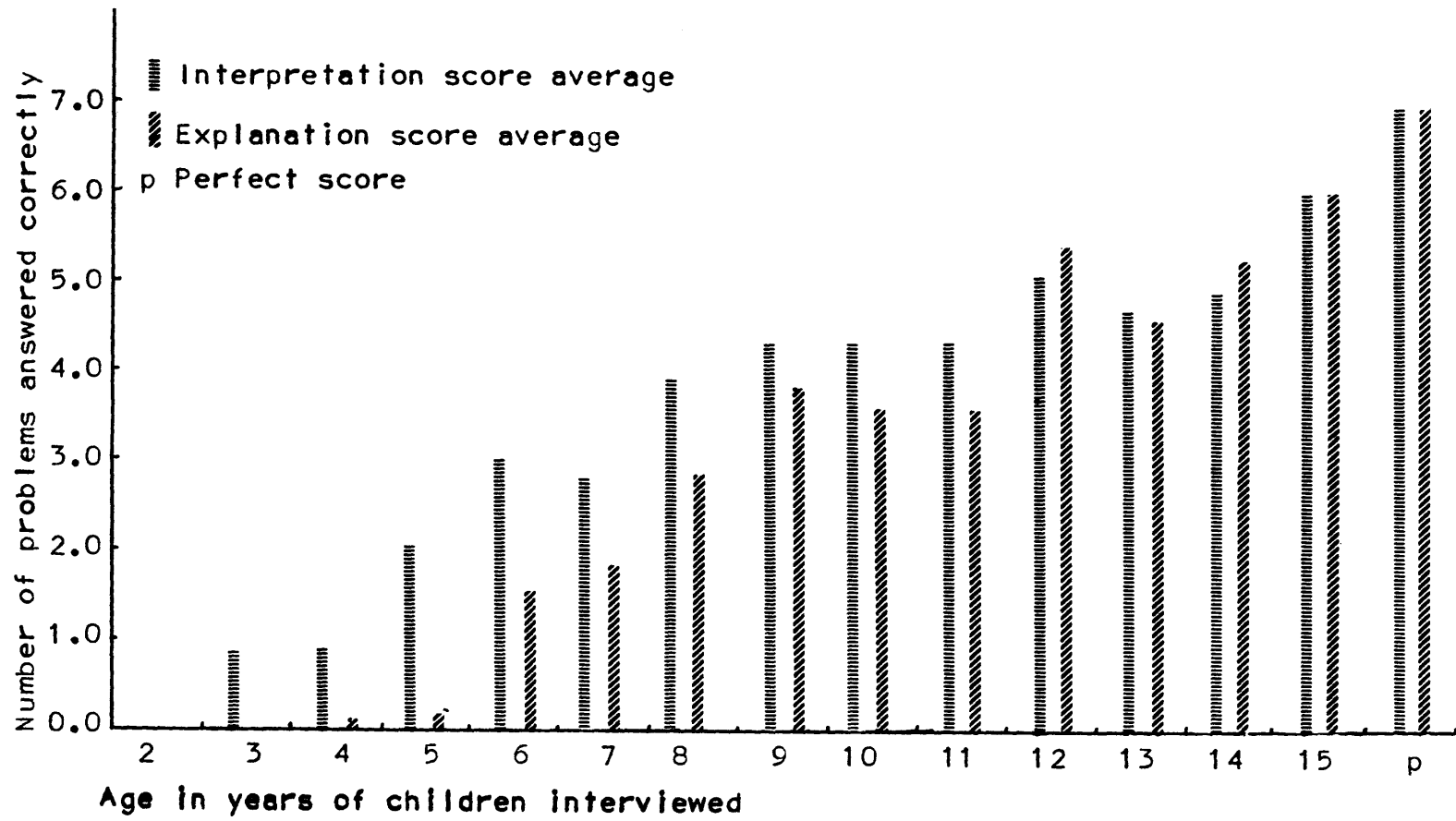


Fig. 7. Interpretation and Explanation of Figurative Analogy  
Problem Score Averages Graphed by Age



Averages are based on ten children per age category.

**Fig. 8. Interpretation and Explanation of Analogy Problem**  
**Score Averages Graphed by Age**



Averages are based on ten children per age category.

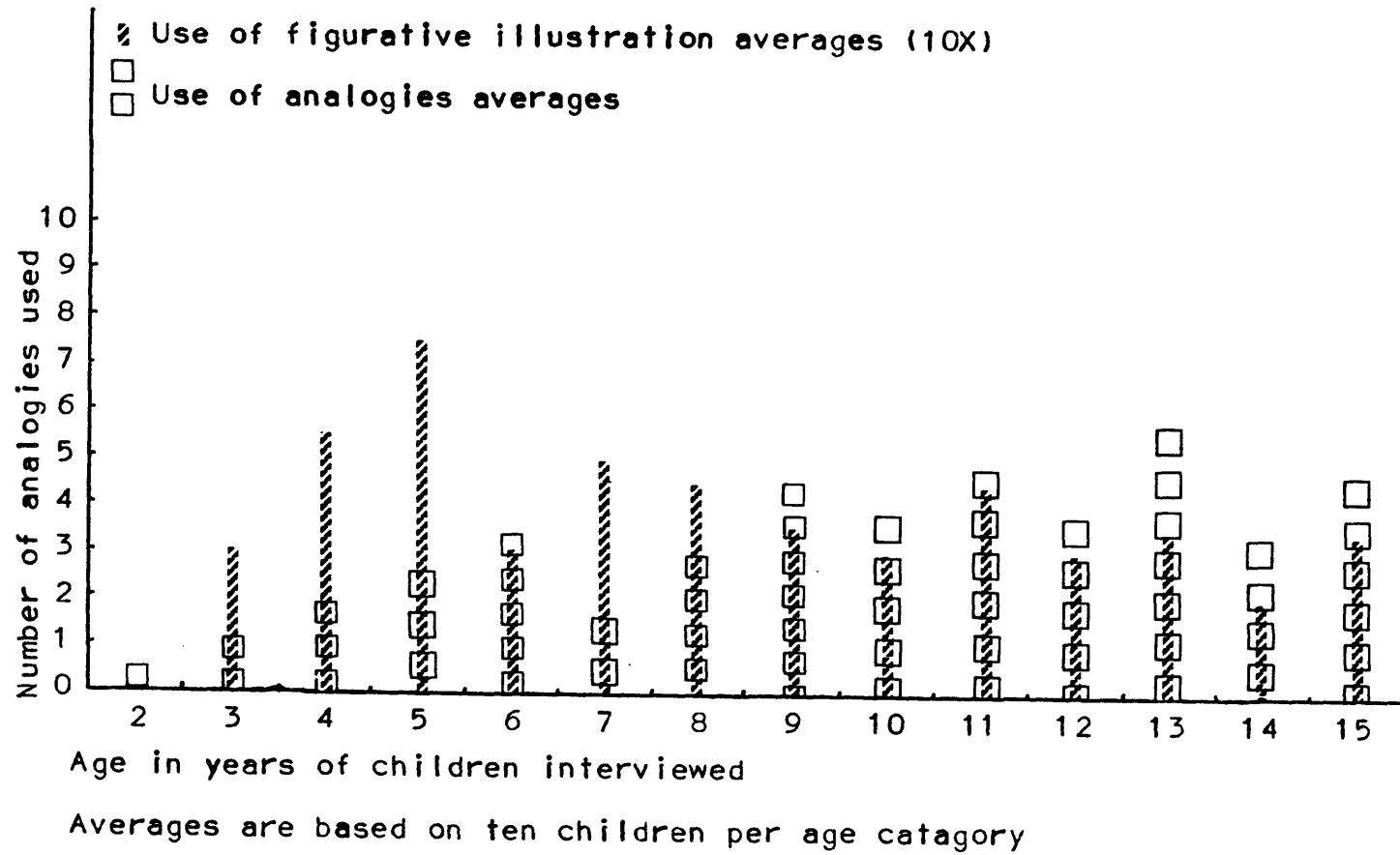
Figure 9 - The use of figurative illustration and use of analogies scores are graphed by age. Note here the early abilities at both activities and no increase in ability with age. After age eight the fluctuations for both activities are relatively parallel.

Figure 10 - Use of analogies averages and identification of analogies averages are graphed by age. For the identification task, performance increases with age through eight years old and after that it remains relatively constant. In contrast the use of analogies averages fluctuate widely after age six.

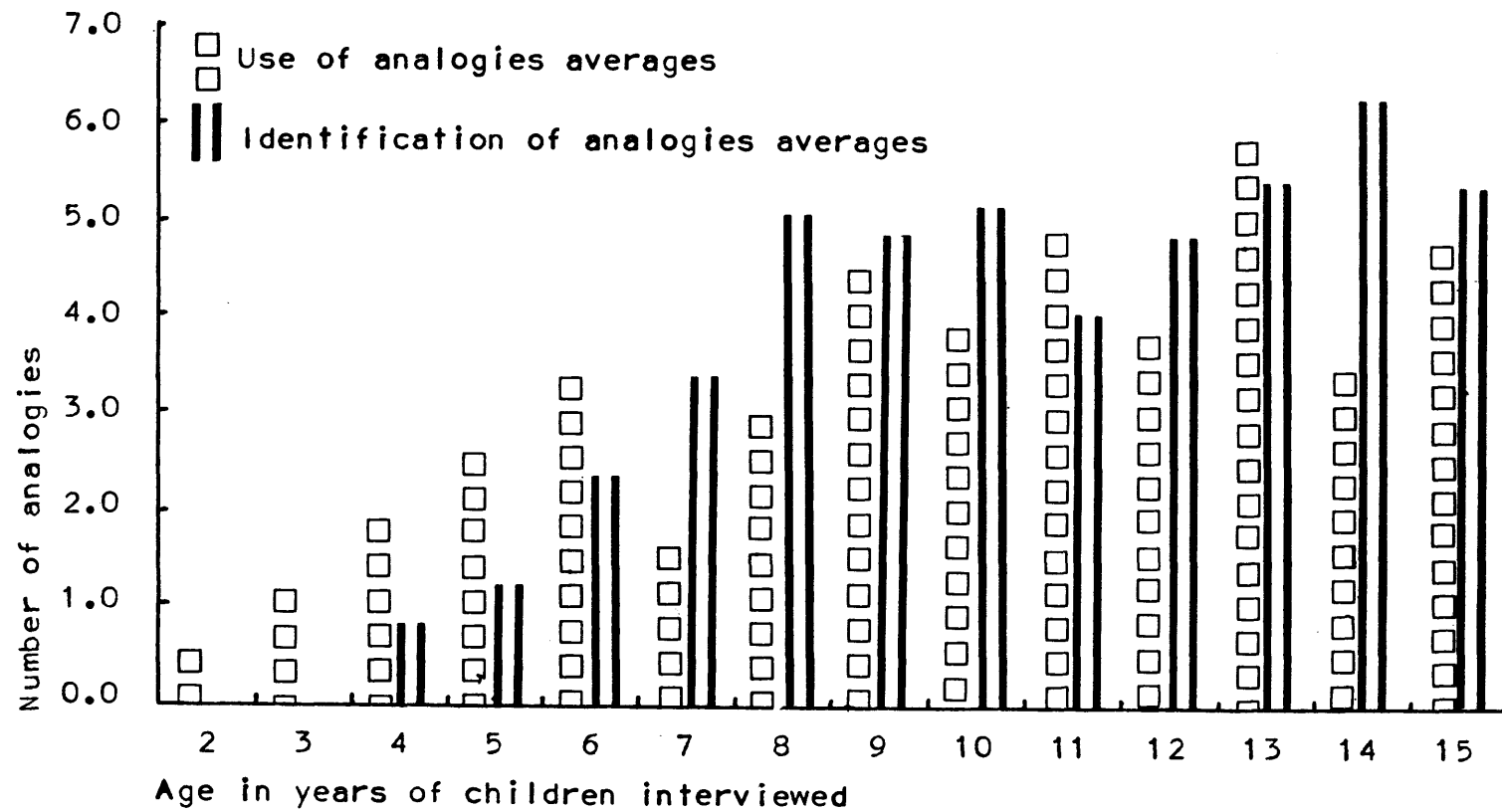
Figure 11 - Use and identification of analogies grammatical classification averages are graphed by age. This four component graph shows that when the child first uses metaphors, he does not recognize them as analogies. Both abilities involving metaphors fluctuate with age. The young child more ably identifies than uses similes. The ability to identify similes increases with age, but the use of similes fluctuates with age.

Figure 12 - Interpretation and explanation of analogy problems, use of figurative illustration, and use and identification of analogies performance averages are graphed by age. The graph shows a jumble of divergent patterns. Connecting the performance averages for each task by age in line graph style helps to define the changes.

**Fig. 9. Use of Figurative Illustration and Use of Analogies**  
**Score Averages Graphed by Age**



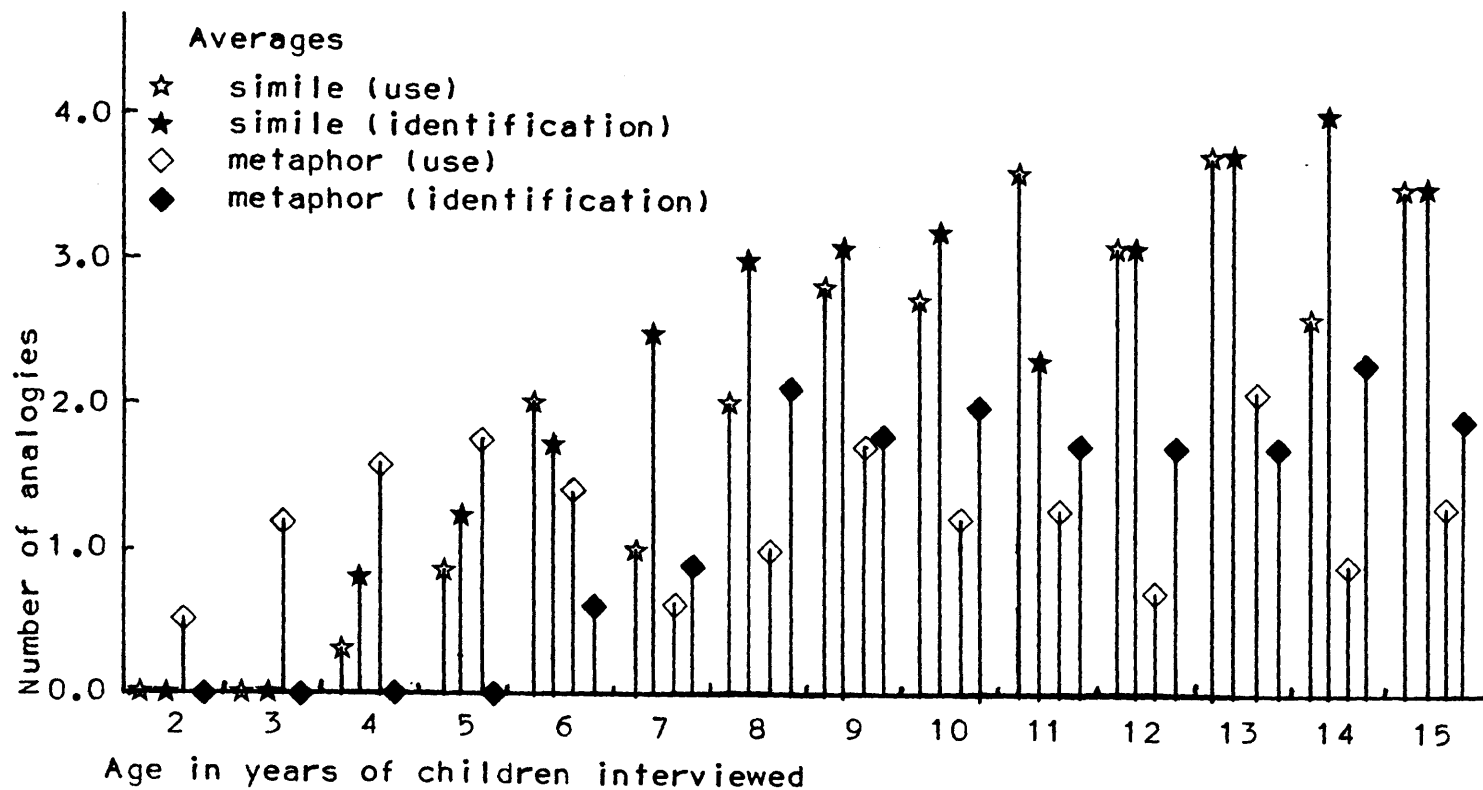
**Fig. 10. Use of Analogies Averages and Identification of Analogies Averages Graphed by Age**



Averages are based on ten children per age category

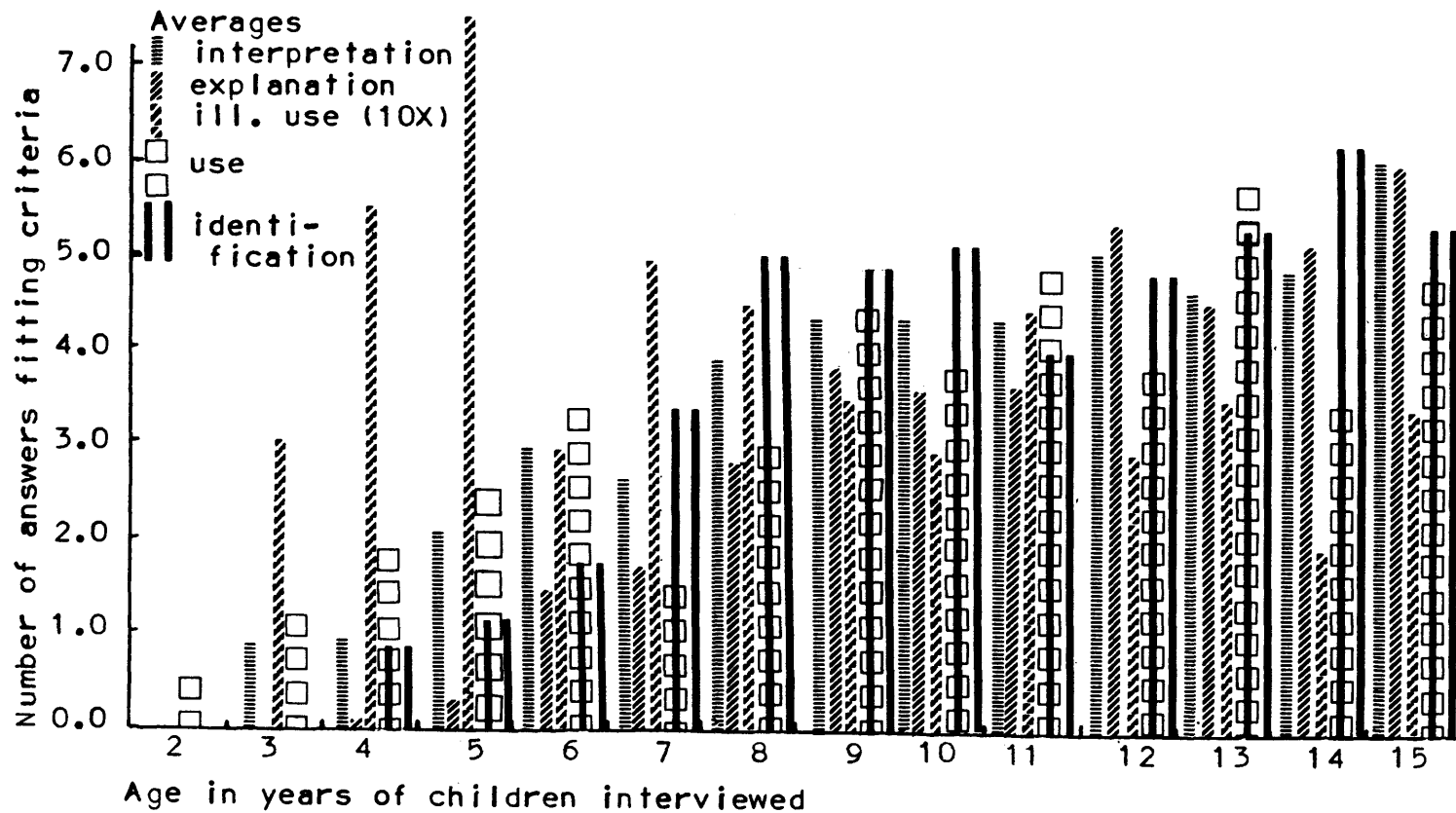


Fig. 11. Use and Identification of Analogies  
Grammatical Type Averages Graphed by Age



Averages are based on ten children per age category.

Fig. 12. Interpretation and Explanation of Analogy Problems,  
Use of Figurative Illustration, Use and Identification of Analogies  
Averages Graphed by Age



Averages are based on ten children per age category

### Tabulated Significant Score Patterns

To consider data irrespective of age, particular performance levels for each task were chosen. The significant scores were then divided into high performance and low performance levels. These are defined for each task in table 6.

TABLE 6

SIGNIFICANT SCORES AND HIGH AND LOW LEVELS OF PERFORMANCE

task	indicator	significant range	high	low
Interpretation	A	4 - 7	6 - 7	4 - 5
Explanation	B	4 - 7	6 - 7	4 - 5
Illustrative use	C	2 anal./0-2 err.	2/0-1	2/2
Use of analogies	D	4 - 11	7 - 11	4 - 6
Identification	E	score of 3 - 12	5 - 12	3 - 4

Of those interviewed, 45 children failed to score significantly on any task. The 99 who did score significantly are included in the three charting patterns: task groups, task pairs, and individual tasks.

Table 7 - Patterns of significant scores and combined frequencies and performance levels on the five major tasks are presented.

Each of the 99 interviewees who scored in the significant range is charted at the appropriate combination and performance level. To be counted in the

high performance level, the child had to have at least one score in the high range. Note the number of high versus low range scores for tasks A and D versus tasks B, C, and E. Tasks A and D are determined to exhibit gradual ability development. Tasks B, C, and E show immediate ability development upon concept awareness. Tables 7 - 9 show this phenomenon.

Many combinations have no scores tallied. These facts are as informative as are those having many inclusions. With no one scoring in task combinations of B, C, D, and E, significant performance in one would not predict able performance in the others.

Table 8 - Task pairings are tabulated and presented for the number of significant scores and the number in each the high and the low range of task scores. To be included in the high range, one of the two task scores must be in the high performance category.

Interviewees must have scored significantly in two or more tasks to be included in the pairings chart. Those scoring in two tasks are recorded once; those with three appear three times; those with four appear six times; and the three individuals scoring five significant scores appear in all ten pairing categories. Seventy four children's performances are included in the table.

Here as in table 7 the high versus low range scores can be compared for tasks A and D versus B, C, and E.

TABLE 7

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PATTERNS OF SIGNIFICANT SCORES ILLUSTRATING  
COMBINATION FREQUENCIES AND PERFORMANCE  
LEVELS ON FIVE MAJOR SURVEY TASKS

number of tasks	indicators * total significant scores high and low performance totals										sum for row
zero	none 45										45
one	A	B	C	D	E						25
	9	0	5	9	2						5
	0		3	1	1						20
	9		2	8	1						
two	AB	AC	AD	AE	BC	BD	BE	CD	CE	DE	28
	8	1	5	3	1	1	0	2	3	4	17
	3	1	3	2	1	0		1	3	3	11
	5	0	2	1	0	1		1	0	1	
three	ABC	ABD	ABE	ACD	ACE	ADE	BCD	BCE	BDE	CDE	24
	2	9	10	0	0	3	0	0	0	0	21
	2	8	9			2					3
	0	1	1			1					
four	ABCD	ABCE	ABDE	ACDE	BCDE						19
	1	1	17	0	0						18
	1	1	16								1
	0	0	1								
five	ABCDE										3
											3
											0
Significant score	6										
high	4	Total scoring significantly									99 99
low	2	Total high level scores									64
		Total low level scores									35
Grand total - survey interviews											144

\* See table 5 for indicator definitions.

TABLE 8  
TASK PAIRING TOTALS FOR INTERVIEWEES SCORING  
TWO OR MORE SIGNIFICANT SCORES

category	task pairs *									
	AB	AC	AD	AE	BC	BD	BE	CD	CE	DE
Significant scores	51	8	38	37	8	31	31	6	7	27
high	31	8	22	29	8	23	26	5	7	20
low	20	0	16	8	0	8	5	1	0	7

\* See table 5 for indicator definitions.

Table 9 - The tabulations of significant scores are presented for each task with the related age and sex tabulations. This table includes performance of all ninety nine children scoring significantly. The child's performance is recorded for each task on which he scored significantly.

Age range patterns for the tasks and high and low score ranges again show Tasks A and D as gradually developed abilities and Tasks B, C, and E as rapidly developing abilities. The ratios of high to low performance scores for this dicotomy of task groups.

The sex ratios vary among the tasks. The smaller the decimal number, the more girls' performances were significant than boys' performances for that task. Tasks C and D show sex dominant performance favoring girls.

TABLE 9  
TOTAL INDIVIDUALS SCORING SIGNIFICANTLY ON TASKS

category	task *				
	A	B	C	D	E
Significant					
score totals	72	53	19	54	46
average age (years)	11.3	12.2	9.2	10.5	11.6
age range	5-15	7-15	3-15	3-15	4-15
male/female ratio	0.92	0.93	0.46	0.69	0.81
High group					
score totals	20	29	15	18	27
average age	13.4	13.2	9.9	10.8	12.4
age range	10-15	9-15	4-15	6-15	7-15
male/female ratio	1.10	0.76	0.67	0.60	0.80
Low group					
score totals	52	24	4	36	19
average age	10.5	11.0	6.5	10.3	10.4
age range	5-15	7-15	3-15	3-15	4-15
male/female ratio	0.86	1.18	0/4	0.73	0.82

\* See table 5 for indicator definitions.



### Statistical Procedures

All data manipulations beyond addition, averaging, and ratio determination are included in this section. Statistical techniques which proved useful here include the mean and standard deviation per task or subtask, correlations, and analysis of variance.

#### Mean and Standard Deviation

Age, sex, heritage, and attitude are considered in the figures and tables for the selected mean and standard deviation results.

The unbiased formula for standard deviation was used:

$$s = \sqrt{\frac{\sum (x - \bar{x})^2}{n - 1}}$$

where:

$s$  = standard deviation

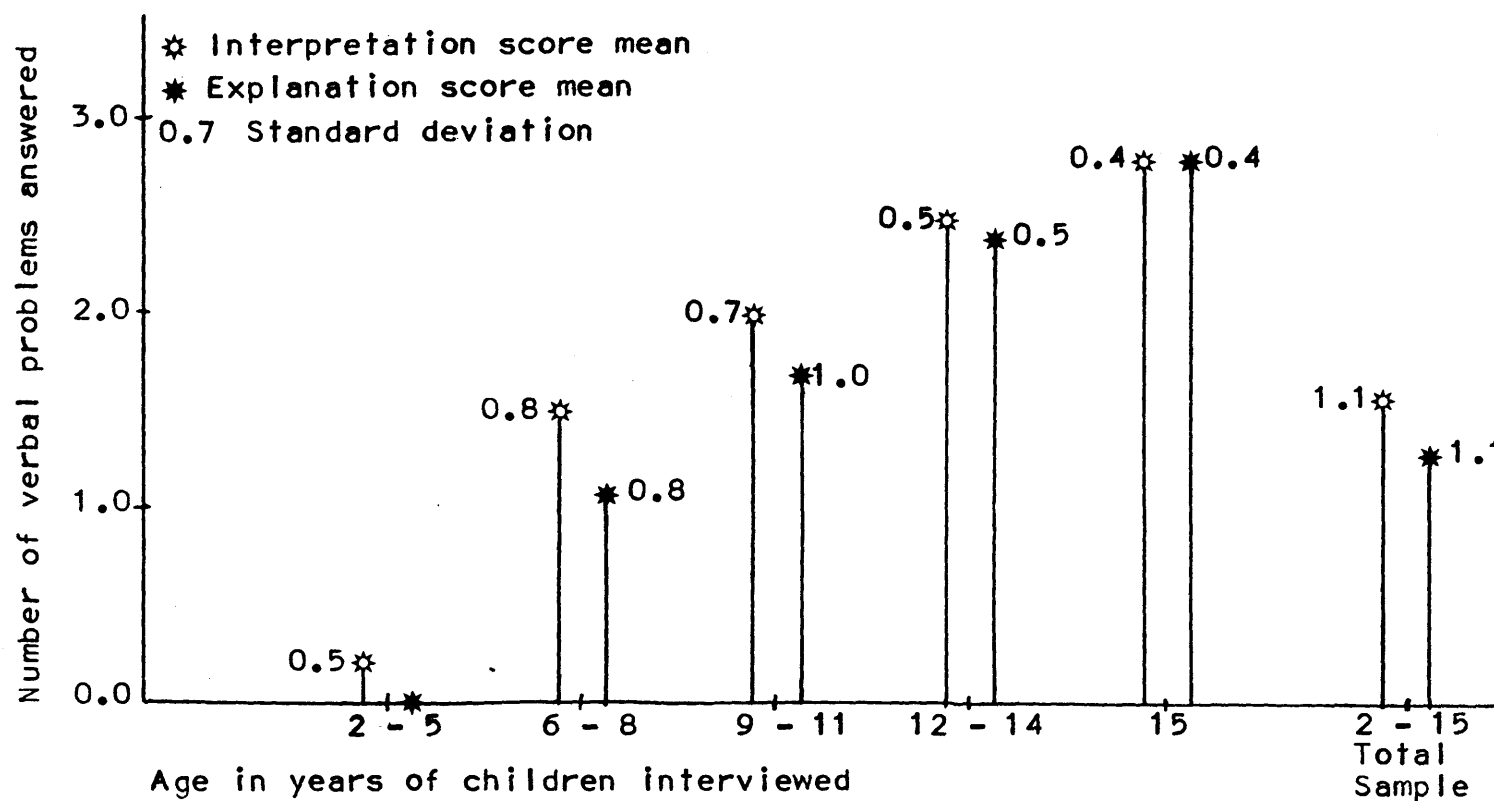
$x$  = score

$\bar{x}$  = mean

$n - 1$  = degrees of freedom.

Figure 13 - Interpretation and explanation of verbal analogy problem means and standard deviations are given for age groups and the total sample. The number beside the mean symbol is the standard deviation. Age groups and the included number of interviewees are: 2 - 5 (41 youngsters), 6 - 8 (32 youngsters), 9 - 11 (31 youngsters), 12 - 14 (30 youngsters), and 15 (10 youngsters). The total sample includes 144 youngsters.

Fig. 13. Interpretation and Explanation of Verbal Analogy Problem  
Score Means and Standard Deviations for Age Groups and Total Sample



Increasing scores and decreasing standard deviations indicate better and more uniform performance on these verbal problems with increasing age.

Figure 14 - Interpretation and explanation of figurative analogy problem means and standard deviations are given for age groups and the total sample. The gradual development of interpreting figurative analogy problems contrasts with rapid development of explaining or stating the reasoning leading to the solution to the problems. Performance deviation is great for figurative problems compared to that for verbal problems (figure 13).

Table 10 - Performance by sex and heritage is compared with total sample performance expressed as means and standard deviations for the major survey tasks. The number of children and their average age describe each sample.

Significant differences between the samples are: Girls use more analogies than boys. Girls recognize more analogies in context, but boys are more accurate as reflected in the score data. Chicanos recognize more analogies in context than Anglo-Saxons and they do it accurately.

Table 11 - The attitude dependence of analogy task performance was tested with the question, "Are analogies important in communication?" Major task score means and standard deviations are given for those

Fig. 14. Interpretation and Explanation of Figurative Analogy Problem  
Score Means and Standard Deviations for Age Groups and Total Sample

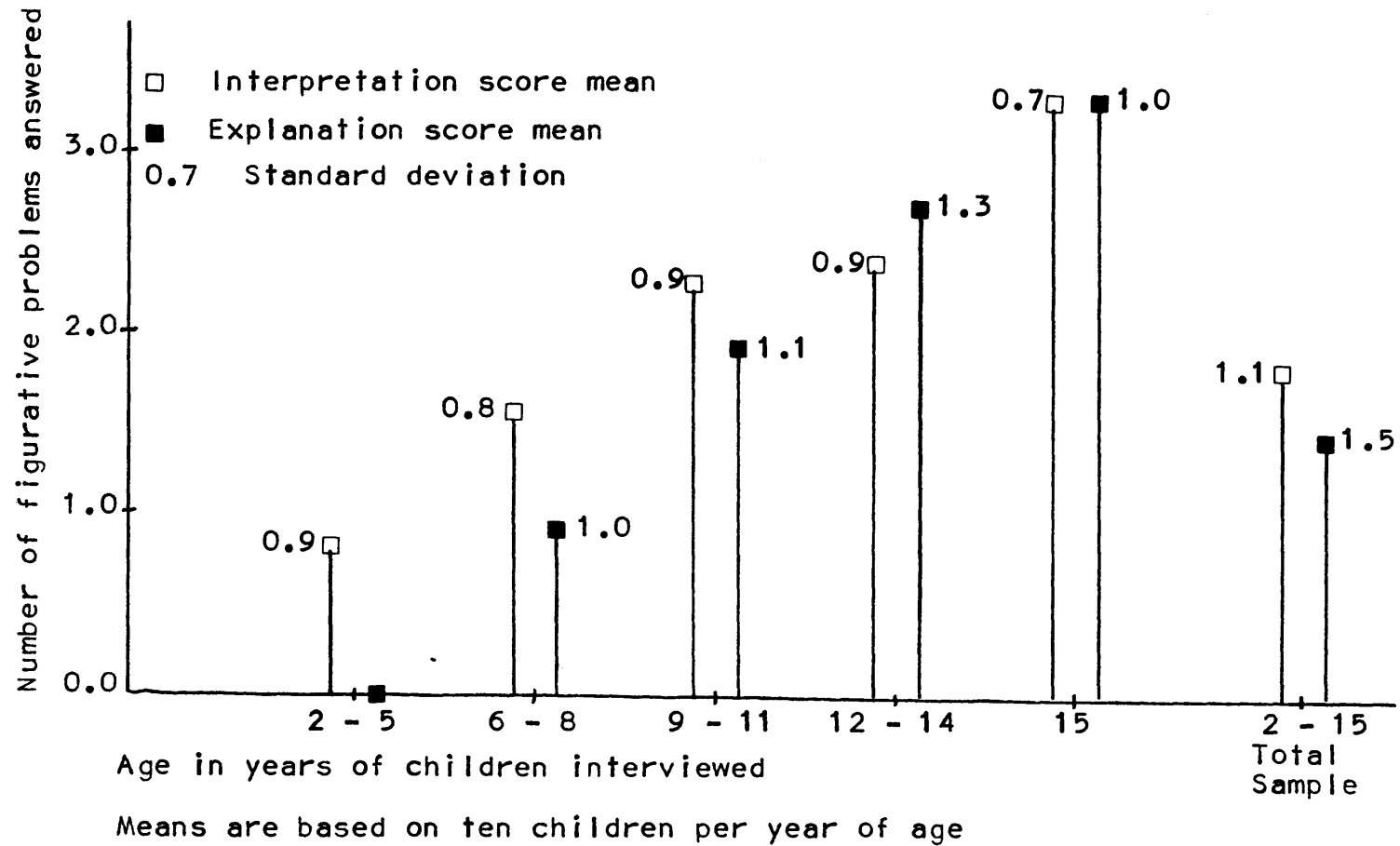


TABLE 10

## MEANS AND STANDARD DEVIATIONS

category	males	females	total sample	Chicano	Anglo-Saxon	variation between means
number	70	74	144	11	133	
average age	8.26	8.64	8.45	9.82	8.34	
TASK *						
A $\bar{X}^s$	3.4 <sup>2.1</sup>	3.3 <sup>2.0</sup>	3.3 <sup>2.0</sup>	3.2 <sup>1.9</sup>	3.4 <sup>2.1</sup>	0.2
Av	1.6 <sup>1.2</sup>	1.5 <sup>1.1</sup>	1.6 <sup>1.1</sup>	1.4 <sup>1.0</sup>	1.6 <sup>1.1</sup>	0.2
Af	1.8 <sup>1.2</sup>	1.8 <sup>1.1</sup>	1.8 <sup>1.2</sup>	1.8 <sup>1.1</sup>	1.8 <sup>1.1</sup>	0
B	2.7 <sup>2.4</sup>	2.8 <sup>2.4</sup>	2.8 <sup>2.4</sup>	2.6 <sup>1.9</sup>	2.8 <sup>2.4</sup>	0.2
Bv	1.3 <sup>1.2</sup>	1.4 <sup>1.1</sup>	1.3 <sup>1.1</sup>	1.2 <sup>0.9</sup>	1.4 <sup>1.2</sup>	0.2
Bf	1.4 <sup>1.5</sup>	1.4 <sup>1.4</sup>	1.4 <sup>1.5</sup>	1.5 <sup>1.2</sup>	1.4 <sup>1.5</sup>	0.1
D	2.8 <sup>2.5</sup>	3.6 <sup>2.8</sup>	3.2 <sup>2.7</sup>	3.1 <sup>2.6</sup>	3.2 <sup>2.7</sup>	0.8
E	3.1 <sup>3.0</sup>	3.8 <sup>3.3</sup>	3.5 <sup>3.1</sup>	5.5 <sup>3.8</sup>	3.3 <sup>3.0</sup>	2.4
score	2.2 <sup>2.7</sup>	2.3 <sup>2.3</sup>	2.3 <sup>2.4</sup>	3.6 <sup>3.6</sup>	2.1 <sup>2.4</sup>	1.5

$\bar{X}^s$  =        std. deviation  
 $\bar{X}$  = mean

v = verbal

f = figurative

\* See table 5 for indicator definitions.

TABLE 11

PERFORMANCE MEANS AND STANDARD DEVIATIONS  
FOR TASKS SCORED BY CHILDREN ANSWERING  
THE QUESTION, "ARE ANALOGIES IMPORTANT  
IN COMMUNICATION?"

answer	'yes'	'don't know'	'no'
number (no answer)	90	10	7
37 average age (yrs.)	10.0	11.4	7.9
TASK *			
A $\bar{X}$ s	4.1 <sup>1.6</sup>	3.9 <sup>1.0</sup>	3.1 <sup>2.1</sup>
Av	2.0 <sup>1.0</sup>	2.2 <sup>0.6</sup>	1.3 <sup>1.1</sup>
Af	2.2 <sup>1.0</sup>	1.7 <sup>0.9</sup>	1.9 <sup>1.2</sup>
B	3.6 <sup>2.2</sup>	3.3 <sup>2.2</sup>	2.1 <sup>2.7</sup>
Bv	1.8 <sup>1.0</sup>	1.6 <sup>1.0</sup>	1.0 <sup>1.2</sup>
Bf	1.8 <sup>1.4</sup>	1.7 <sup>1.6</sup>	1.1 <sup>1.7</sup>
D	3.8 <sup>2.9</sup>	1.6 <sup>1.7</sup>	4.6 <sup>3.0</sup>
E	4.3 <sup>2.9</sup>	3.4 <sup>1.7</sup>	3.4 <sup>3.3</sup>
score	2.7 <sup>2.4</sup>	2.3 <sup>1.7</sup>	2.4 <sup>3.0</sup>

$\bar{X}$  s = mean std. deviation

v = verbal      f = figurative

\* See table 5 for indicator definitions.

answering, "yes", "don't know", and "no". Thirty seven children either did not answer or were not asked the question. The one interesting datum concerns the high mean score for speaking and writing with analogies by the children stating that analogies are not important in communication.

### Correlation Coefficients

To determine whether ability in one task can forecast performance on another, correlation matrices can be utilized. If one individual scores well on two tasks, the correlation between those tasks will be higher for the inclusion of that pair of scores. Sections of extensive correlation matrices are included because they help define performance relationships between the survey tasks

Coefficients are reduced from four decimal places to one place for ease of interpretation. A perfect correlation, 1.0, occurs between one task and itself. For other comparisons, the greater the number, the more instances of individuals scoring high on the one task also scoring high on the other. A correlation near zero would indicate little or no predictability. The larger the negative number, the more frequently a high score on one task is attained by an individual who has a low score on the other.

All 144 interviewees are included in these calculations.

Table 12 - Correlation coefficients are given for the interpretation, explanation, use, and identification of analogies activities. The high correlation between interpreting and explaining analogy problems is partially explained by the fact that the explaining task could not be counted correct unless the interpretation was correct. Speaking and writing with analogies is the least related to other activities.

TABLE 12  
CORRELATION COEFFICIENTS FOR INTERPRETATION, EXPLANATION,  
USE, AND IDENTIFICATION OF ANALOGIES

		A	B	D	E
Interpretation	A	1.0	0.9	0.4	0.6
Explanation	B	0.9	1.0	0.4	0.6
Use of Analogies	D	0.4	0.4	1.0	0.4
Identification	E	0.6	0.6	0.4	1.0

Table 13 - An expanded correlation coefficient includes the verbal and figurative components of the interpretation and explanation tasks and the score for the identification of analogies task. The relatively low coefficient for interpreting figurative analogy problems for both verbal problem interpretation and explanation shows the discrepancy between verbal and figurative tasks.



TABLE 13

CORRELATION COEFFICIENTS FOR VERBAL AND FIGURATIVE  
COMPONENTS OF INTERPRETATION AND EXPLANATION TASKS  
WITH THE USE AND IDENTIFICATION TASKS

	Av	Af	Bv	Bf	D	E	score
Av	1.0	0.6	0.9	0.7	0.4	0.5	0.5
Af		1.0	0.6	0.7	0.4	0.5	0.5
Bv			1.0	0.7	0.4	0.5	0.6
Bf				1.0	0.4	0.5	0.5
D					1.0	0.4	0.4
E						1.0	0.8
score							1.0

Table 14 - Age, sex, heritage, and attitude concerning the importance of analogies in communication are correlated with the interpretation, explanation, use, and identification tasks including identification scores.

This table substantiates the mean and standard deviation and graphed averages findings that speaking and writing with analogies is the least age dependent activity (figures 4 and 10); that girls speak and write with more analogies than boys (table 10); that girls recognize more analogies in context, but lack accuracy (table 10); and that heritage as tested in this survey enhances the abilities in recognizing analogies in context when Chicano and Anglo-Saxon children are compared (table 10).

TABLE 14

CORRELATION COEFFICIENTS BETWEEN AGE, SEX, HERITAGE, AND  
ATTITUDE WITH INTERPRETATION, EXPLANATION,  
USE AND IDENTIFICATION OF ANALOGIES TASKS

task	age	sex	heritage	attitude*
A	0.8	0	0	0.2
B	0.9	0	0	0.2
D	0.5	0.2	0	0.1
E	0.6	0.1	0.2	0.1
score	0.6	0	0.2	0.2

\*Attitude is based on the answer to the question,  
"Are analogies important in communication?"

Table 15 - Individual analogy problems scores for both the interpretation and explanation tasks are correlated with the four major task scores including both components of the identification task.

This is mainly included to illustrate a fact for test and experts in educational material design, that not all questions of a kind have equal predictive natures. Af-5 is the figurative problem dealing with rotation. Verbal versus figurative analogy problem interpretation is shown here with verbal problems being more predictive than figurative problems for the abilities to state the reasoning leading to the solution to analogy problems and recognizing analogies in text.

TABLE 15

CORRELATION COEFFICIENTS BETWEEN INDIVIDUAL  
ANALOGY PROBLEM SCORES AND TASK SCORES

TASK *	A	B	D	E	score
problem					
Av 1	.5	.6	.2	.3	.4
2	.6	.5	.2	.3	.3
3	.7	.5	.1	.2	.2
Af 4	.6	.5	.3	.3	.3
5	.3	.1	.0	.1	.1
6	.6	.5	.2	.1	.3
7	.3	.3	.0	.1	.2
Bv 1	.5	.6	.2	.4	.4
2	.4	.5	.1	.1	.2
3	.6	.7	.1	.4	.4
Bf 4	.6	.8	.2	.4	.4
5	.5	.7	.3	.2	.3
6	.7	.8	.2	.2	.4
7	.5	.6	.1	.2	.2

\* See table 5 for indicator definitions.

v = verbal, f = figurative

## Analysis of Variance

Analysis of variance is a statistical procedure by which scores are analysed by variable and the degree of significance of that variable is determined.

In the included data, the item (activity or question) is one variable and age a second. A second section has the analysis of major tasks with sex and age as variables.

Results are reported by stating the level of significance of the F ratio. This ratio is found using

the formula:

$$F = \frac{sb^2}{sw^2} \quad \text{where}$$

$$sb^2 = \frac{\sum_{j=1}^k \sum_{i=1}^{n_j} (X_{ij} - \bar{X}_{ij})^2}{N - k} \quad \text{and}$$

$$sw^2 = \frac{\sum_{j=1}^k n_j (\bar{X}_j - \bar{X})^2}{k - 1}$$

s = sums of squares (w = within the variable)  
(b = between variables)

k = the number of events

N = k x the number of observations of the event (n)

X = score                       $\bar{X}$  = mean of the scores.

A table of critical values of F (Ferguson, 1971, pp. 452-5) giving the .01 and .05 levels of significant values was used to interpret the calculated F ratios. If the F ratio is less than the .01 level figure, the variable is of greater significance and can be said to affect the outcome of the results. If age is a significant factor in performance on an analogy activity, its level of significance will be .01 or less.

Table 16 - Levels of significance for parts of the survey were calculated for age and item significance. Scores are given as less than .01, between .01 and .05, and greater than .05. All 144 interviewees were used. Children were considered according to age using the totals for groups of ten or eleven of one age as one observation.

Applicable information from this table includes: Verbal analogy problems are age significant in both tasks, but figurative are age significant only in stating the reasoning leading to its solution. Speaking and writing with specific types of analogies was age significant.

Table 17 - Age groups (30 to 32 children) and sex (70 to 74) were variables for data on the five analogy tasks and significant components of the tasks. Data are presented as the calculated significance of F. Those variables with less than a .01 level of significance can be said to contribute to variance of scores.

TABLE 16

LEVELS OF SIGNIFICANCE FOR AGE AND ITEM WITHIN  
AND BETWEEN TASKS DETERMINED BY  
ANALYSIS OF VARIANCE

Variable tested	Task			
	Interpretation		Explanation	
	Av	Af	Bv	Bf
item age	.01-.05	> .01	>.01	>.01
	> .01	< .05	>.01	>.01
item age	Use of figurative illustrations str., fig., and err.      str. and fig. *			
	< .05		>.01	
	< .05		<.05	
item age	Use of analogies types      gram.		Identification types      gram.	
	> .01	<.05	>.01	> .01
	> .01	<.05	<.05	< .05
item age	Use and identification of analogies use and # correct      Use and score			
	<.05		<.05	
	>.01		>.01	

\* str. = illustration representing story event.

fig. = illustration analogically related to story event.

err. = illustration not related to story event.

TABLE 17

LEVELS OF SIGNIFICANCE FOR AGE GROUPS\* AND SEX  
ON TASKS AND SUBTASKS OF THE SURVEY  
USING ANALYSIS OF VARIANCE

Variable tested	Task					
	Interpretation			Explanation		
	A	Av	Af	B	Bv	Bf
age	.001	.001	.001	.001	.001	.001
sex	.231	.272	.999	.999	.999	.999
	Use of figurative illustration					
	straight		analogical		erroneous	
	.001		.236		.001	
age	.200		.037		.067	
sex						
	Use of analogies			Identification		
				# correct	score	
	.001			.001	.001	
age	.999			.999	.999	
sex						
	Use of analogies					
	Types of analogies used** Grammatical class					
	per.	dir.	sym.	fan.	simile	metaphor
age	.001	.002	.999	.131	.001	.302
sex	.999	.296	.209	.999	.164	.999

\* Age groups were 3-5, 6-8, 9-11, and 12-14 year olds. Two and 15 year olds were not included. Sex computations used the full set of 144 youngsters.

\*\* Types include: personal (pers.), direct (dir.), symbolic (sym.), and fantasy (fan.).

Three sections of the correlation matrix comparing the classifications of analogies used by each individual with the classifications of analogies identified are in Appendix D. Interpretation from these three sections are:

Table 21 - Types of analogies

1. Those who identified the personal analogy used personal analogies in their speaking and writing.

2. Those who identified direct analogies used more personal and symbolic type analogies than direct analogies in their expressions.

3. Those who identified symbolic analogies used more direct analogies.

4. Those identifying direct analogies used Emotive I analogies.

5. Those who identified direct analogies and those who identified symbolic analogies used more similes than metaphors.

Table 22 - Emotive level

6. Those identifying Emotive I analogies used more Emotive I figurative expressions and more direct and fantasy analogical expressions and more metaphors than those who identified symbolic (emotive) analogies.

Table 23 - Grammatical classification

7. Those identifying metaphors used more direct analogies, more symbolic (emotive) analogies, and more similes than did the simile identifiers.



### Tallied Information for Use and Identification of Analogies

To further define the performance patterns of these verbal activities, simple tallies were prepared for the male and female performance on the Use and Identification activities and activity performance by age and categories of analogies used by age for the Use of Analogies task.

Figure 20 - Male and female tallies by age for use and identification of analogies. For use, noteworthy analogies (appendix D) were tallied by age and sex. For identification, significant scores (table 6) were used.

Superior male performance is evident during the preschool years, superior female performance during the elementary years, and able performance by both sexes is evident during adolescence.

Table 24 - The number of analogies used per activity is arranged by age. This table indicates the effectiveness of the use activities to elicit analogy use. Percentages given show the picture and action description activities to best serve this end. Eighty two per cent of the children used analogies at a rate of 3.93 per thirty minute interview for ages two through fifteen years.

Table 25 - Specific classifications of analogies used by interviewees arranged by age. Note here metaphor and simile use patterns and the fluctuating diversity of the types of analogies categories, and percentages by type.

### Findings Related to the Hypotheses

After reviewing all the data reported in "Analytical Techniques", pertinent facts were arranged by hypothesis and are reported herein. Criteria stated form the basis for acceptance or rejection of each hypothesis.

Hypothesis 1: There is no significant relationship between the age of the child and his performance on individual analogy tasks.

Each individual task is considered, and the hypothesis is tested in the light of results for each task.

Sub-hypothesis 1a: There is no significant relationship between the age of the child and his performance on the Interpretation of Analogy Problems task.

Older interviewees answered analogy problems correctly more frequently than younger ones. An eleven year old was the youngest to answer all seven problems correctly (figure 1). Age correlates with this task at 0.8 (table 14) and is significant at the .001 level using analysis of variance (table 17).

For interpretation of analogy problems, sub-hypothesis 1a is rejected. Age is a significant factor for performance in interpreting analogy problems.

Sub-hypothesis 1b: There is no significant relationship between the age of the child and his performance on the Explanation of Analogy Problems task.

The average score for analogy problems increases with age with a peak of performance at 12 year. The first perfect score was made by an 11 year old (figure 2). The first real performance on this task occurred at 7 - 8 years (figure 8). Age correlates highest with this task at 0.9 (table 14) and is significant at the .001 level using analysis of variance (table 17).

For the explanation task, the sub-hypothesis 1b is rejected. Age is a significant factor in explaining how one figures out the answer to analogy problems.

Sub-hypothesis 1c: There is no significant relationship between the age of the child and his performance on the Use of Figurative Illustration task.

The frequency of choosing analogical illustrations for the one excerpt from literature did not increase with age. Between three and nine years, most were chosen (figure 3).

Using analysis of variance, choice of analogical illustration was not significant. With erroneous scores decreasing with age, some 11, 13, and 15 year olds scored significantly (figure 3 and table 9).

For use of figurative illustrations, the sub-hypothesis 1c is accepted. Age has no significant effect on the child's choice of figurative illustrations.

Sub-hypothesis 1d: There is no significant relationship between the age of the child and his performance on the Use of Analogies task.

The use of analogies does not increase with age. Charting performance by year age of the interviewees, use of analogies peaks at 6, 9, 11 - 13 and 15 years. The greatest use per individual is at 6, 12, 13, and 15 years (figure 4).

Comparing this task with age gives a correlation coefficient of 0.5, the lowest for the set of tasks. Using analysis of variance age by year gives an F value of less than .01 for the types of analogies, but greater than .05 for grammatical classifications (table 16).

The sub-hypothesis 1d is accepted. For use of analogies, age is not significant.

Sub-hypothesis 1e: There is no significant relationship between the age of the child and his performance on the Identification of Analogies task.

Identification of correct analogies increases somewhat with age, although scores accounting for incorrect guesses appear more age dependent (figure 5). A seven year

old found most analogies, 13 or the 17 (table 5). Highest age group scores were for 12 - 14 and outstanding age scores were for 4 and 13 - 15 year olds (table 5).

For identification of analogies, sub-hypothesis 1e is rejected. Age is a significant factor in predicting abilities of accurately identifying analogies.

Hypothesis 2: There is no significant relationship between the sex of the child and his performance on individual analogy tasks.

Each individual task is considered, and the hypothesis is tested in the light of results for each task.

Sub-hypothesis 2a: There is no significant relationship between the sex of the child and his performance on the Interpretation of Analogy Problems task.

Male and female performance was comparable for interpretation of analogy problems (table 10). The second highest male/female ratio was for high level significant performance on this task (table 9). The correlation coefficient for this task and sex was 0 (table 14).

For interpretation of analogy problems, sub-hypothesis 2a is accepted. Sex is not a significant factor for performance in interpreting analogy problems.

Sub-hypothesis 2b: There is no significant relationship between the sex of the child and his performance on the Explanation of Analogy Problems task.

Comparable performance by boys and girls was exhibited in the explanation task (table 10). The highest male/female ratio in the study was for the low level of significant performance for this task (table 9). The correlation coefficient with sex is 0 (table 14).

For the explanation of analogy problems task, sub-hypothesis 2b is accepted. Sex is not a significant factor in performance on this task.

Sub-hypothesis 2c: There is no significant relationship between the sex of the child and his performance on the Use of Figurative Illustration task.

Use of figurative illustration has a .037 level of significance using analysis of variance calculations for sex and this task. That is the highest level of any task or subtask in the survey (table 17). The male/female ratio for significant performance on this task is 0.46 with high performance at 0.67 and low at 0 (table 9).

For the use of figurative illustration task, sex is a significant factor. Therefore sub-hypothesis 2c is rejected.

Sub-hypothesis 2d: There is no significant relationship between the sex of the child and his performance on the Use of Analogies task.

Use of analogies has a male/female ratio of 28/36 (table 10) and a high level of significant performance of .69 (table 9). The correlation coefficient for sex and this task is 0.2, the highest in the study (table 14).

With tallied noteworthy analogies created by interviewees for this task, males dominated between ages four and eight, and females dominated after that (figure 20).

For the use of analogies task, sub-hypothesis 2d is rejected. Sex is a significant factor in performance on this task.

Sub-hypothesis 2e: There is no significant relationship between the sex of the child and his performance on the Identification of Analogies task.

For the identification of analogies task, females identified more analogies as indicated by the male/female ratio, 31/38. However, males are more accurate. See the score ratio, 22/23 (table 9). Correlation coefficients show this with a 0.1 coefficient for analogies identified and a 0 coefficient for the score (table 14).

For significant scores females dominate between the ages of 8 and 11, but the sexes equate between 12 and 15 years (figure 20).

For the identification of analogies task, sub-hypothesis 2e is accepted. Sex is not a significant factor in the performance of this task.

Hypothesis 3: There is no significant relationship between performance on verbal and figurative activities.

Both analogy problem performance and use provide comparison for verbal and figurative abilities of the child.

Sub-hypothesis 3a: There is no significant relationship between performance on verbal and figurative analogy problems.

The onset of solving analogy problems began at three years with figurative problems. Verbal problems interpretation began at five (figure 1). Explaining the reasoning leading to the solution began with the verbal problems at five years and with figurative success beginning at seven years (figure 2).

While adolescent interpretation and explanation scores were equal for verbal problems, the explanation task performance surpassed the interpretive for figurative



problems (figures 6, 7). For adolescents the reason led to the solution.

Correlation coefficients among these subtasks were 0.9 for interpretive verbal with explanation verbal; 0.6 for interpretive figurative with both interpretive and explanation verbal; and 0.7 for all remaining combinations (table 13). This would indicate interference of the verbal component with figurative thinking.

Performance by year data for age significance was determined using analysis of variance indicating interpretation of verbal analogy problems significant at less than .01 and figurative greater than .05. The explanation task for both modes were significant at less than .01 (table 16).

On both tasks the standard deviation of verbal problems were noticeably smaller than the figurative (figures 13, 14) indicating a greater diversity of performance by interviewees in figurative problems. Correlation coefficients between individual problems and major tasks show higher correlations with the identification task and these activities except for the interpretive figurative problems (table 15).

For the interpretation and explanation of analogy problems tasks, sub-hypothesis 3a is accepted. Whether

the problem is verbal or figurative does not affect performance on the task.

Sub-hypothesis 3b: There is no significant relationship between performance on use tasks with figurative responses and those with verbal responses.

Comparing use of figurative illustration results with use of analogies as figurative vs. verbal, the by year performance curves run parallel (figure 9) though significant scores data show only six interviewees performed significantly on the pair of tasks (table 8).

Significant performance data per task (table 9) indicates that the use of analogies task has a greater number of low level performances than high, whereas the use of figurative illustration has more high level than low. Use of analogies performance is on a normal curve as language development would exhibit. Use of figurative illustration performance is on a skewed curve as a concept based task would have.

Sub-hypothesis 3b is accepted. If a child performs well using one mode, he does not necessarily perform well using the other.

Hypothesis 4: There is no significant relationship between performance on different analogy tasks.

Of the 144 youngsters interviewed, only three performed significantly on all five tasks and 19 on four of the five tasks. Fifty two performed significantly on two or three tasks (table 7).

The following differences in performance between tasks are:

Interpretation and Explanation of Analogy Problems - up to 11 years old interpretive scores are higher than explanation scores. Between 12 and 14, verbal scores are equal and figurative has explanation scores greater than interpretive. Both are equal at 15 years (figures 6, 7). Considering significant scores, the interpretation task has more low than high. The explanation task has more high than low scores (table 9). The explanation task is concept based, the interpretive not. The youngest child performing significantly in the high level is 10 years old for interpretive and 9 for explanation; however, the low level is 5 and 7 years respectively (table 9).

Use of Figurative Illustration - this task has only ten interviewees with significant scores paired with any other task. Six of these combine with use of analogies (table 8). There was but one year difference between the

youngest interviewee scoring in the low level and high level of significant performance with low being a three year old (table 9). Age is not a significant factor and the task is performed better by females.

Use and Identification of Analogies - these tasks have opposite fluctuations in their mutual graph by year with initial use of analogies reported at four years and identification at six years. Peak years for use are 6, 9, 11, and 13 years; for identification are 8 - 12, and 13 - 15 years (figure 10).

Average age for levels of significant performance are 10.8 high and 10.3 low for use, and 12.4 high and 10.6 low for identification (table 9).

Among the tasks, interpretation, explanation, use and identification of analogies, there are many significant score pairings (table 8), but the graph of their combined performance patterns by year indicates little in common between these tasks (figure 12).

Hypothesis 4, concerning the relatedness of the tasks one to another, is accepted. Performance on one task does not foretell success on others.

Hypothesis 5: There is no significant relationship between identification and use of analogies in speech and writing.

The categories of classification of analogies which will be tested by this hypothesis include the types of analogies and grammatical classes.

Sub-hypothesis 5a: There is no significant relationship between identification and use of analogies in speech and writing concerning the types of analogies involved.

Using analysis of variance, it was determined that use of types of analogies is age significant at less than .01 and identification at greater than .05 (table 16).

Correlation coefficients for the data show personal analogy identifiers used personal analogies, but direct analogy identifiers used more personal and symbolic type analogies, and symbolic identifiers used more direct analogies (table 22).

Sub-hypothesis 5a is accepted. The types of analogies used by the child does not match that of the analogies he identifies.

Sub-hypothesis 5b: There is no significant relationship between identification and use of analogies in speech and writing concerning the grammatical classes of the analogies.

Grammatical classification data show those identifying metaphors used more similes than did simile identifiers (table 23).

Metaphor use leads simile use for two through five year olds. Similes were more frequently used after that (figure 5). Simile identification surpassed metaphor for all ages (figure 6).

Eight year olds identified most metaphors. Children ages two through six and thirteen used most metaphors. The highest metaphor/simile ratio for identification is at eleven years of age at which time the ratio for use is low (figure 11).

Sub-hypothesis 5b, concerning use and identification of analogies based on grammatical classification, is accepted. The grammatical classes of analogies used by the child does not match that of analogies identified.

#### Summary

Data from this survey of analogy use and interpretation have provided findings which divide analogy encounters into tasks with varying performance patterns by age, sex, verbal and figurative abilities, and specific classifications of analogies.

The wide variety of data included in "Research Findings" clearly defines performance on the survey instrument by the 144 two through fifteen year olds

interviewed. The five hypotheses and related sub-hypotheses are either accepted or rejected as shown in table 18.

TABLE 18  
STATUS OF HYPOTHESES

Hypotheses	1	2	3	4	5
Tasks There is no significant relationship between:	the age of the child and his performance on individual analogy tasks.	the sex of the child and his performance on individual analogy tasks.	performance on verbal and figurative activities.	performance on different analogy tasks.	identification and use of analogies in speech and writing.
Interpretation	reject	accept	accept	accept	Types of Analogies
Explanation	reject	accept			Grammatical Classification
Use of Figurative Illustration	accept	reject			
Use of Analogies	accept	reject	accept		
Identification of Analogies	reject	accept	-		accept

## CHAPTER 5

### SUMMARY, CONCLUSIONS AND RECOMMENDATIONS FOR FURTHER RESEARCH

This survey identified children's analogical abilities as they were inherent in the seven activities included in the interview instrument. It determined how these abilities relate one to another and described how each varies with age and sex of the child within the limitations ascribed for the study.

This chapter summarizes the methods and results and presents the warranted conclusions and recommendations for further research.

#### Summary of the Study

A summary of methods describes the instrument, the survey interviews, transcriptions, instrument reliability, and data analysis. Following are results by hypothesis.

#### Methods

A means to determine the basal use of analogies by children ranging from initial language expression through adolescence was sought.



### Preparation of the Instrument

The instrument was designed by selecting a representative task from as many of the methods as possible and still have an interview within the limits of a child's attention for a one session encounter.

The final instrument included these tasks which were presented in the following order:

Interpretation - seven four part analogy problems as, "Pants are to legs as a shirt is to \_\_\_\_.", were composed. Three problems were verbal with one substitute question having the same concept but easier terms. Four problems were figurative using geometric line figures with some areas filled in. Each problem was presented on a separate strip. (R. L. Thorndike, Hagen, and Lorge, 1964, 68, and 81)

Use of Figurative Illustration - a paragraph from a children's book provided a concept. The child was to pick as many of six pictures as he felt went with the story. One photo pictured the story event, two paralleled the concept (analogical responses), and three pictured unrelated events. (Pearson and Maddi, 1966)

Use of Analogies - activities were developed that would elicit a child's spontaneous answers, responses, and creative writing. These were analysed for use of

of figurative language. (Pollio, H. R., 1973, and Pollio, M. 1973) The eight activities include:

"How do you feel today?", with no priming activity informing the child that figurative language is acceptable, or priming his thought for that type response. No figurative expressions occurred.

"Describe your sleep.", was introduced by a poem filled with analogies relating to sleep. The child's own experience and impressions were sought.

A science experiment was run, successfully about 90% on the first attempt. The child was to describe what happened and why.

The child was shown a model poem and Cinquain and asked to compose something using one of the formats. He wrote it himself or dictated it.

A work of art was provided. The child was asked to describe it. "Another World" by M. C. Escher (1947) was as titled and yielded almost half of the figurative expressions.

Three questions, "What is it like to swing?, ride a bike?, and fly?", allowed the child to express his feelings and action experiences.

Identification - a children's magazine article with 17 analogies in one column of print was discovered. It was presented and the child picked out the analogies by reading them aloud or stopping the interviewer when they were found as the article was read to him.

Explanation - the interpretation task analogy problems were reviewed. The child was asked to explain why he chose the answers he gave. Only two children did not recall their original answers given 15 to 25 minutes previously.

The above combination of tasks retained the attention and active participation of most four and five year olds and all older subjects. The younger ones were given bits and pieces as the researcher felt they could participate.

### The Survey Interview

The techniques of administration and choice of subjects are discussed here.

To get fullest participation by each subject, a tape recorded interview was chosen. In this way the interviewer and instrument were guaranteed full attention of the child. The child was unaware that he was evaluated on the tasks.

A random selection of subjects was achieved by having the local school administration assign two schools for each age group in which interviews could take place. From these school populations, youngsters were chosen if they had their birthdays during the month of the interview.

This birthday-based selection not only provided randomness, it defined clearly the age of the child by year. The age of each subject is the exact year  $\pm$  30 days.

### Transcriptions

When the interviews were complete, the tapes were transcribed onto data forms (figure 18) with the Use of Analogies section taken verbatim. The use forms (figure 19) were completed on review of these transcriptions.

### Instrument Reliability

An interrater reliability check gave an 85% level of scoring accuracy for the entire instrument. Statistical reliability on activities interpreting and explaining both verbal and figurative analogy problems was 0.894 as determined using the Kuder Richardson (formula 20) procedure.

### Data Analysis

Interview responses were defined numerically and using the resultant data, variations by age and sex within individual tasks and performance between tasks were analysed. The small second samples for heritage and attitude categories were reviewed for ideas for further research.

Analysis techniques employed include averages and score ranges by age (10-11 children), grouping of significant performances, means and standard deviations by age groups (30-32 youngsters), correlation, and analysis of variance.

## Results

Hypotheses and sub-hypotheses were accepted or rejected based on findings described by data analysis. Results are summarized by hypothesis.

Hypothesis 1: There is no significant relationship between the age of the child and his performance on individual analogy tasks.

Sub-hypotheses which applied to each individual task were analysed. The sub-hypotheses for use of figurative illustration and use of analogies were accepted. Age is not significant in performance of these tasks.

Sub-hypotheses for interpretation and explanation of analogy problems and identification of analogies were rejected. Performance on these tasks are age dependent. The identification task is age dependent in that accuracy in choosing analogies increases with age.

Hypothesis 2: There is no significant relationship between the sex of the child and his performance on individual analogy tasks.

Sub-hypotheses which applied to each individual task were analysed. The sub-hypotheses for interpretation and explanation of analogy problems and identification of

analogies were accepted. Sex is not significant in performance of these tasks. For the identification task, females picked more analogies but also made more errors so this phenomenon was not considered sex related performance on the task itself.

Sub-hypotheses for use of figurative illustration and use of analogies were rejected. Both were performed quantitatively better by females.

Hypothesis 3: There is no significant relationship between performance on verbal and figurative activities.

Sub-hypotheses based on activities yielded two evaluations, one for dealing with analogy problems, the interpretation and explanation tasks, and the other use, with use of figurative illustration and use of analogies. Both sub-hypotheses were accepted.

Performance on verbal and figurative analogy problems differed in age of able performance and interpretation/explanation ratios.

Use differed because youngsters who performed well figuratively were not frequently those who used analogies in their verbal expressions.

Hypothesis 4: There is no significant relationship between performance on different analogy tasks.

This hypothesis was accepted. Divergent performance patterns were exhibited for all tasks. Interpretation of analogy problems and use of analogies had normal curve performance profiles indicating a language development type pattern. Explanation of analogy problems, use of figurative illustration, and identification of analogies had skewed curves as would represent concept based performance.

Hypothesis 5: There is no significant relationship between identification and use of analogies in speech and writing.

Sub-hypotheses for types of analogies and grammatical classifications were both accepted. Expressive and receptive use of language differ in that individuals who identify notably direct and symbolic analogies more often use other types of analogies in their expression. Similarly, those identifying metaphors or similes do not consistently use that construction in their analogical expressions.

### Conclusions

The state of the hypotheses, the outstanding data presented in the figures and tables, and the results reported in Appendix D on the use and identification of analogies activities form the basis for the conclusions for this study. With respect to the limitations inherent in this study, the following conclusions are warranted:

1. Many abilities comprise children's analogical thought. Their analogical abilities include at least:

- a. interpreting verbal analogy problems.
- b. interpreting figurative analogy problems.
- c. stating the reasoning leading to the solution of verbal analogy problems.
- d. stating the reasoning leading to the solution of figurative analogy problems.
- e. selecting pictures of analogous events for a story concept.
- f. speaking and writing with analogies.
- g. recognizing analogies in context while listening or reading.

2. Children gradually develop the abilities of interpreting both verbal and figurative analogy problems and speaking and writing using analogies.

3. Children develop the following abilities immediately upon concept awareness: stating the



reasoning leading to the solution of both verbal and figurative analogy problems, selecting pictures of analogous events for a story concept, and recognizing analogies in context while listening or reading.

4. Children as early as four years old exhibit analogical abilities of interpreting figurative analogy problems, selecting pictures of analogous events for a story concept, and speaking with analogies.

5. By the intermediate grades, children exhibit all analogical abilities identified in this study.

6. Children's abilities to write or speak with analogies differs from their abilities to recognize analogies as they listen or read.

a. Metaphors were the only analogical type which two and three year old children used in speaking, and were the dominant analogical type which four and five year olds used in speaking. Beginning at six and through adolescence, the simile was the dominant analogical form children used in speaking and writing.

b. Similes were the only type of analogies recognized in auditory context through age five. At age six children did recognize metaphors, but similes were the dominant form they recognized through adolescence.

7. Children speak and write with analogies freely when analogy use is acceptable and encouraged.

8. Interpreting figurative analogy problems and selecting pictures of analogous events for a story concept exhibit greater divergence in abilities and less age dependence than verbal activities.

9. Pre-adolescent children exhibit greater abilities in interpreting verbal analogy problems than in stating the reasoning leading to their solution. Both abilities are evident at six years old.

10. Pre-adolescent children exhibit greater abilities in interpreting figurative analogy problems than in stating the reasoning leading to their solution. Abilities in interpreting the problems were evident at four years old, but the stating the reasoning for the solution were not evident until eight years old.

11. Adolescent children exhibit equal abilities in interpreting and stating the reasoning leading to the solution of verbal analogy problems.

12. Adolescent children exhibit greater abilities in stating the reasoning leading to the solution to figurative analogy problems than in interpreting them.

13. Neither selecting pictures of analogous events to a story concept and speaking and writing using analogies are age dependent.

14. Girls exhibit greater abilities than boys in selecting pictures of analogous events for a story concept.

15. The abilities of both sexes vary with age in speaking and writing with analogies. Preschool boys speak with analogies more than girls. Girls speak and write with analogies more than boys during elementary years. Both sexes use analogies equally during adolescence.

#### Recommendations for Further Research

This study began to define children's analogical abilities. How these findings relate to Jean Piaget's theories of operational thought (1969), L. S. Vygotsky's stages of thought and language development (1962), and J. P. Guilford's Model of the Intellect (Meeker, 1969) needs to be determined. What changes in children's analogical abilities occur with W. J. J. Gordon's Synectics Educational System (1966) will either support or refute Aristotle's (384-22 BC) statement that metaphor "is one thing that cannot be learnt from others." (p. 674)

To know what ability levels are exhibited by children demonstrating variations in cerebral dominance and how patterns of brain waves change as the child participates in the survey activities would help further define these observed analogical phenomena.

Replication of this study would provide data of statistical significance for children of each age. Where

differences occur in the development of analogical abilities can be better analysed.

Returning to the reviews of Dawes and Siojo (1972) and Emig (1972), the first attempt at a timetable for analogical abilities is presented in table 19. Careful review of their stated research needs will indicate areas this study has spoken to. Inventorying other current analogy and metaphor research, a review update is needed to describe and evaluate the current state of research in the field.

Application of analogy research in reading is essential. Recognition of analogies is but a beginning. Comprehending and discerning the depth of meaning in both reading and listening situations is needing definition by age and with regard to other factors as heritage and experience base of the child with the topic discussed.

Last, the early interpretation of figurative analogy problems raises the question of whether this ability is based in motor sensory development in the child rather than operational thought development when considering Piagetian theory. Were this true, then the stating the reasoning leading to the solution would require two levels of abstraction and require formal operational thinking which would explain the timing factors observed.



## APPENDIX A

### THE INSTRUMENT

## APPENDIX A

## THE INSTRUMENT

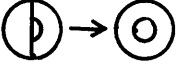
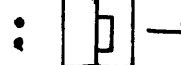






























## Introduction

"Hi, I am Denny McNutt. Have a seat. Your birthday is this month. When exactly?" "How old are you?"

## Instrument

"Here are some statements. Can you complete them?"

1. Pants are to legs as a shirt is to \_\_\_\_\_.
2. A cow is to a calf as a bear is to a \_\_\_\_\_.
- (Substitute statement) A dog is to a puppy as a cat is to a \_\_\_\_\_.
3. A shovel is to snow as a spoon is to \_\_\_\_\_.

4.  →  :  → a.  b.  c.  d.  e. 
5.  →  :  → a.  b.  c.  d.  e. 
6.  →  :  → a.  b.  c.  d.  e. 
7.  →  :  → a.  b.  c.  d.  e. 

In Winnie The Pooh (A. A. Milne, 1926, p. 48) we have this passage:

It was a fine spring morning in the forest as he started out. Little soft clouds played happily in a blue sky skipping from time to time in front of the sun as if they had come to put it out, and then sliding away suddenly so that the next might have its turn.

8. "What pictures do you feel fit the passage?"

Figure 15 is the picture selection.

From Winnie-the-Pooh by A. A. Milne, illustrated by Ernest H. Shepard. Copyright, 1926, by E. P. Dutton + Co.; renewal (c) 1954 by A. A. Milne. Reprinted by permission of the publishers, E. P. Dutton. (Illustration and paragraph, p. 48)

9. "How do you feel?"

"Robert Louis Stevenson (1957, p. 57) wrote this

poem:

(Rights are in the public domain.)

My Bed Is a Boat

My bed is like a little boat;  
Moms helps me in when I embark;  
She girds me in my sailor's coat  
And starts me in the dark.

At night, I go on board and say  
Good night to all my friends on shore;  
I shut my eyes and sail away  
And see and hear no more.

And sometimes things to bed I take  
As prudent sailors have to do;  
Perhaps a slice of wedding cake,  
Perhaps a toy or two.

All night across the dark we steer;  
But when the day returns at last,  
Safe in my room, beside the pier,  
I find my vessel fast."

10. "Do you ever feel like this poem describes?"
11. "How would you describe your sleep?"



**Fig. 15. Photos for the Use of Figurative  
Illustration Task**



**Small cumulus clouds**



**Overcast sky**

Fig. 15. Continued



Children taking turns drinking from a hose



Children swinging



Fig. 15. Continued

Pooh in front of the mirror  
(A. A. Milne, 1926)



Children taking turns using a slide

A science experiment will be performed using a birthday candle, a match, a plastic base, a gas bottle with tube and clamp on the narrow outlet.

The candle is placed on the plastic base, lit, and the gas bottle with the clamp closing the tubing is placed over it. The candle will go out. Wait a moment and lift the gas bottle. Note the base stays with the bottle. Release the clamp and listen for any sound. Lift the gas bottle again. It is free of the plastic base.

12. "Please describe what happened in the experiment."

"I have here two special forms of writing, a poem and a Cinquain (Torrance, 1971, p. 38)."

#### A Poem

With a bike  
One can hike  
Further and faster  
And be leader and master  
    With no flat tire  
    It's my desire.

#### A Cinquain

Bike  
Two wheels  
Goes really fast  
Blows wind through hair  
Bicycle, vehicle of my heart.

13. "Which would you like to compose?" The child writes or researcher records the child's creation as he dictates it.

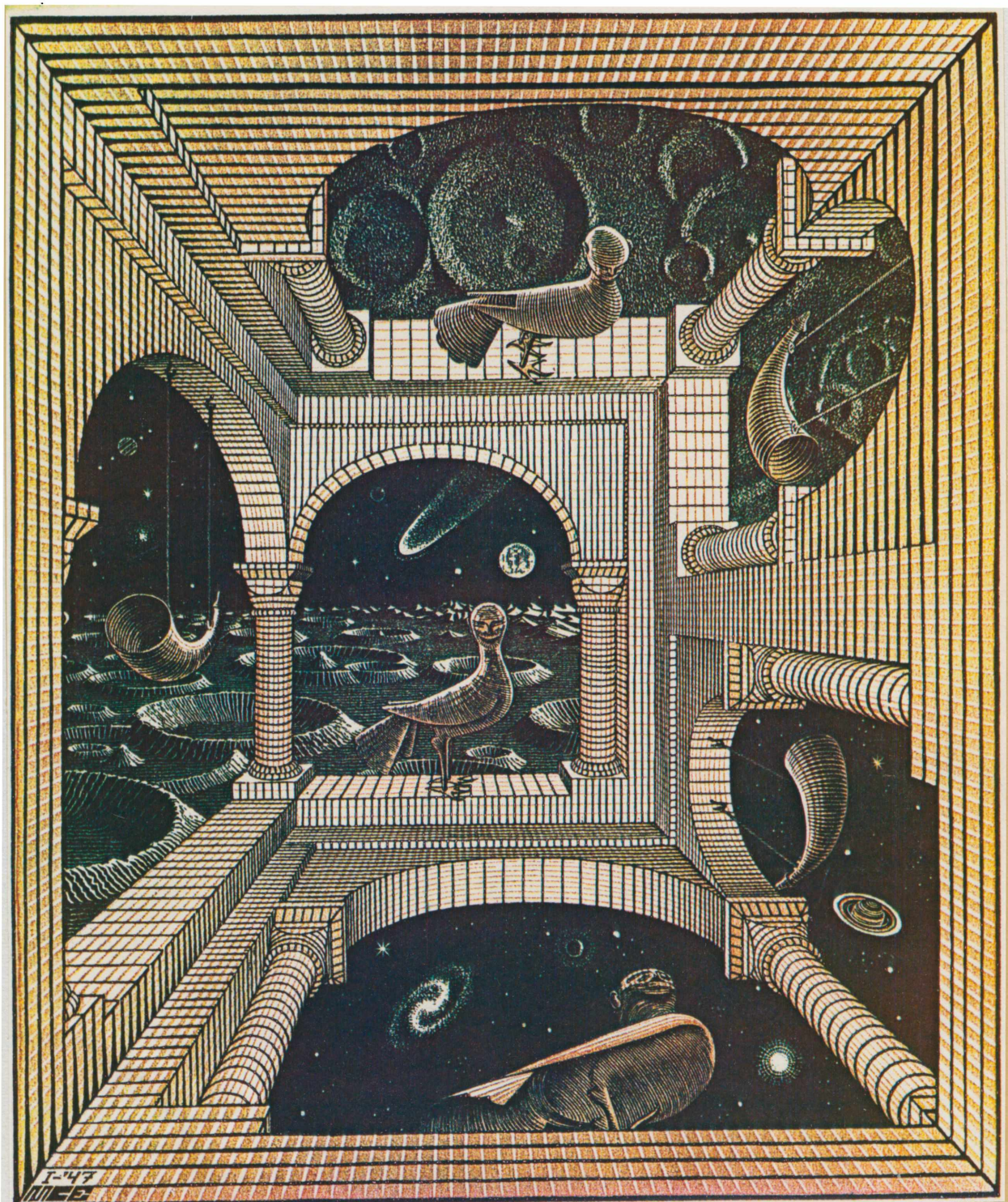
Researcher shows the child "Another World", a woodcut by Maurits C. Escher (1947).

14. "Please describe this picture."



Fig. 16. "Describe this picture."  
Use of Analogies Task

M. C. Escher, 1947. "Another World"  
Collection Haags Gemeentemuseum - The Hague



15. "What is it like to swing?"
16. "What is it like to ride a bike?" (tricycle?)
17. "What is it like to fly?"

"We have been working with analogies in this interview. You created some (give examples, or) you have seen some in the poem "My Bed is a Boat". Here is an answer to a question asked by an 11 year old printed in the Ranger Rick Nature Magazine (December, 1975, p. 12-3).

18. "Can you find the analogies in this passage?"

The child either reads the analogies aloud or stops the researcher's reading when he hears one.

Analogies are underlined to serve as an answer key.

#### WHO-O-O KNOWS?

(Article  
reprint in  
Figure 17)

Bigger than a school bus!

Dear Wise Old Owl,

Do you think scientists will discover more dinosaur bones or fossils? Lindsay Price, Age 11, Albuquerque, New Mexico.

Yes indeed! Some amazing fossils are recently dug up in Texas. They were wing bones from a giant flying reptile with wings longer than those on a jet fighter plane!

These Texas Giants are the biggest flying creatures ever discovered. Scientists call them PTEROSAURS (TER-ah-sores), which means "winged lizards". They lived on earth 70 million years ago, about the same time as the dinosaurs. Like airplane-sized bats, Texas Giants soared through the skies on leathery wings. Were they hunting for food on the ground below? Some scientists think these pterosaurs ate carrion (dead animals) as vultures do today.



When they spotted a dead dinosaur, they would swoop down for a prehistoric feast. Their long, strong necks and storklike jaws were good tools for picking into a dead dinosaur's body!

But here's the big mystery . . . Did Texas Giants flap or glide? Some scientists think those huge wings were just too big and heavy to be flapped up and down. But then how did Texas Giants get into the air? Did they crawl to a high mountain ledge and leap into the air to soar like gliders?

Wise Old Owl loves a mystery! I wonder what color they were. . . cardinal red? bluebird blue? goldfinch yellow? I wonder. . . did they fold their wings like accordions as they walked on their tiny legs? Did they use their claws to cling to ledges while they slept?

Yes, scientists are still finding fossils of dinosaurs and other prehistoric creatures. Millions and millions of fossils are hidden in the earth - just waiting to be discovered.

And who knows when someone (perhaps even you!) will find fossil bones from another amazing, mysterious creature like the Texas Giant?

#### Wise Old Owl

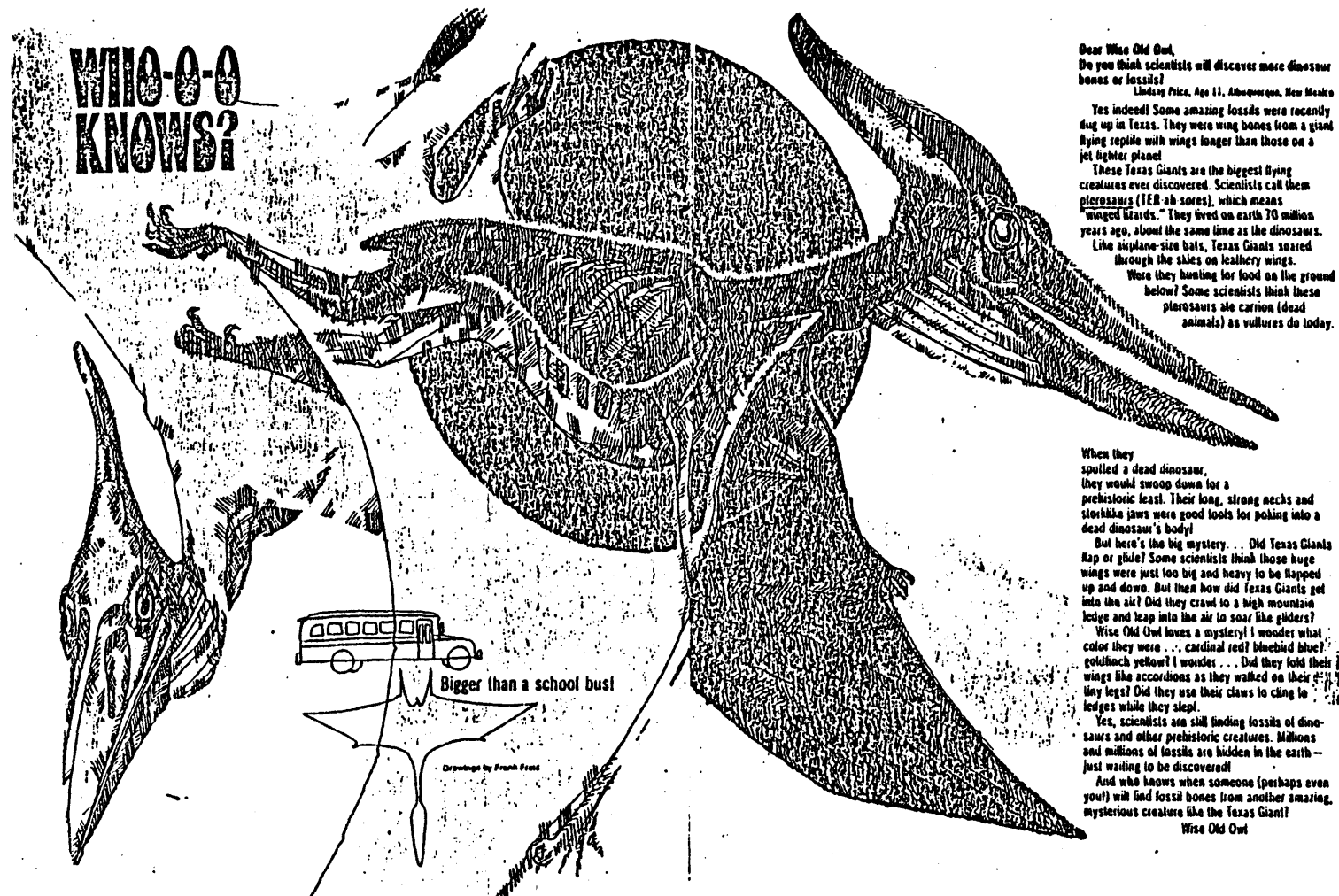
19. "Do you think analogies are useful in communication?"

"You have answered all the questions I have, but for trying to figure what the relationships are for the first seven questions. Here they are.

20. "Can you tell me how each of these are related?"

"Thank you for joining me in this interview."

Fig. 17. "Who-o-o Knows?". Ranger Rick's Nature Magazine, December, 1975. These pages, 12 and 13, are printed with the expressed permission of The National Wildlife Federation, Washington, DC.





## APPENDIX B

### LETTERS AND FORMS DEVELOPED FOR STUDY



# **The University of Northern Colorado**

GREELEY, COLORADO 80639

College of Arts and Sciences  
Department of Science Education  
303/351-2188

A PERMISSION SLIP FOR \_\_\_\_\_ TO  
PARTICIPATE IN A DISSERTATION SURVEY INTERVIEW.

Researcher: Mrs. Denny McNutt  
Major Advisor: Leslie W. Trowbridge

This interview will include the researcher and the child for a 20 - 30 minute session during school time.

The purpose of the interview is to determine usable language patterns for children from age 2 through 15 years.

Children born during the month of the interview, for now, in May, will be interviewed to give results that are age specific.

The preparation of science materials that are the right language style for each age group is one major goal of this study.

If you are willing to allow your child to participate, please sign this letter in the affirmative and return it to school with your child.

-----

May \_\_\_\_, 1976

I will  
I will not allow my child \_\_\_\_\_ to  
participate in this study.

Signed: \_\_\_\_\_  
Parent or Guardian

Thank you very much.

Sincerely,

Mrs. Denny McNutt  
Doctoral Student

Mrs. Denny McNutt  
Science Education  
356-6061

April 27, 1976

Dear Panelists,

The purposes of your reviewing this survey interview format for my dissertation study are to determine:

- its appropriateness for the age group of your concern within the 2 - 15 year old age span.
- its validity as a means to allow analogy interpretation and use as it will occur naturally in the expression of the child.
- its workability as a study method including the administration techniques and means to evaluate responses.

The entire instrument is in Appendix A with IBM copies of illustrative materials included.

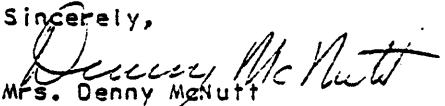
The instrument, administration, and evaluation techniques are found on pages 3-7 through 3-11 of Chapter III.

The entire Chapter III is included to allow referencing as may be needed by you panelists.

If there are questions you have, please call me.

I greatly appreciate your taking this time to help me in this manner.

Sincerely,

  
Mrs. Denny McNutt  
Doctoral Student

Panelists: Betty Lowry, Professor  
Doug Burron, Professor  
Jay K. Hackett, Asst. Prof.

Fig. 18 DATA FORM FOR INTERVIEW TABULATIONS

Interview date:        /        /        Birthdays:        /        /       

M C A W N I. A. R H  
F T R C I E S O W S      number      age

19. Yes:        No:         
    + + + ? - - -

Verbal Analogies      20. Why?

Answer	Cor.	Inc.	Reason	Cor.	Inc.	Ans.	Chg.
1. <u>      </u>	<u>      </u>	<u>      </u>	<u>      </u>	<u>      </u>	<u>      </u>	<u>      </u>	<u>      </u>
2. <u>      </u>	<u>      </u>	<u>      </u>	<u>      </u>	<u>      </u>	<u>      </u>	<u>      </u>	<u>      </u>
3. <u>      </u>	<u>      </u>	<u>      </u>	<u>      </u>	<u>      </u>	<u>      </u>	<u>      </u>	<u>      </u>

Figurative Analogies

4. <u>      </u>	<u>      </u>	<u>      </u>	<u>      </u>	<u>      </u>	<u>      </u>	<u>      </u>	<u>      </u>
5. <u>      </u>	<u>      </u>	<u>      </u>	<u>      </u>	<u>      </u>	<u>      </u>	<u>      </u>	<u>      </u>
6. <u>      </u>	<u>      </u>	<u>      </u>	<u>      </u>	<u>      </u>	<u>      </u>	<u>      </u>	<u>      </u>
7. <u>      </u>	<u>      </u>	<u>      </u>	<u>      </u>	<u>      </u>	<u>      </u>	<u>      </u>	<u>      </u>

8. Representative Picture:                                          

Interpretation: Str.        Fig.        Err.       

---

Number of Analogies      Types:

   p d s f c n m p e<sup>1</sup> e<sup>2</sup>

9. Feeling <u>      </u>	<u>      </u>	<u>      </u>	<u>      </u>	<u>      </u>	<u>      </u>	<u>      </u>	<u>      </u>	<u>      </u>	<u>      </u>
10. Yes <u>      </u> No <u>      </u> N. Und <u>      </u>	<u>      </u>	<u>      </u>	<u>      </u>	<u>      </u>	<u>      </u>	<u>      </u>	<u>      </u>	<u>      </u>	<u>      </u>
11. Sleep <u>      </u>	<u>      </u>	<u>      </u>	<u>      </u>	<u>      </u>	<u>      </u>	<u>      </u>	<u>      </u>	<u>      </u>	<u>      </u>
12. Sci. Exp. <u>      </u>	<u>      </u>	<u>      </u>	<u>      </u>	<u>      </u>	<u>      </u>	<u>      </u>	<u>      </u>	<u>      </u>	<u>      </u>
13. Poem <u>      </u> Cinq. <u>      </u>	<u>      </u>	<u>      </u>	<u>      </u>	<u>      </u>	<u>      </u>	<u>      </u>	<u>      </u>	<u>      </u>	<u>      </u>
<u>      </u>	<u>      </u>	<u>      </u>	<u>      </u>	<u>      </u>	<u>      </u>	<u>      </u>	<u>      </u>	<u>      </u>	<u>      </u>
14. Picture <u>      </u>	<u>      </u>	<u>      </u>	<u>      </u>	<u>      </u>	<u>      </u>	<u>      </u>	<u>      </u>	<u>      </u>	<u>      </u>
15. Swing <u>      </u>	<u>      </u>	<u>      </u>	<u>      </u>	<u>      </u>	<u>      </u>	<u>      </u>	<u>      </u>	<u>      </u>	<u>      </u>
16. Ride <u>      </u>	<u>      </u>	<u>      </u>	<u>      </u>	<u>      </u>	<u>      </u>	<u>      </u>	<u>      </u>	<u>      </u>	<u>      </u>
17. Fly <u>      </u>	<u>      </u>	<u>      </u>	<u>      </u>	<u>      </u>	<u>      </u>	<u>      </u>	<u>      </u>	<u>      </u>	<u>      </u>
18. Identification of Analogies	<u>      </u>	<u>      </u>	<u>      </u>	<u>      </u>	<u>      </u>	<u>      </u>	<u>      </u>	<u>      </u>	<u>      </u>

Total        Cor.        Inc.        Score       

COMMENTS:



## APPENDIX C

### CONTENT VALIDITY OF SURVEY INSTRUMENT AND INTERRATER RELIABILITY CHECK

# CONTENT VALIDITY OF SURVEY INSTRUMENT OPINIONS OF PANELISTS

Comments of referees for content validity of the instrument are:

Betty Lowry, Professor, Elementary Education

Be flexible especially with younger interviewees so as to develop the opportunities to engage them in instrument activities.

Doug Burron, Asst. Chairman, Elementary Education

For the young (2-6) children, you are likely to 'bomb out' on the analogies as constructed. Both the level of difficulty and construction induce this observation. Let me illustrate.

1. A 'first-order relationship', wherein the child must attribute a specific and correct characteristic to an object, place, event, etc., is probably the easiest form of an analogy (ie, relationship) with which to confront the child.

e.g. a. Grass is \_\_\_\_\_.  
b. A chair has \_\_\_\_\_.  
c. A ball is \_\_\_\_\_.

2. Then, keeping to the same construction, move to:
  - a. Grass is green; the sky is \_\_\_\_.
  - b. A chair has legs; a car has \_\_\_\_.
  - c. A ball is round; a block is \_\_\_\_.

It may be significant to explore or to structure openings which give clues as to types of relationships which children can or cannot handle; e.g., relationships of, for example,

- a. Object and attribute (characteristic)
- b. Object and function
- c. Object and composition
- d. Object and part.

Finally, I think some sequencing - simple to complex - would enhance the possibility of significant findings. The construction "\_\_\_ is to \_\_\_ as \_\_\_ is to \_\_\_" will be, I think, very hard for little kids to handle.

Guided by these findings, considering the time of attention factors of the young child, it was decided that if a child failed to respond to a verbal problem, a figurative one would be shown him. With no response there either, the interviewer would skip to the Winnie the Pooh passage and other more creative endeavors, omitting, of course question 20.

Jay K. Hackett, Asst. Professor, Earth Science

The instrument appears to carry out the purpose for which it was designed.

Dr. Hackett aided the researcher in perfecting the science experiment to attain an optimum degree of success in carrying out the experiment in the interview situation.



TABLE 20

REFEREES SCORES BY ITEM GIVEN AS PERCENTAGES  
 REPRESENTING THE NUMBER OF REFEREES' SCORES  
 IN AGREEMENT WITH THAT OF THE RESEARCHER

task	problem	score	accumulated score
Interpretation			
verbal	1	84%	92%
	2	100	
	3	94	
figurative	4	100	88
	5	71	
	6	84	
	7	97	
Explanation			
verbal	1	84	90
	2	97	
	3	90	
figurative	4	94	85
	5	87	
	6	61	
	7	100	
Illustrative Use			85
straight		97	
figurative		71	
erroneous		87	
Use of analogies			86
feeling		100	
sleep		86	
science experiment		71	
poem, cinquain		100	
picture		73	
swing		86	
bike		86	
fly		86	
Identification			
Analogies identified		86	86
incorrect choices		75%	75%

## APPENDIX D

### RESULTS OF COMPARISON OF USE OF ANALOGIES TASK WITH IDENTIFICATION OF ANALOGIES

TABLE 21

TYPES OF ANALOGIES IDENTIFIED CORRELATED  
WITH CLASSIFICATIONS OF ANALOGIES USED

Types of analogies identified	Classifications of analogies used									
	E #	personal	direct	symbolic	fantasy	symbolic	emotive I	emotive II	simile	metaphor
personal	14	.2	.1	.0	.0	.0	.3	.0	.2	.0
direct	1	-.1	-.2	.0	.0	-.2	-.1	.0	-.2	.0
	3	.2	.2	-.1	.0	.2	.2	-.1	.3	-.1
	5	-.1	.1	.1	-.1	.1	.0	.0	.0	.2
	6	.2	.0	.1	-.1	.0	.2	-.2	.2	-.1
	8	.0	-.1	.1	-.1	-.1	.0	.0	.0	-.2
	10	.1	.0	.0	.0	.0	.2	-.1	.1	.0
	12	.2	.1	.1	.1	.1	.2	.1	.1	.1
	16	.3	.1	.3	.0	.1	.3	.2	.2	.2
symbolic	2	.1	.0	.1	-.1	.0	.2	-.1	.1	.0
	4	.0	.1	-.1	.0	.1	-.1	-.1	.1	-.1
	7	.0	.1	.1	-.1	.1	.0	-.1	.1	.0
	9	-.1	.2	.2	.2	.3	.1	.2	.1	.3
	11	.1	.1	.0	-.1	.1	.1	-.1	.2	-.1
	13	.2	.1	.1	.1	.0	.3	.0	.2	.0
	15	.1	.1	.1	.0	.1	.2	.0	.2	.1
fantasy	17	.0	.1	.0	.0	.1	.0	.1	.1	.0

TABLE 22

EMOTIVE LEVELS OF ANALOGIES IDENTIFIED  
CORRELATED WITH CLASSIFICATIONS  
OF ANALOGIES USED

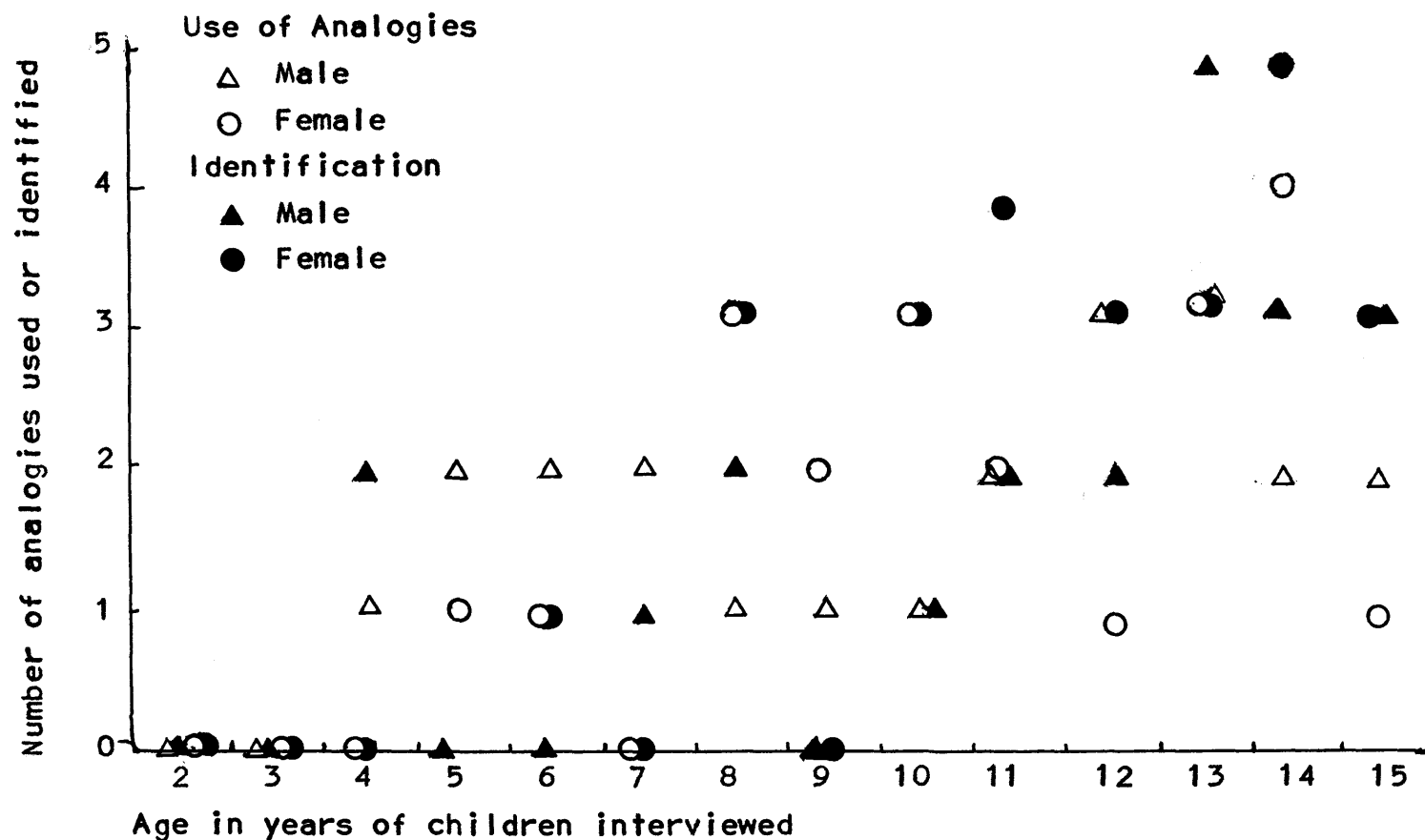
Emotive levels of analogies identified	Classifications of analogies used									
	E #	personal	direct	symbolic	fantasy	symbolic	emotive I	emotive II	simile	metaphor
symbolic	1	-.1	-.2	.0	.0	-.2	-.1	.0	-.2	.0
	3	.2	.2	-.1	.0	.2	.2	-.1	.3	-.1
	5	-.1	.1	.1	-.1	.1	.0	.0	.0	.2
	6	.2	.0	.1	-.1	.0	.2	-.2	.2	-.1
	7	.0	.1	.1	-.1	.1	.0	-.1	.1	.0
	8	.0	-.1	.1	-.1	-.1	.0	.0	.0	-.2
	10	.1	.0	.0	.0	.0	.2	-.1	.0	.0
	11	.1	.1	.0	-.1	.1	.1	-.1	.2	-.1
	16	.3	.1	.3	.0	.1	.3	.2	.2	.2
emotive I	2	.1	.0	.1	-.1	.0	.2	-.1	.1	.0
	4	.0	.1	-.1	.0	.1	-.1	-.1	.1	-.1
	9	-.1	.2	.2	.2	.3	.1	.2	.1	.3
	12	.2	.1	.1	.1	.1	.2	.1	.1	.1
	13	.2	.1	.1	.1	.0	.3	.0	.2	.0
	14	.2	.1	.0	.0	.0	.3	.0	.2	.0
	15	.1	.1	.1	.0	.1	.2	.0	.2	.1
emotive II	17	.0	.1	.0	.0	.1	.0	.1	.1	.0

TABLE 23

GRAMMATICAL TYPES OF ANALOGIES IDENTIFIED  
CORRELATED WITH CLASSIFICATIONS  
OF ANALOGIES USED

Grammatical types of analogies identified	Classifications of analogies used									
	E #	personal	direct	symbolic	fantasy	symbolic	emotive I	emotive II	simile	metaphor
simile	1	-.1	-.2	.0	.0	-.2	-.1	.0	-.2	.0
	3	.2	.2	-.1	.0	.2	.2	-.1	.3	-.1
	5	-.1	.1	.1	-.1	.1	.0	.0	.0	.2
	6	.2	.0	.1	-.1	.0	.2	-.2	.2	-.1
	8	.0	-.1	.1	-.1	-.1	.0	.0	.0	-.2
	10	.1	.0	.0	.0	.0	.2	-.1	.1	.0
	12	.2	.1	.1	.1	.1	.2	.1	.1	.1
	16	.3	.1	.3	.0	.1	.3	.2	.2	.2
metaphor	2	.1	.0	.1	-.1	.0	.2	-.1	.1	.0
	4	.0	.1	-.1	.0	.1	-.1	-.1	.1	.1
	7	.0	.1	.1	-.1	.1	.0	-.1	.1	.0
	9	-.1	.2	.2	.2	.3	.1	.2	.1	.3
	11	.1	.1	.0	-.1	.1	.1	-.1	.2	-.1
	13	.2	.1	.1	.1	.0	.3	.0	.2	.0
	14	.2	.1	.0	.0	.0	.3	.0	.2	.0
	15	.1	.1	.1	.0	.1	.2	.0	.2	.1
	17	.0	.1	.0	.0	.1	.0	.1	.1	.0

Fig. 20 Male and Female Tallies by Age for Use and Identification of Analogies. For Use, Notable Analogies are Counted  
For Identification, Significant Scores were Counted.



Tallies give performance of 10 or 11 youngsters interviewed per age.

NOTEWORTHY ANALOGIES USED BY INTERVIEWEES  
ARRANGED BY QUESTION

What is it like to sleep?

Age

- 7 "My pillows are cushions." (fitting to a boat)
- 8 "Like you're floating in the air on a magic carpet."
- 9 "Like you're waving in the clouds."
- 10 "I try to remember. When I go to sleep I remember something there. When I can't remember, that's when I go to sleep."
- "I think I'm in a huge castle."
- 11 "soft."
- "the poem is right, especially in a waterbed."
- "I have dreams about funny things like lots of magic. Like when I'm laying on my back, I'm just going around in circles."
- 13 "It's kind of when you can just dream and think and don't have to worry about anything else."
- "It would probably be in a rough car because I sleep with my little brother. Real rough. It might be like that (poem) only out on a rough sea."
- "Like lying out on the grass."
- 14 "It's just like a little world when you get to sleep."
- "Like you don't have any problems."
- "Dead, quiet, peaceful."
- 15 "Safe, nothing can harm me."

Describe what happened. (Science Experiment)

Age

- 6 "It was a machine."
- 9 "Like sucking."
- 11 "The candle has to be in air to breath."

Write a poem or Cinquain.

Age

- 8
- Wish  
A wish  
is a lucky  
thing to have around  
a wish is like a dream.
- 10 "The sea roars softly: Its waves are full of beauty.  
It flows like the wind."
- 13
- Clouds float away so swiftly  
To form a soft blanket in the sky.  
When they turn black,  
Sometimes the result is yuck.
- 15
- Smiles  
shiny teeth  
Shows your happiness  
Makes people feel sunny  
Smiles, makes everyone's days brighter.

Describe this picture. (M. C. Escher's "Another World")

Age

- 5 "a happy birdman"
- 6 "king, queen. When you're a balloon, you'd pop and fall."
- 7 "up in heaven"
- 8 "like tops, stars in another land."
- 9 "like a little old prison."



## Describe this picture (contd.)

Age

10 "Wait a minute! This is half on the moon, half off."

11 "bird houses people sit in."

"Little people like chickens enjoying themselves on a building in outer space."

12 "A building with some birds on it; maybe made out of mirrors."

13 "It's like some artist's drawing some sort of picture he had in - he or she had in his or her mind. Some dream . . . like some fictional place."

"Like the painting is sideways."

14 "It's somewhere where there isn't any gravity."

"Like a temple upside down."

"The bird is like a reflection on both sides because you see it hanging in different directions. It's like a three dimensional reflection."

"It's a bird's eye. Like in the old Egyptian times when they used god for a bird or something."

"Like you're on the moon and your mirror is on the ceiling of the building and kind of turned on its side."

"It's in the future with ancient things in it. I can't explain it. It's not that easy 'cause nothin's in unison. It only has two walls."

15 "That's kind of the same picture at different angles, I guess."

What is it like to swing?

Age

- 6 "It felt like you're up in the sky."
- 8 "You feel like you're flying."
- 10 "Like flying like an angel; leap like a frog."
- 12 "I remember how I used to swing - fly - my legs were the gears."
- "When the chain got loose, it feels like the plane going down in a storm."
- 13 "Feel gravity pulling at your face."
- "A free feeling."
- "It looks like the whole countryside is going up with you, down with you and up with you, down with you again."
- "Like limping."
- 14 "You don't care about time."
- 15 "It's like being a little kid again."

What is it like to ride a bike?

Age

- 5 "A bike is like a speeding bullet."
- 11 "You forget all your problems."
- 13 "Like you're on your own."
- "It lets me think more."
- "It's composing."
- "You feel light. When you pedal you feel like you're running."
- 14 "Like you're soaring."

What is it like to fly?

Age

- 4 "Fly? I'd be a birdeo!"
- 5 "Bike:pedal::fly:wings."
- 6 "Then I'd be a manbird."  
"It's fun when you're superman."
- 7 "You just float up in the air."
- 8 "Probably like an angel, like a bird."
- 9 "You could sit in the clouds."
- 11 "Like Captain Marvel."
- 12 "Be like an eagle for the day."
- 13 "When you take off, your stomach is gone."

## FINDINGS RELATED TO USE AND IDENTIFICATION OF ANALOGIES

Some interesting facts emerged based on heritage and attitude which have only small second data sets. Chicano and Anglo-Saxon components are included in this survey for heritage factors. Answers of 'yes', 'don't know', and 'no' to the question, "Are analogies important in communication?" comprise the attitude categories.

To compare results here with other research, the child's expressions were analysed in the use of analogies task for the number of analogies produced per activity and the number of analogies which fit the criteria for the specific classifications of analogy. Both sets of data are presented as percentages.

### Heritage

Chicano performance was equal to Anglo-Saxon for the interpretation, explanation, and use of analogies tasks; however, the identification of analogies task had a Chicano/Anglo-Saxon ratio of 1.67 for the number of analogies identified and a 1.50 ratio for scores (table 10).

Correlation coefficients for tasks and heritage were zero, except for the identification task which was 0.2 (table 14).

This superior Chicano performance in identification of analogies could be based on their 'native' language - second language (English) experience. Spanish is idiomatic and in Chicano home experiences words are lacking to express the more modern school experiences. This would necessitate speaking in parallelisms or analogies.

### Attitude

The majority of youngsters answered "Are analogies important in communication?" with 'yes'. The small sets for 'don't know' and 'no' are quite different in average age from the 'yes' set.

Interpretation and explanation scores are equal if age compensation is made between the 'yes' and 'no' sets. The 'don't know' set had low performance (table 10). The correlation coefficients for these tasks are 0.2 (table 14).

Use of analogies task showed an exceptionally high use frequency for those answering 'no'. This could be a modesty or humility factor. (table 10)

Identification of analogies had high performance for those answering 'yes' for the number of analogies identified, but their performance in the score aspect of the task was on a par with the other groups. The 'yes'

group was less accurate in their choices (table 10). Both use and identification tasks had correlation coefficients of 0.1 (table 14).

Attitude as determined in the survey could be further studied in its relation to use and identification of analogies to see if there is any significance to the unusual indications noted here.

#### Use of Analogies Activities

Activities included in the survey to stimulate analogy use are given with the percentage of the 464 analogical responses for each in table 24.

Eighty two per cent of the youngsters used analogies in the Use of Analogies task during the interview.

#### Classifications of Analogies Used

Each analogy used was analysed as to its type of analogy, its frequency of use, level of language expertise with the topic, degree of emotion involved, and grammatical class. Those found useful to discuss based on the ease and reliability of classifying were types of analogies and grammatical class.

Totals for each category by age and totals for the entire sample with percentages are presented in table 25.

TABLE 24

NUMBER OF ANALOGIES USED PER ACTIVITY  
ARRANGED BY AGE

Children		Age	Activities for Analogy Use							TOTAL FOR AGE
Not using	Using Analogies		Sleep	Science experiment	Poem, Cinquain	Describe picture	What is it like to: swing?	ride a bike?	fly?	
6	4	2		1		4				5
5	5	3		3		6		1	2	12
3	7	4		2		11		1	5	19
1	10	5	3	4		10	2	2	7	28
2	9	6	2	5		17	5	5	3	37
5	6	7	2	3	1	4	2	2	3	17
0	10	8	6	2	5	13	2		2	30
1	10	9	2	3	1	27	7	3	6	49
1	9	10	4	3	3	15	3	3	8	39
0	10	11	5	3	3	24	6	5	3	49
2	8	12	4			21	5	2	6	38
0	10	13	7		3	27	9	5	7	58
0	10	14	1	4	2	15	4	6	3	35
0	10	15	3	1	2	29	6	2	5	48
26	118	$\Sigma$	39	34	20	223	51	37	60	464
18	82	%	8	7	4	48	11	8	13	100

Analogies used per child: 3.22 per child interviewed  
 3.93 per child using analogies

TABLE 25

SPECIFIC CLASSIFICATION OF ANALOGIES USED  
BY INTERVIEWEES ARRANGED BY AGE

Age	Classification categories of analogies used												TOTAL FOR AGE	
	personal	direct	symbolic	fantasy	cliché	novel	master's	pupil's	symbolic	emotive I	emotive II	simile		metaphor
2		4		1	3	2		5	5				5	5
3	1	8	1	2	6	6		12	12				12	12
4	4	13		2	8	11	4	15	16	3		3	16	19
5	5	17	3	3	14	14	9	19	20	8		8	20	28
6	7	25	1	4	23	14	10	27	28	9		22	15	37
7	1	12	1	3	12	5	4	13	11	6		11	6	17
8	4	20	3	3	18	12	15	15	21	7	2	20	10	30
9	11	34		4	29	20	13	36	32	16	1	31	18	49
10	6	28	1	4*	26	13	12	27	26	13		27	12	39
11	7	32	5	5	35	14	23	26	33	14	2	36	13	49
12	9	27	1	1	19	19	9	29	30	8		31	7	38
13	20	33	4	1	31	27	28	30	33	25		37	21	58
14	11	22	1	1	19	16	24	11	21	14		26	9	35
15	12	32	3	1	30	18	18	30	32	16		35	13	48
Σ	98	307	24	34	273	191	169	295	320	139	5	287	177	464
*				1										
%	21	66	5	7	59	41	36	64	69	30	1	62	38	100

\* Compressed conflict was produced by a 10 year old.



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## VITA

The period between 1966 and 1974 was one of increasing educational activity for Denny McNutt. It included: teaching science at the Aquinas School, Alexandria, Va.; math and science at Parkmont School, Arlington, Va.; curriculum developer for the Childeveloper for the Community Learning Corporation; consultant for the American Association for the Advancement of Science on the Science: A Process Approach project, Ohaus Scale Corporation, and the Children's Division of the National Geographic Society; freelancer for Children's House Magazine; and president of Educational Innovations, Inc..

The clout of the graduate degree was missing and proved an obstacle to any university activities.

On hearing the President's Address of Leslie W. Trowbridge at the 1974 National Science Teachers Association National Convention in Chicago, and finding his ideas matched the forming ones in her endeavors, she applied for study in the Department of Science Education at the University of Northern Colorado. Studies began January, 1975.

With an individualized graduate program including a minor in Educational Media and activity in Reading in the Content Fields, she is ready to develop materials.



Returning to Oxon Hill, Maryland, for the 1976-7 school year, she is presently a consultant for the Reading Model for the Deaf project at Gallaudet College, Washington, DC, working under Clarence M. Williams, Dean of Research, and Orin Cornett, Vice President and developer of Cued Speech.

Returning to her maiden name, Denyse Claire DuBrucq, this University of Wisconsin graduate with research and graduate experience under Gerald C. Gerloff, Professor of Mineral Nutrition, Botany, is finally in a position to pursue her goals in life as a qualified individual.