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by

LORAIN SZABO WANKOFF

A dissertation submitted to the Graduate Faculty in Speech and Hearing Sciences in partial fulfillment of the requirements for the degree of Doctor of Philosophy, The City University of New York.

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Abstract

SELECTED METALINGUISTIC VARIABLES AS THEY RELATE TO CONSERVATION AND READING ACHIEVEMENT IN NORMALLY-ACHIEVING AND SOME LEARNIND-DISABLED CHILDREN

by

Lorain Szabo Wankoff

Advisor: Professor Helen S. Cairns

This study focused upon ambiguity detection, segmentation, conservation skill, and reading achievement in sixty-nine normal achievers (5, 6, 7, and 8 year olds) and eight learning-disabled children (7, 8, and 9 year olds). The data obtained provided support for the major experimental hypotheses investigated: (1) ambiguity detection ability is a predictor of conservation skill, (2) segmentation skill is a predictor of conservation skill, (3) ambiguity detection ability is a predictor of reading skill.

Overlap in conservation skill and ambiguity detection ability was found across ages. Thus, substantial differences in reading and conservation scores for groups of children differing in ambiguity detection skill cannot be attributed to age. Also, differences in ambiguity detection for groups of children differing in conservation skill cannot be attributed to age.

The results suggest a parallel in development of ambiguity detection, segmentation, and conservation that is independent of

age. To excel in any of these domains the child must adopt a reflective mode that will enable him/her to correctly judge an ambiguity, to evaluate correctly a conservation problem, or to analyze correctly a series of phonetic segments.

The underlying cognitive skill is necessary but not sufficient for the development of ambiguity detection and segmentation. Support is provided primarily by data on individual achievements for ambiguity detection or segmentation within each of the conservation subgroups. Preconservers never excelled in either metalinguistic domain. This suggests that the underlying cognitive skill is necessary for successful segmentation or ambiguity detection. However, some conservers never excelled in either metalinguistic domain. This suggests that their cognitive skill is not sufficient to predict successful ambiguity detection or segmentation. Furthermore, the cognitive and linguistic measures obtained do not provide sufficient information to explain the markedly low ambiguity detection scores obtained by the learning-disabled subjects.

Results obtained further substantiate the link between reading and metalinguistic skills.

The ability to switch from one's initial interpretation of a lexical ambiguity to the other possible interpretation ("switching skill") was examined in selected subjects. Findings suggest:
(1) switching skill is a predictor of ambiguity detection skill,
(2) a weaker relation exists for "switching" and either conservation ability or reading achievement than with ambiguity detection.

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CHAPTER I

INTRODUCTION AND STATEMENT OF PROBLEM

This study focused upon selected metalinguistic skills as they develop in children and as they relate to conservation and reading achievement in these children. The interest was in understanding the acquisition of the metalinguistic judgment of ambiguity detection (in addition to the metalinguistic segmentation skill) as it fits into the array of developing metalinguistic achievements. As Levelt, Sinclair, and Jarvella (1978) suggest, metalinguistic awareness as a linguistic behavior in its own right should be studied, described, and explained.

In addition, this study was designed to complement the work of Hakes (1980) in describing the relation between ambiguity detection and conservation skill. Finally, it was expected that this study would provide data not only on the relation between reading achievement and segmentation as did Liberman (1974; 1977); but also on the relation between reading achievement and the ability to detect ambiguity.

Metalinguistic development

An increasing number of investigators have begun to focus upon metalinguistic skills in children. Generally, it appears that there is a distinction between the "early" vs. "later" metalinguistic skills. Regarding language awareness, Sinclair (1978) presents the

Piagetian conception: Some awareness is evident in very early forms, e.g., self-corrections. Somewhat later, metalinguistic awareness is evident through remarks on word meanings, corrections of other children and plays on words. With time, children can make judgments about sentences, exercise their segmentation skills, and even explain how they succeeded in constructing certain sentences.

This presentation is similar to Clark's (1978). However, in Clark's description there is greater focus on the distinctive quality of early vs. later metalinguistic awareness. For the most part, Clark's data are presented developmentally. That is, Clark uses the Levelt et al. 'criterion of developmental stage'. She provides a description of the 'first signs' of reflexive ability which, she says, begin to appear at about age two. These include spontaneous self-corrections; questions about the right words, right pronunciation, or appropriate speech style; comments about the speech of others; limited judgments about linguistic structure and function; and questions about other languages and about languages in general (p. 18).

With time, the child can correct word order and wording in sentences earlier judged as "silly." Furthermore, the child can reflect on an utterance by identifying linguistic units and providing definitions. Finally, the child is able to construct puns and riddles; and explain why certain sentences are possible and how they should be interpreted.

To represent ongoing development, Clark presents a taxonomy of metacognitive skills and awareness of language. This scheme demonstrates that the Levelt et al. 'criterion of developmental stage' and the Levelt et al. 'criterion of explicitness' are inter-related and interdependent features of the metalinguistic awareness data. That is, Clark lists the various skills that have been discovered in investigations of metalinguistic awareness. The skills are listed in roughly developmental order.

Clark points out that the last two skills (riddle construction, explanations of why certain sentences are possible and how they should be interpreted) emerge relatively later than the others. These are the skills that appear to require more explicit, reflective judgments. These are the skills that are, perhaps, evidence of cognitive advancements, that engender an emerging literacy.

Cognitive development and metalinguistic skills

Piaget's view that cognitive development precedes and provides the foundation for linguistic development is well known. Most extensive discussions have focused upon the first two years of life or the "sensory-motor period." During this time, when children first begin to use language productively, researchers have suggested that a particular cognitive achievement is prerequisite for some related language development (Brown, 1973; Greenfield and Smith, 1976; Bates, 1977). As Hakes (1980) points out, however, the data do not allow a detailed account of the nature of the relationships between particular cognitive and linguistic achievements. Furthermore, Piaget's theory is not sufficiently explicit to predict precisely occurring aspects of language and language developments while ruling out nonoccurring aspects (Cairns, 1976). A number of researchers agree, however, that during the transition from "preoperations" to "concrete operations" parallel developments in cognition and linguistic skill are more apparent (Hakes, 1980; Cairns, 1976).

Piaget has often argued that preoperational thought tends to be intuitive. Attention is "centered" or focused on a particular aspect of a situation at a time, rather than on its several defining aspects. This is evident in the performance of preoperational children on one of the most characteristic Piagetian tasks--conservation. If, for example, a quantity of liquid from a short, wide container is poured into a tall, narrow container, the preoperational child does not typically give a correct judgment when asked about the equality of amounts. Interestingly, for the older preoperational child, explanations are systematically incorrect rather than random. The child might say that the container, whose surface level is higher, has more liquid. Thus, explanations reflect attention to, and response on the basis of, perceptual properties in the post-transformation display, e.g., height, length, etc. (Hakes, 1980).

As Piaget argues, the transition to "concrete operations" is characterized by a progressive increase in the ability to decenter attention. This is accompanied by an increasing ability to consider several parameters of a situation simultaneously.

Furthermore, the child becomes able to think about the relation among these parameters with regard to the present situation, or to past or possible situations. For example, with regard to conservation of liquids, the increased ability of the "concrete operational" child to "decenter" enables him to understand the inverse relation between height and width. Furthermore, it allows the child to consider simultaneously the pre- and post-transformational states of the display. The child can now understand the nature of the transformation when providing a judgment and explanation about the equality or inequality of quantities of liquid (Hakes, 1980).

The literature on language development suggests that during middle childhood and during the emergence of concrete operational thought, there is a parallel set of linguistic developments that requires cognitive skills that go beyond those involved in the comprehension and production of utterances. These metalinguistic skills require reflecting upon some aspect(s) of language, rather than automatically processing it.

It appears that the concrete operational child, who can "decenter," and who can reflect simultaneously on various parameters of a visual array, is the child who is also more flexible linguistically. The child who is capable of sophisticated metalinguistic judgments can remove himself from the linguistic context; and can consider, individually or simultaneously, various aspects of the linguistic utterance (e.g., phonological, semantic, or syntactic aspects). He can understand their relation to the immediate or other contexts. Aside from using linguistic information during the processing of the utterance, the child can use his metalinguistic awareness in order to make judgments about the utterance in question.

Whether the judgment concerns sentential appropriateness, synonymy of sentences, unit analysis, or the presence of two possible interpretations, sophisticated metalinguistic judgment is a deliberate, decontextualized analysis of language.

The link between certain metalinguistic skills and cognitive development can be documented. For example, Hakes found parallels in the development of segmentation skill, well-formedness judgments, and the development of concrete operational thought (Hakes, 1980). The extent to which other metalinguistic skills, e.g., ambiguity detection, are linked to cognitive development has not been adequately investigated.

Reading and metalinguistic skills

The child who can learn to read must be able to separate his knowledge of the sounds of language from his knowledge of the meanings in language. He must be able to operate with the language phonology, to interpret sound manipulations, and to conceive of meaningful units. Within a phonologically-based writing system in English, the child must become able to manipulate language pieces as though they were unrelated to any immediate need to communicate. Such metalinguistic flexibility requires that necessary cognitive advancements have occurred (Peters & Zaidel, 1980).

Most importantly, certain metalinguistic skills are said to be predictors of reading achievement. The literature indicates that language awareness for phonological segmentation is a predictor of reading achievement. As Helen Tager-Flusberg and Carol Smith (1982) suggest, the extent to which other metalinguistic skills are also predictors of reading achievement has not been adequately investigated.

How this study addresses these issues

This study was conducted to further explore the relation among metalinguistic skills, cognitive skills, and reading achievement. In this study, selected metalinguistic skills (the ability to determine the number of phonological units in a word; and the ability to perceive lexical and structural ambiguities), conservation ability and reading achievement were examined in sixty-nine normal achievers and eight learning-disabled children. It was hypothesized that the development of metalinguistic skills, conservation ability, and reading achievement are related to a common underlying ability and emerge around the same time.

In a follow-up to the study, with only the six and seven year old normal achievers, an ambiguity processing skill was examined: the child's ability to switch from his initial interpretation to the other possible interpretation of lexically ambiguous sentences when provided with context sentences. Expected findings were a strong, positive relation among the total number of switches when processing lexically ambiguous sentences and each of the following: the metalinguistic ability to detect the presence of two different meanings, conservation skill, and reading achievement.

CHAPTER II

REVIEW OF THE LITERATURE

In this review of the literature, three major areas of research will be examined. These are previous studies on:

1. the acquisition of selected metalinguistic skills: well-formedness, synonymy, and segmentation
2. ambiguity detection and ambiguity processing in children
3. the relation between metalinguistic awareness, reading achievement, and/or cognitive development

Studies on selected metalinguistic skills

Well-formedness

Several studies have demonstrated that in even the very young child, some rudimentary ability to deal with questions about acceptability is present. Interestingly, it appears that the criteria for judging well-formedness used by the very young child are qualitatively distinct from those used by older children.

In a report of an informal study of early metalinguistic awareness, Gleitman, Gleitman, and Shipley (1972) present data on their attempt to elicit well-formedness judgments from three girls, all about 2½ years of age. Children had to indicate whether sentences were "good" or "silly." Sentences consisted of telegraphic imperatives along with their inverses: "Bring me the ball," "Bring ball," "Ball me the bring," and "Ball bring." Well-formed imperatives were judged by all three children to be "good" more often than chance, though less than 100%. While inverted imperatives were less likely to be judged as "good" than the well-formed ones, the inverted imperatives were more likely to be judged as "good" than as "silly." Telegraphic imperatives were judged as "good" less often than the well-formed imperatives by only one of the three children.

Acceptability judgments were also studied by De Villiers and De Villiers (1972). Children had to judge and correct utterances produced by a puppet. Utterances included anomalies and well-formed imperatives, along with correct-order and reverse-order imperatives. (E.g., Throw the stone; Throw the sky; Brush your teeth; Teeth your brush.) Subjects ranged in age from twenty-eight to forty-five months. Eight subjects were tested. Findings indicated that almost all children judged anomalous imperatives to be "wrong" more often than correct control sentences. Only the older, more linguistically advanced children judged the reverse-word order imperatives to be "wrong" more often than the correct-order control sentences.

Results of these studies suggest that while very young children can sometimes distinguish between well-formed and not well-formed utterances, the criterion used by the young child is different from the older child or the adult. Children approximately 2½ years of age appear to be more sensitive to the meanings conveyed by words within the stimulus sentences than to the ordering of words within the stimulus sentences. As Hakes (1980) suggests, the fact that younger subjects in the De Villiers' (1972) study rejected only the anomalous imperatives, while older subjects and, to some extent, subjects in the Gleitman et al. (1972) study rejected both anomalous and reverse-order imperatives is a result of the developing comprehension strategies of the young child. Children who do not yet use word-order strategies for comprehension behave as though they "understand" both well-formed and reverse-order imperatives. For anomalous imperatives, since no ordering of the words is sensible, these stimulus sentences are judged to be unacceptable by the young child.

As the word-order strategy becomes functional, the older child rejects the reverse-order imperatives as unacceptable. A strong positive correlation between children's word-order corrections and their comprehension of reversible passives (De Villiers & De Villiers, 1974) provides some evidence for this explanation of the child's judgments about well-formedness.

Taylor (1976) investigated the ability of kindergarten, first, and second grade children to make linguistic judgments about sentences that were either correct or disrupted along semantic or grammatical lines. Sentences were systematically transformed according to specified rules. Children were required to listen to a puppet say the sentence and to judge whether the sentence was said the wrong way or the right way. The findings indicated that judgments about acceptability improve with increasing age. Findings were in accordance with previous studies (De Villiers & De Villiers, 1972, 1974; Gleitman, et al., 1972) in that chiidren scored higher on semantically than grammatically disrupted sentences at all grade levels. By second grade the difference between performances on these two types was significant. Performance on both sentence types was related to reading achievement at first grade. Only performance on grammatically disrupted sentences remained related to reading achievement at second grade. These findings were based on positive and statistically significant correlations obtained between scores on the acceptability task and on the reading subtest of the Metropolitan Achievement Test.

Gindes (1980) corroborates the above finding that the metalinguistic ability to judge acceptability is related to reading achievement.

Johns (1979) explored a different aspect of well-formedness judgments, its growth, and its relation to reading achievement. After a pretraining procedure, children were instructed to listen to an audio tape and to respond "yes" if he or she heard one word and "no" if he or she did not hear one word. Test stimuli consisted of five items in each of eight different categories of stimuli. These categories were: non-verbal abstract (e.g., hissing sound); non-verbal real life (e.g., person coughing); isolated phonemes (e.g., /a/); isolated syllables (e.g., /trov/); short words (e.g., fire); long words (e.g., automobile); phrases (e.g., big bad wolf); sentences (e.g., They went to the zoo). Findings were that more than 50% of children in the youngest age group (ages 5.6 to 6.5) consistently failed to recognize a spoken word as a word. Children in the next group (ages 6.6 to 8.0), in their first year of formal reading instruction, seemed to have an accurate concept of short words; but there appeared to be confusion about longer words. The oldest children (8.1 to 9.5) showed improved ability, but still made errors with 'long' spoken words. The findings demonstrate that, generally, metalinguistic awareness of a spoken word improves with age. Findings demonstrated, further, a significant relation between children's metalinguistic awareness of spoken words and reading achievement. This relation was shown by positive and statistically significant Pearson product-moment correlations for the total group and for the two youngest groups, between reading scores and word concept scores.

Synonymy

Studies by Beilin and his associates (Beilin, 1975) suggest a link between metalinguistic awareness and specific cognitive advancements. Findings indicated that developmental changes in performance in a task measuring operational reversibility paralleled those for children's synonymy judgments. By first grade, six year olds could perform adequately on comprehension and production of passive sentences. However, accurate synonymy judgments of active-passive pairs were not achieved until second grade. According to Beilin, the "reflective" function is distinct from typical language processing and is related to the concomitant development of the child's knowledge of logical reversibility.

Segmentation

The work of Liberman et al. (1974, 1977) demonstrated that the metalinguistic judgment of phonological segmentation is a reliable predictor of reading achievement. The 1974 study was designed to determine how well nursery, kindergarten, and first grade children could identify the number of phonemic segments or syllabic segments in spoken utterances. They included forty-six preschoolers (mean age = 4.9 years), forty-nine kindergarteners (mean age = 5.8 years), and forty first graders (mean age = 6.9 years). The hypothesis that syllabic segmentation would be easier than phonetic segmentation and, therefore, be acquired earlier was explored.

A game was played in which children tried to tap the number (from one to three) of segments (phonemes in the case of one group and syllables in the case of the other) in each member of a list of test words. A pretraining procedure preceded administration of the test list to demonstrate to the child what was expected of him. The test list consisted of forty-two trials where one, two, or three segment words or nonsense words were randomly assorted. Incorrect responses were correctly demonstrated. Testing was continued through the forty-two trials or until a criterion of six consecutive correct trials was reached.

The number of children who were able to reach criterion was markedly greater in the syllable segmentation group at every grade level. Of the nursery school children, none could segment by phonemes, while nearly half (46%) could segment by syllables. Only 17% of the kindergarteners could do phoneme segmentation, while almost half (48%) of the first graders could do syllable segmentation. At the end of first grade, only 70% succeeded in phoneme segmentation, while 90% could perform on the syllable segmentation task.

Findings indicate that for the syllable segmentation task, the proportion of children who reached criterion in the first six trials increased steadily over the three age levels: 7% for preschoolers, 16% for kindergarteners, and 50% for the first graders. For the phoneme segmentation task, no child at any grade level attained the criterion in the minimum time.

Data were also analyzed in terms of mean number of errors. The mean number of errors to passing or failing a criterion of six consecutive correct trials without demonstration decreased at successive grade levels; but the greater difficulty of the phoneme segmentation task was clearly demonstrated at every grade level.

To summarize the Liberman et al. findings, results indicated that at all grade levels the number of children reaching criterion was markedly greater in the group required to segment by syllable than in the group required to segment by phoneme. Furthermore, the proportion of children at each age who reached criterion level in the minimum number of trials also reflected the greater in difficulty of the phoneme segmentation task. The mean number of errors for the two tasks demonstrates further the greater difficulty of phoneme segmentation at every level.

In order to explore the relation between phonemic segmentation and reading, Liberman, et al. (1977) measured the reading achievement of the children who had taken part in the experiment on phonemic segmentation. They tested their subjects at the beginning of the school year, and found that half of the children in the lowest third of the class in reading achievement had failed the phoneme segmentation task the previous June; on the other hand, there were no failures in phoneme segmentation among the children who scored in the top third in reading ability.

Hakes (1979)

Hakes (1979) demonstrated that the pattern of development for selected metalinguistic performances is similar to the developmental pattern for conservation in normal children. Hakes examined conservation skill in relation to the metalinguistic abilities to judge synonymy and acceptability, and to determine the number of phonological segments. In his design, one hundred children, twenty each of ages four, five, six, seven, and eight years were tested.

The acceptability task used by Hakes (1979) was a modification of the De Villiers and De Villiers (1972) task. Children were introduced to a purple elephant and were asked to help the elephant learn to talk right. The child was instructed to inform the elephant if the elephant said something the right way. Furthermore, the child was instructed to inform the elephant if what the elephant said was wrong, and to tell the elephant why it was wrong and how he should have said it.

Thus, the task elicited judgments of acceptability, unacceptability, and reasons for unacceptability. The thirty-six sentences for the acceptability task consisted of fifteen deviant, fifteen nondeviant, and six that were meaningful, well-formed, but empirically false. The deviant sentences were changed systematically along various predetermined criteria. These included:

1. word order changes; e.g., *The string chased the kitten
2. subcategorization rule violations; e.g., *The teacher coughed the car
3. selectional restriction violations; e.g., *The playground walked to the store
4. some vs. any violations; e.g., *Any children came to play after school
5. inalienable possession violations; e.g., *The nurse blinked the doctor's eyes

Data on the acceptability task, indicated an increasing ability of children to make accurate acceptability judgments with increasing age. At all ages, performance was better for nondeviant than for deviant sentences.

As in previous studies by Gleitman et al. (1972) and De Villiers and De Villiers (1972), children were more likely overall to judge sentences as acceptable than unacceptable. However, Hakes' youngest subjects judged deviant sentences unacceptable more often than not.

Unlike the Gleitman et al. (1972) and De Villiers and De Villiers (1972) studies where subjects were much younger, in the Hakes data, the deviance of word-order change was detected prior to other kinds of deviance. Even the five year olds were nearly unanimous in judging deviant word-order as unacceptable. Hakes found it plausible that word-order changes should be more obvious cases of deviance, perhaps because they often involve violations of several rules (e.g., grammatical and semantic as in *The string chased the kitten).

As in the findings of Gleitman et al. (1972) and De Villiers and De Villiers (1972), the data for the acceptability task yielded developmental changes in the basis on which children make judgments. Youngest children rejected sentences as unacceptable with reference to sentence content. That is, sentences were rejected if they were not believed to be true or were descriptive of unacceptable situations. These children's judgments were sometimes based on linguistic properties but, in general, sentences were evaluated as unacceptable if they were not understood. Development reflects (1) an increasing familiarity with grammatical rules since fewer "unacceptable" sentences are accepted by older children, and (2) a decreasing tendency to judge sentences on the basis of their content.

The synonymy task of Hakes (1979) was developed by Carlota Smith in unpublished research and was similar to the acceptability task developed by De Villiers and De Villiers (1972). Children were introduced to two stuffed animals, a dog and a turtle. It was explained to the child that the animals liked to play a game in which the dog spoke and then the turtle would say the same thing, but in a different way. After examples were given to the child, the experimenter explained that sometimes the turtle was "tricky." That is, the turtle sometimes would fool the dog and say something really different. After more examples were discussed, the child was told to indicate whether the turtle was playing the game "okay" or whether he was being "tricky." An example of a pair of sentences presented to the child is the following:

The nurse was called by the doctor.

It was the nurse that the doctor called.

The data for the synonymy task in the Hakes study indicate a marked increase in correct judgments with increasing age.

The synonymy data that Hakes presents are characterized by a developmental change in the criterion on which children's judgments are based. Youngest children could make neither form nor meaning comparisons. Later, judgments are made on the basis of form alone; and finally, children make judgments based on both form and meaning. Hakes suggests that the emergence of the ability to judge synonymy in an adult-like manner involves an ability distinct from comprehension. He provides published comprehension data, pilot data for his study, and comprehension pretest data. These suggest that what caused the difficulty was the retention and comparison of the semantic representations they were able to construct. Hakes maintains that, conceptually, this metalinguistic skill of retaining meanings and comparing them is similar to the skill required for correct conservation response. According to Hakes, "Both require decentering attention from the most recent input to consider an earlier input and to reflect upon its relationship to that most recent input" (p. 73).

Hakes' phonemic segmentation task was that used by Liberman et al. (1974) described earlier. Instructions and test items were identical to those of the Liberman task, but only the phonemic (not the syllabic) segmentation task was used.

Data for the segmentation task, as well, reflected an increasing ability for older children to segment on the basis of phonemic units. The data were treated in terms of the number of trials needed to reach criterion. Failures to reach criterion occurred predominantly in the younger age groups. Trials to criterion decreased with increasing age. Older children were most adept at discovering the phonemic segmentation principle and using it correctly with only minimal instruction and practice (p. 89).

For the conservation tasks, the Goldschmid-Bentler Concept Assessment Kit - Conservation, Form A (Goldschmid & Bentler, 1968) was used by Hakes. The six tasks are designed to evaluate conservation performance in six situations: two-dimensional space, number, substance, continuous quantity, weight, and discontinuous quantity. Standardized materials, instructions, and scoring procedures are used. Hakes found that improvement in performance with increasing age was highly significant.

When examining the relations among the tasks, Hakes obtained positive and statistically significant correlations. According to Hakes, the intertask correlations along with the conceptually logical relations among tasks provide compelling evidence that " . . . there is some common denominator underlying performances on the several metalinguistic tasks" (p. 92).

The results of Hakes (1979) suggest that the ability underlying developing metalinguistic skills is the same as that underlying the emergence of concrete operational thought. Hakes suggests that this underlying reflective capacity is applied deliberately and intentionally by the child. Most importantly, Hakes suggests that this reflective capacity is decontextualized. Thus, the child might use it to analyze or evaluate an utterance or solve a conservation problem or in countless other situations.

Ambiguity

Several studies have assessed the development of the metalinguistic judgment of ambiguity in children (Kessel, 1970; Shultz & Pilon, 1973). In the Kessel study, ambiguous sentences were either 'lexical' ambiguities, 'surface structure' ambiguities, or 'deep structure' ambiguities. According to Kessel, in 'lexical' ambiguities a word in the sentence has two distinct meanings, e.g., The soldiers liked the port; where 'port' can mean either "wine" or "harbor." According to Kessel, ambiguity at the 'surface structure' level involves the possibility of two distinct groupings of adjacent words, e.g., Small boys and girls are frightened easily. If the word "small" is grouped with "boys and girls" then both the "boys and girls" are small. But if "small" is grouped only with "boys," then only "the boys" are small. Finally, in ambiguities at the 'underlying' structural level there are alternative representations for the logical relations between words, e.g., The mayor will ask the police to stop drinking. In this sentence, the police will be asked either to stop drinking themselves, or to stop others from drinking. Selection of particular sentences was reportedly based upon the depictability of the two possible meanings.

In the Kessel study, a picture verification procedure was used. The child was presented with four line drawings, two of which were correct representations of the alternative meanings of the ambiguity and two of which were incorrect representations. The child was asked to select which pictures (or picture) go with the sentence. A selection was followed by extensive cross-questioning regarding alternative pictures.

Results of the Kessel study indicated that most children in kindergarten and first grade (six and seven year olds) comprehended both meanings of lexical ambiguities. The author reports that although a small number of six year olds could detect two meanings for surface structure and deep structure ambiguities, and although eight year olds show some improvement in the form of partially correct answers, the most marked improvement occurred for the nine year olds (Kessel, 1970). The twelve year olds made few errors with either deep or surface structure ambiguities.

Some methodological problems in the Kessel study should be addressed. While selection of sentence was to be based on depictability of both possible meanings, several of the sentences present rather odd circumstances, oddly stated circumstances or two meanings that are not distinct. For example:

The boy looked at the three masted boats.

He told her baby stories.

The eating of the chicken was sloppy.

Furthermore, there appears to have been no attempt to control for bias in the ambiguity or to match sentences for structural complexity. Also, for surface structure ambiguities the experimenter repeated the sentence, if a correct response was not obtained, using different intonation contours. Finally, the stimulus pictures do not represent the activities as clearly as they might have. With a picture verification procedure such as this, there is no measure of the child's ability to detect two meanings without the prompt provided by the pictures.

It appears, further, that extensive cross-questioning was pursued regarding a chosen or not chosen picture. This procedure was reportedly consistent from child to child for a particular sentence. However, the pattern of questioning appears not to have been consistent across children.

Findings reflected vast differences in performance by children on lexical, surface, and deep structure ambiguities. However, the extent to which these findings are confounded by lack of controlled variables (structural complexity, bias, intonation, oddly stated propositions, etc.) is not clear. In fact, it appears that the structural complexity variable alone might have artificially inflated scores of the kindergarteners to lexical ambiguities, while artificially deflating the scores of all children on structural ambiguities.

Shultz and Pilon (1973) also assessed the development of the ability to detect ambiguity. Children in four grade levels were selected: first, fourth, seventh, and tenth. Various types of ambiguous sentences were used: lexical, phonological, surface structure, or deep structure. A "phonological" ambiguity was taken to occur when a given phonological sequence could be interpreted in more than one way. Thus, it could result from an ambiguous word boundary, e.g., eighty cups vs. eight tea cups; or when two distinct words happen to have similar pronunciations, e.g., pear vs. pair.

The investigators claimed that they selected "simple" vocabulary; sentences that were relatively short, and constant in length; sentences that were relatively simple syntactically and "roughly equated" across type. Children were required to paraphrase the stimulus sentence. This was followed by a picture-verification task. Children were required to justify their picture selection. It was expected that the paraphrase measure would provide a conservative measure of ambiguity perception, while the picture verification procedure would provide a more liberal measure because of the pictorial prompt. Paraphrase and picture responses were scored for the presence or absence of each of two relevant meanings.

The investigators indicate that with both the paraphrase measure and the picture verification measure, structural ambiguities were not detected until grade seven and there failed to be improvement until grade ten. Since not all grade levels were sampled, this is hardly surprising.

Lexical ambiguity detection improved steadily throughout grade levels. Performance was relatively low, however. While actual percentages correct are not provided, graphs indicate that on the paraphrase task, first graders achieved less than 10% correct responding; and on the picture verification task about 10% correct responding. Fourth graders achieved approximately 20% correct on the paraphrase task and, on the picture verification task, approximately 35% correct.

As reported above, these investigators claimed that they selected "simple" vocabulary, sentences that were relatively short and constant in length, and sentences that were relatively simple syntactically and "roughly equated" across type. However, there was apparently no attempt to control for meaning bias in the ambiguities. Furthermore, the validity of a category such as "phonological ambiguity" is questionable. The "phonological" ambiguity of "patience vs. patients" is not functionally different from a lexical ambiguity for the typical first grader. That is, the typical first grader does not have knowledge about English spelling that is sufficiently sophisticated to render "phonological ambiguity" a valid category.

If we compare the findings in the Kessel and Shultz and Pilon studies, detection of lexical ambiguities by first graders was far more frequent in the Kessel investigation than in the Shultz and Pilon investigation. As mentioned above, it appears that detection of lexical ambiguities might have been inflated for first graders in the Kessel study. However, in the Shultz and Pilon study, subjects appear to have performed relatively poorly. The availability of two meanings for each lexical ambiguity was never pre-tested. The six lexical ambiguities presented to children in the Shultz and Pilon study were: club, plant, crabs, tank, bank, dough. The possibility that these items were not functionally ambiguous for the younger children is an important consideration.

In a study by Hirsh-Pasek, Gleitman and Gleitman (1978), ambiguity perception and reading ability were studied. Forty-eight children in grades one through six consisting of twenty-four 'good' readers and twenty-four 'bad' readers were required to explain jokes that turned on various kinds of language ambiguity. An analysis of variance yielded significant main effects of grade and of reading ability. There was no interaction between reading ability and ambiguity type. The authors attribute this to the fact that probably few of their subjects were actually 'below average' in verbal talent or reading achievement.

Peters and Zaidel (1980) investigated the acquisition of homonym recognition by asking children between ages 3-3 and 6-3 to select homonyms from pictures. After "prenaming" and "training" sessions, children were asked to "Find two pictures that sound just the same but mean different kinds of things." Children were encouraged to keep trying, even after errors were made. Finally, the experimenter told the child the meaning of one of the homonym pair and asked, "Can you find another picture that sounds exactly like this one?"

Out of eighteen possible correct responses, the mean number of correct first tries for the oldest group of subjects (mean age = 5.8) was 10.7; for the middle group (mean age = 4.9) it was 9.0; and for the youngest group (mean age = 3.1) it was 2.5.

Thus, findings indicated a marked improvement in homonym-finding ability with increased age. Older children did markedly better than younger children on first tries. Younger children benefited more than older children from additional tries. According to the authors, the developmental patterns indicate that younger children are unable to cope with the cognitive complexity of the task; i.e., to access the vocabulary items, rehearse immediate results and implement a search strategy.

As the authors describe their findings, a number of cognitive prerequisites become evident. To accomplish the homonym selection, children must simultaneously (1) understand what "sound the same" means, (2) complete an exhaustive search through alternative pictures, (3) map out the phonological representation of the words, (4) retain the label while searching for a label to match it, and (5) repeat the search in case of a mismatch (pp. 204-5).

The description resembles the analysis, retention, and comparison characteristic of the typical description of metalinguistic ability. The prompting, the modelling, the pretraining and the encouragement which characterize different aspects of the Peters and Zaidel procedure, results in a relatively easy task. That is, preoperational children are sometimes able to perform the task.

It must be noted, however, that the relatively poor performance by the youngest children might be due to the fact that the acceptability of two meanings was never pre-tested by the investigators.

The relation between judgments of linguistic ambiguity and cognitive skill has been examined from another orientation in a study by Keil (1980). This study was designed to examine task specificity of ambiguity perception in the linguistic and pictorial domains. The question addressed was whether ability to perceive linguistic ambiguities was correlated with ability to perceive pictorial ambiguities. Keil's stimuli consisted of (1) "linguistic ambiguities" that were either symbolic or structural, and (2) "pictorial ambiguities" that were either symbolic or structural. For both ambiguous sentences and pictures, the lexical or symbolic ambiguity contained one symbol that could represent two different referents but was not itself parsed into different structures. In structural ambiguities, the sentence or picture could be parsed into two different meaningful structures. An example of a symbolic pictorial ambiguity was a picture that could be interpreted as either railroad tracks or a ladder; an example of a structural pictorial ambiguity used was a picture that could be interpreted as a picture of a woman holding a mirror or a profile of a man, depending upon how it is parsed. According to Keil, high positive correlations between ambiguity detection in the two domains would imply that the skills are not characterized by task specificity.

Eighteen children in five different grades (first, third, fifth, and eighth) were subjects. Ambiguity stimuli for pictures and sentences were pretested for comprehension. In the task, children were only asked to provide the two different meanings for ambiguous sentences and pictures; i.e., no non-ambiguous items were presented.

Findings revealed no positive correlations between the sentence and picture tasks. Keil suggests that this result supports the view that "the perception of linguistic ambiguities has a different psychological basis than the perception of pictorial ambiguities" (p. 226).

The Keil study provides evidence that symbolic or lexical ambiguities are perceived at an earlier age than structural ones. Marked increases in performance for lexical linguistic ambiguities occurred between first and third grade; for structural linguistic ambiguities marked improvement occurred between third and fifth grades.

Keil also describes the different developmental patterns in the two different modes. For sentence ambiguities, there were rapid performance increases over short time intervals, while for pictorial ambiguities, the improvement was more gradual and less dramatic.

In an investigation by Frommer (1975), a series of interviews was conducted with four, six, and eight year old children in an effort to study the comprehension of lexical ambiguities within particular linguistic contexts. In an initial interview, children listened to stories containing lexical ambiguities. Each lexical ambiguity appeared twice in the presentation. The goal of the interview at Time 1 was to assess for each child the presence of both possible interpretations for each of the lexical ambiguities. At Time 2, children listened to stories containing the series of lexical ambiguities in "neutral" linguistic contexts. Questions were presented to the child in order to elicit from the child his/her preferred interpretation of the lexical ambiguity. At Time 3, children were presented stories containing lexical ambiguities along with a linguistic context suggesting the less preferred interpretation for the particular linguistic ambiguity. That is, the linguistic context to be used for each item and for each child was pre-selected on the basis of results obtained at Time 2.

While age and not conservation skill was the independent variable in this study, the implication of Frommer's findings were similar to those of Hakes (1979). Eight year olds were found to demonstrate less cognitive rigidity than four and six year olds. This was demonstrated by the fact that eight year olds were more likely to switch from their preferred interpretation of lexical ambiguities when the ambiguities were presented within different linguistic contexts. Furthermore, for all children tested, more than twice as many shifts in meaning occurred in the prior context condition. While measures of operational thought were not obtained, Frommer hypothesized that the ability to integrate linguistic context and to access either meaning of a lexical ambiguity is more characteristic of the child with operational thought and cognitive reversibility.

A study by Evans (1976) was designed to determine whether conservers and non-conservers differ systematically on a measure of online processing difficulty while comprehending sentences containing ambiguous words. A word-monitoring task was used with ambiguous and non-ambiguous sentences. It was hypothesized that the "operational" child might react more quickly in a word-monitoring task used with lexically ambiguous sentences than the "preoperational" child. It was hypothesized further that such a finding might contribute to our understanding of the developmental pattern that characterizes riddle comprehension.

The results indicated that overall reaction times for ambiguous sentences were significantly longer than reaction times for the control sentences. Furthermore, the older concrete operational children were consistently faster in responding to both kinds of sentences than were younger preoperational children. However, both groups reacted faster to targets following control words than to targets following ambiguous words. The findings suggest that preoperational and operational children do not differ significantly in the way lexical ambiguities are processed.

The results of the Evans study show continuity in processing. Therefore, an explanation is not provided for the fact that children do not at first comprehend riddles containing ambiguities the way adults do. Evans suggests that in riddle comprehension the individual requires two abilities. He must be able to switch from one reading to another and he must be able to realize its ambiguity. According to Evans, the data from her study do not enable us to understand how the two abilities operate.

Metalinguistic skills, reading, and cognitive development

As we reported earlier, the work of Liberman, et al. (1974, 1977) demonstrated that the metalinguistic judgment of phonological segmentation is a reliable predictor of reading achievement. Another study discussed earlier was the investigation by Hirsh-Pasek, Gleitman, and Gleitman (1978). Children in grades one through six were required to explain jokes that turn on various kinds of ambiguity. While "good" readers reportedly did substantially better than the "poor" readers, there was no interaction found between reading ability and ambiguity type. That is, there was no marked difference obtained in performance by "good" and "poor" readers on the various types of ambiguities tested. As we reported earlier, the authors attribute this to the fact that probably few of their subjects were actually "below average" in verbal talent or reading achievement.

In the 1976 Taylor study that was discussed earlier, findings obtained indicated that not only did acceptability judgments improve with age, but performance on all sentence types was related to reading achievement at first grade. Only performance on grammatically disrupted sentences remained related to reading achievement at second grade. The Gindes (1980) study corroborates the above findings: that the metalinguistic ability to judge acceptability was found to be related to reading achievement. As reported earlier, in the Johns (1979) study, findings demonstrated a significant relationship between children's metalinguistic awareness of spoken words and reading achievement.

The studies support the hypothesis that metalinguistic awareness that is tested through an auditory channel is related to reading skill, whether the focus is upon the phonemic unit, the word unit, or the sentence unit.

The notion that the acquisition of reading skill requires awareness not only of the spoken word but of the link between written language and spoken language is addressed by Taylor (1981). A battery of four reading readiness assessment tasks was administered to 267 first grade children. The tasks included were (1) the aural word boundaries task--in which children were required to segment oral sentences into component words; (2) the rye-rhinoceros task (modelled after Rozin et al., 1974)--in which children were presented with cards containing word pairs beginning with the same letter. The child was told, for example, that "one of these words is 'rye' and the other is 'rhinocerous'" and asked, "Which word is 'rye'?" (Items were counterbalanced for length of target word and position of the long or short word on the cards.); (3) the aural consonant cloze task--in which the child had to "assist" the examiner by completing a sentence where a word was omitted at the end of the sentence. The examiner would read the stimulus sentence to the child and halt at the last word, providing only the initial consonant of the missing word. This task measured the child's ability to utilize word-initial consonant and preceding context to identify unknown words at the end of sentences; and (4) the metalinguistic interview--which was designed to measure the child's awareness of technical aspects of written language: e.g., knowledge of the term 'alphabet' and recognition of a letter, a word, or a sentence, both orally presented and orthographically presented. Familiarity with reading concepts was also assessed: e.g., front-back orientation toward the text in a book, reading of words rather than pictures, top-bottom orientation toward text on a page, etc. (p. 6).

According to the author, the results indicate that " . . . the Written Language Awareness Test continues to function as a good predictor of end of the year reading achievement, and to predict as well as the Metropolitan Readiness Test (MRT) which is a more conventional measure of readiness" (p. 7).

A number of studies has indicated that, at best, there appears to be a moderate relation between reading achievement and cognitive development. In a study by Brekke, Williams, and Harlowe (1973), conservation was found to be positively and moderately correlated with reading readiness. They suggest that conservation skill would be of interest to teachers of first graders as a predictor of the child's readiness to read. This is supported by the findings of

Briggs and Elkind (1973). In this study, sixteen matched pairs of five year old readers and non-readers were given a battery of perceptual, motor, cognitive, and personality tests. A factorial and discriminant analysis of scores yielded an "operativity factor" on which readers were significantly superior to nonreaders. The "operativity factor" in this study consisted of scores from Piagetian conservation tasks, and a reflection-impulsivity measure. The authors interpret these findings as supporting the notion that learning to read English is facilitated by "concrete operations" (pp. 279-80).

A somewhat different finding is presented by DeVries (1974). In her investigation, five, six, and seven year old children received Piagetian, I.Q., and achievement assessments. Findings indicate that Piagetian tasks (conservation included), I.Q., and achievement tasks (reading included) overlap to some degree; but also measure different aspects of cognitive functioning (p. 746).

A study by Lunzer (1976b) reports a significant relation between reading achievement and an 'operativity factor'. In this investigation, a factor analysis indicated that the heaviest contributions to the operativity factor were derived from tests of seriation and multiple seriation rather than conservation (1976a). In fact, the two conservation tasks loaded on a separate factor. The Lunzer et al. study demonstrated that while the 'operativity factor' was the single best predictor of reading and mathematical skill, conservation scores contributed to the prediction of mathematics, but not reading.

Few studies have examined metalinguistic skills and conservation along with reading achievement. An eight-month longitudinal study of 124 kindergarteners by Jewell (1978) examined the development of metalinguistic awareness of written stimuli and conservation skill as predictors of reading achievement. Results obtained indicated a low positive correlation between conservation skill and the metalinguistic skills examined. Metalinguistic awareness for written language rather than conservation skill was shown to be a predictor of reading achievement. However, there appeared to be some common factor tapped by both conservation and metalinguistic tasks: A relation between cognitive stage, as indicated by scores on a series of conservation tasks, and metalinguistic awareness of written language was found.

The limited age range of subjects studied and, as Jewell suggests, the fact that many children at the age of five or six are likely to be in a transitional phase between preoperational and operational thought may have concealed the relation between conservation and other variables. "It may be that cognitive stage is less important to the reading development of first-grade children during early months of instruction, but will become more important as comprehension of written language is the major task" (Jewell, 1978, p. 176).

Present investigation

Like the Jewell study discussed above, this investigation examined metalinguistic skills, conservation, and reading achievement. However, this examination of somewhat older subjects and the data obtained on learning-disabled children may shed further light on the relations among these variables.

Investigations of the metalinguistic judgment of ambiguity in children have been discussed. Rather than examining the acquisition of homonym-pair selection, as in the Peters and Zaidel (1980) study, this study focuses on the acquisition of the capacity to detect lexically and structurally ambiguous sentences. Following the Peters and Zaidel design, this study incorporates systematic prompting and follow-up questioning, so that different levels of response emerge. Furthermore, the use of structural as well as lexical ambiguities, the use of sentence analysis rather than word analysis, renders this study appropriate for a wide age range. In an effort to describe systematically and explain cognitive differences in relation to performance on the ambiguity detection task, this study also incorporates a conservation measure as well.

Like Keil (1980), this study investigates linguistic ambiguity detection as a skill, in relation to the cognitive domain. However, in an attempt to describe metalinguistic and cognitive domains, correlations between and developmental trends for ambiguity detection, phonological segmentation, conservation skill, and reading skill will be examined.

This ambiguity detection task is designed to tap a broader spectrum of responses than did Keil (1980), since children are allowed to descriminate between ambiguous and non-ambiguous sentences if they are able to do so. Furthermore, this study provides qualitatively distinct levels of response including verbal prompting with no pictures present, and picture prompting. This hierarchy of response was designed to determine the earliest age at which judgments of ambiguity detection can be made. Like Tager-Flusberg and Smith (1980), who present preliminary findings of a study of other metalinguistic skills in preschool children, our attempt was to simplify the task of ambiguity detection and so make it more accessible to young children.

It must be noted that none of the reported studies examined cognitive achievements and reading acquisition in relation to ambiguity detection. Further, the relation between metalinguistic ambiguity detection and the processing of ambiguous sentences has not been addressed in any of the aforementioned studies.

This study is designed to incorporate a number of control variables that many previous investigators of ambiguity detection in children overlooked. These include meaning bias, sentence complexity and length, clarity and discriminability of meanings, and comprehension of the two possible meanings in lexical ambiguities.

Earlier, we reported that Evans (1976) examined whether conservers and non-conservers differ systematically on a measure of online processing difficulty while comprehending sentences with ambiguous words. The results of her study showed continuity in processing. That is, for concrete operational children, the discrepancy between reaction times for ambiguous vs. control conditions was not any smaller than for preoperational children. Therefore, an explanation was not provided for the fact that children do not at first comprehend riddles containing ambiguities as adults do. Evans suggested that in riddle comprehension the individual requires two abilities. He must be able to switch from one reading to another and he must be able to realize its ambiguity. According to Evans, the data from her study does not enable us to understand how the two abilities operate.

Rather than using a measure of on-line processing difficulty, the present study uses a task requiring a metalinguistic judgment of ambiguity. Also, the child's ability to switch from his initial interpretation of a lexical ambiguity is examined. Perhaps these measures will reflect more accurately the skills that Evans suggests are operative: the ability to switch from one reading to another, and to recognize ambiguity.

While Frommer (1975) focused upon the child's ability to use contextual information to resolve ambiguous sentences, in this study some additional questions are asked: To what extent is this skill in utilizing disambiguating contexts related to any of the following: (1) the reflective, metalinguistic judgment characteristic of ambiguity detection, (2) conservation ability, or (3) reading acquisition?

Studies of metalinguistic awareness, cognitive development, and reading acquisition have been discussed. In the present investigation we sought further evidence of (1) the link between metalinguistic awareness and cognitive development, and (2) the link between metalinguistic awareness and the acquisition of reading skills. This study of the acquisition of ambiguity detection addresses two major questions:

1. How does the acquisition of ambiguity detection proceed during the development of metalinguistic skills in general? Can we distinguish early vs. later manifestations of ambiguity detection?
2. How do ambiguity detection and segmentation relate to developing skills in other domains: i.e., conservation skill and reading

ability?

The following experimental hypotheses have been tested in this study:

1. Ambiguity detection skill is a predictor of conservation skill independent of age
2. Segmentation skill is a predictor of conservation skill independent of age
3. Ambiguity detection skill is a predictor of reading skill
4. Segmentation skill is a predictor of reading skill
5. The ability to switch from one's initial interpretation of a lexically ambiguous sentence to the other possible interpretation ("switching ability") is a predictor of ambiguity detection skill
6. Switching ability is a predictor of conservation skill
7. Switching ability is a predictor of reading skill
8. More frequent switching will occur in the prior-context position as compared to the post-context position

Developmental patterns based on grade comparisons of scores obtained will be described for the following: ambiguity detection, segmentation skill, conservation skill, and language scores.

CHAPTER III

METHODOLOGY

In this study, sixty-nine normal achievers consisting of twenty kindergarteners, twenty first graders, twenty second graders, and nine third graders participated. The kindergarteners ranged in age from 5.2 years to 5.9 years with a mean age of 5.6 years. The first graders ranged in age from 6.1 years to 6.8 years with a mean age of 6.4 years. The second graders ranged in age from 7.2 years to 8.2 years with a mean age of 7.7 years. The third graders ranged in age from 8.2 years to 9.3 years with a mean age of 8.8 years.

Children were in attendance at a New York City public school in a primarily white middle class neighborhood. Children were considered "normal achievers," representative of the population, and eligible to participate in the study if the following criteria were met:

1. Fluency in English as reported by classroom teacher (foreign-born students were allowed to participate)
2. No suspected learning deficit, emotional disturbance, or retardation according to classroom teacher
3. Conversational skills were informally assessed as socially appropriate in five-minute interchange with experimenter. Dialogue involved elicitation of information and comments by experimenter about the child's family, interests, hobbies, reaction to school, etc.

Eight learning-disabled children were evaluated whose ages ranged from 8 years 2 months to 9 years 3 months. Their mean age was 8.8 years. While all of our subjects were students in the New York City public school system, normal achievers were obtained from one elementary school and learning-disabled children were obtained from another in Queens, New York in primarily white, middle-class neighborhoods. The learning-disabled children in this study had been evaluated within the New York City school system and were attending a class designed to meet their learning deficits. These children were considered eligible to participate in the study if the following criteria were met:

1. Fluency in English as reported by the classroom teacher (foreign-born students were allowed to participate)
2. No suspected emotional disturbance or retardation according to the classroom teacher
3. Conversational skills were informally assessed as socially appropriate as in procedure used with normal achievers

To collect data in relation to the experimental hypotheses under investigation, the following measures were used: (See descriptions below)

Concept Assessment Kit: Conservation

The Concept Assessment Kit was designed to be used in assessing cognitive development among pre-school and early-school age children. This assessment, used by Hakes (1979), includes six tasks. They are designed to evaluate conservation performance in six situations: two-dimensional space, number, substance, continuous quantity, weight, and discontinuous quantity. Standardized materials, instructions, and scoring procedures are used. In each task, the experimenter presents two equal quantities to the child. After eliciting a judgment of equality from the child, the experimenter alters the appearance of one quantity. Children are scored on correctness of judgment and correctness of explanation. Since a child can earn two points on a task, a maximum total of twelve points can be earned on the entire assessment.

Woodcock Reading Mastery Test

The Woodcock Reading Mastery Test provided indices of overall reading achievement. The Woodcock Reading Mastery Test consists of five subtests:

1. Letter Identification--child is required to provide letter names
2. Word Identification--child must read words
3. Word Attack--child must read nonsense words
4. Word Comprehension--child must provide missing word to the verbal analogy after s/he reads sequence to him/herself; e.g., bark-dog, quack-____
5. Passage Comprehension--child must provide missing word to sentences and paragraphs.

Procedures for administering and scoring the mastery tests are specified in the test manual (Woodcock, 1973).

Phonological Segmentation Task

The phonological segmentation task was similar to that of Liberman, Shankweiler, Fischer, and Carter (1974). Instructions, examples, and test items were all taken verbatim from Liberman et al.

However, only the phonemic segmentation task (and not the syllable segmentation task) was included in the investigation. As in the Liberman et al. design, a game format was used in which children were presented with real or nonsense words. Stimuli consisted of either one, two, or three phonological segments. Children were required to tap out the number of segments in a stimulus word with a wooden dowel. Pre-training trials were presented initially. Training consisted of forty-two trials. For each incorrect trial, the experimenter tapped out the correct response, and then proceeded to the next stimulus item. Unlike the Liberman et al. procedure, the task was discontinued if six consecutive incorrect trials were obtained.

Lexical Ambiguity Comprehension Pre-test

Before our ambiguity detection task, all children were required to pass a comprehension pre-test. This pre-test was designed to measure the child's awareness of each of the two possible meanings for our eight lexical ambiguities. The instructions, the procedure, and the presentation of stimulus pictures were designed in accordance with the Peabody Picture Vocabulary Test. Thus, the comprehension task tapped the child's understanding of sixteen meanings (two meanings for each of the eight ambiguous words). Each of the sixteen plates consisted of four pictures where one of the four pictures represented the target meaning. The investigator said, for example, "Show me 'bat'"; and the child was required to point to the appropriate picture. While each lexical ambiguity appeared twice as a discriminative stimulus in the randomized presentation, the two sets of eight lexical items were randomized independently. Therefore, a particular lexical item could not reappear until all eight items had been presented once. (See Appendix A for pictures used.)

Ambiguity Detection Task

The ambiguity detection task was designed to assess the child's skill at detecting lexical and structural ambiguities in sentence judgment, verbal probe, and picture verification tasks. Ambiguous sentences were constructed and selected according to results obtained in a pilot study designed to establish bias estimates for comprehension of stimulus sentences by our youngest subjects. That is, it was our intention to establish the fact that both meanings could be detected by children in the youngest age group. Only ambiguities with approximately equally probable meanings were selected for the ambiguity detection task. Furthermore, lexical and structural ambiguities were matched for sentence length and syntactic structure. Unless bias estimates dictated otherwise, we tried to include only those sentences that we judged to be highly appropriate. In addition to the eight lexical and eight structural ambiguities, a set of eight filler sentences was prepared that were matched to the others for length, syntactic complexity, and appropriateness. Two sets of twelve sentences (four of each type) were randomized independently. This was done to enable us to control for effect of order of presentation. One-half of each subject group from a grade received sentences 1-12 first, while the other half received sentences 13-24 first. (See Appendix B for sentence list.)

In the ambiguity detection task, the experimenter briefly explained the idea that sentences can have more than one meaning. Three examples of ambiguity were discussed with the aid of accompanying pictures. The child was told that he or she was to hear a number of sentences, some which would mean one thing and some which would mean two different things. After hearing a sentence, the child was asked to judge whether or not the sentence in question had two meanings (sentence judgment task). The child was then asked to put the sentence meanings into his or her own words. If only one meaning was given, the child was asked if the sentence could mean anything else. This was done for each sentence, whether or not it was ambiguous. If the child detected the presence of two possible meanings, the child was asked to indicate which of the two meanings he or she noticed first.

If the child could not detect the presence of another meaning, a follow-up question was presented. These questions were designed to serve as verbal probes to facilitate the detection of two possible meanings; to elicit the exact nature of the child's interpretation of sentence meaning; and the extent of his awareness of lexical or syntactic ambiguity. These questions were prepared for the lexical ambiguities, the structural ambiguities, and the unambiguous filler sentences. (See Appendix C for verbal probe questions.) After verbal probe questions were presented, the stimulus sentence was re-presented and the child was asked to judge whether the sentence in question could mean one thing or two. If the child said "two different things," then the child was asked to explain the two different meanings.

For instances where the two meanings of an ambiguity could not be detected, and where verbal questioning did not provide sufficient prompting, our design included yet another prompting condition. The experimenter had a collection of 8 x 10 inch line drawings prepared. The entire set consisted of forty-eight illustrations. That is, two pictures for each of the twenty-four sentences (eight lexical, eight structural, and eight unambiguous). Pictures were designed to control for accuracy, saliency, and attraction of the representation. (See Appendix D for pictures used.)

Two pictures were presented to the child, each illustrating one of the two possible meanings of the sentence. The stimulus sentence was re-presented. The child was asked to point to the picture or pictures that represented sentence meaning. If one picture was selected, the child was asked if the other picture could be appropriate as well. The child was asked to listen to the stimulus sentence again and judge whether the sentence could mean one thing or two things. If the child said that the sentence could have two meanings, the child was asked to explain the two meanings.

Children earned one penny for completion of sentence judgment, or completion of the required verbal or picture probe presentations for each stimulus sentence. It was explained that the twelve pennies would be traded in for the next game to begin. Children were informed that a prize would be earned after a session of playing with the investigator.

A prepared order of test administration was followed for all subjects. Children received tasks in the following order:

Day 1: a) Lexical Ambiguity Comprehension Pre-test

b) Grammatic Closure subtest of the Illinois Test of Psycholinguistic Abilities

c) Woodcock Reading Mastery Test

Day 2: a) Ambiguity detection task--part 1

b) Phonological segmentation task

Day 3: a) Ambiguity detection task--part 2

b) Concept Assessment Kit: Conservation

c) Peabody Picture Vocabulary Test

Ambiguity Switching Task

As an extension to the design described above, the ambiguity switching task was administered to most of the participating first and second graders. This measure was designed to reflect the ability of children to "switch" from their initial interpretation of a lexical ambiguity to the other possible interpretation.

For eight lexical ambiguities, and four filler sentences, context sentences were prepared. For each ambiguity two context sentences were devised, each of which would disambiguate the lexically ambiguous sentence toward one of the two possible meanings.

Subjects were arbitrarily divided into two groups to control for the possible effect of the position of the context sentence--either preceding the ambiguous or filler, or following the ambiguous or filler sentence. The stimulus sentences for each group were counterbalanced for position of context sentence.

The particular context sentence used with a stimulus sentence was pre-selected for each subject, depending upon the subject's preferred or initial interpretation of the lexical ambiguity. (This information had been obtained in the ambiguity detection task.)

In the ambiguity switching task, subjects were told that they were going to hear a little story and that they would be asked to provide some information to explain their understanding of the story. A stimulus sentence and context sentence were presented. Following this, a series of prepared questions was presented. These questions were designed to tap the nature of the subject's present interpretation of the lexical ambiguity; that is, whether or not the subject had now switched from his or her previous interpretation of the lexical ambiguity to the one suggested by the contextual information provided in this task. (See Appendix E for stimulus sentences, context sentences, and follow-up questions.)

CHAPTER IV

RESULTS

With the exception of the last section, tested hypotheses are followed by the results obtained.

1. Ambiguity detection is a predictor of conservation skill independent of age

The findings obtained provided support for this hypothesis. For many of these analyses, conservation scores were categorized into three groups as in the Hakes (1979) study: "preconservers" obtained a conservation score of either 0 or 1; "transitional" children obtained a score within the range of 2-10; and "true conservers" achieved either 11 or 12 points on the conservation measure. Our fifteen preconservers ranged in age from 63 months (5.3 years) to 111 months (9.3 years) and with a mean age of 79.3 months (6.6 years). Our forty-five transitional children also ranged in age from 63 months (5.3 years) to 111 months (9.3 years) with a mean age of 85.27 months (7.1 years). Our seventeen conservers ranged in age from 63 months (5.3 years) to 108 months (9 years) with a mean age of 88.8 months (7.4 years).

For most of our analyses, lexical and structural ambiguity scores were transformed into a 'weighted sum' score. This was done in order to capture the different levels of response implicit in the ambiguity detection procedure. We decided that a spontaneous detection of ambiguity should represent the highest level of response. Thus, for each child, the number of spontaneously detected lexical ambiguities was multiple by "3." A verbally prompted detection was considered to be a somewhat lower level of response. Thus, the number of verbally prompted detections was multiplied by "2." The number of picture-prompted detections was multiplied by "1," as the picture-prompted response was considered the lowest level of ambiguity detection. These products were summed to arrive at the "Weighted Lexical Ambiguity Sum" score (WLSUM). The same analysis was performed on structural ambiguity scores to derive a "Weighted Structural Ambiguity Sum" score (WSSUM). Thus, out of eight possibly correct lexical or structural ambiguities, a maximum WLSUM score or WSSUM score could be 24.

For statistical evaluations that would discriminate among the more skilled and the less skilled ambiguity detectors, we established arbitrary categories of response that enabled us to compare the performances of these groups of children on other measures. For some analyses, we compared the "nondetectors" of ambiguity to all other detectors. A "nondetector" of ambiguity was a subject who obtained six consecutive incorrect items and for whom testing on ambiguity detection was discontinued. In our sample of children, we had twenty-five children in the "nondetector" of ambiguity category. Of these children, three were in the learning-disabled group. These twenty-five children ranged in age from 62 months (5.2 years) to 110 months (9.2 years) with a mean age of 74.6 months (6.2 years). The remaining fifty-two children ranged in age from 63 months (5.3 years) to 111 months (9.3 years) with a mean age of 89.8 months (7.5 years).

In some analyses, we excluded the learning-disabled children and distinguished among three categories of ambiguity detection skill: The "nondetectors" were children who had been terminated because of six consecutive incorrect responses (n = 22); the "minimal" detectors completed the task and obtained a WLSUM score in the range of 1-11 (n = 17); and the "detectors" obtained a WLSUM score within the range of 13-24 (n = 30). The twenty-two "nondetectors" of ambiguity ranged in age from 62 months (5.2 years) to 82 months (6.8 years) with a mean age of 70.8 months (5.9 years). The seventeen "minimal" detectors ranged in age from 63 months (5.3 years) to 111 months (9.3 years) with a mean age of 83.5 months (7 years). The thirty "detectors" of ambiguity ranged in age from 68 months (5.7 years) to 108 months (9 years) with a mean age of 91 months (7.6 years).

In addition to the group comparisons which we present below, our findings for individual achievements on our measures are most revealing. Arbitrary categories for WLSUM and WSSUM were established by examining natural "breaks" in the distributions of scores. An inspection of cells in Table 1 reveals that no "true conserver" obtained a WLSUM score of "0." Most importantly, no preconserving child obtained above an 11 WLSUM score or above a 6 WSSUM score. While some conservation ability appears to be necessary for high performance on ambiguity detection, it is not sufficient for high ambiguity detection performance; i.e., six true conservers were only minimal lexical ambiguity detectors; two true conservers obtained a 0 WSSUM score, ten true conservers achieved between 1-6 points on WSSUM score.

Raw ambiguity detection scores are represented by the mean number of spontaneously correct, verbally-prompted or picture-prompted responses. Raw ambiguity detection scores obtained by the three conservation groups (preconservers, transitional, and conservers) appear in Table 2. It appears that either verbally or visually presented prompts during the ambiguity detection procedure were more accessible to the "transitional" or "conserving" child.

The distribution of ambiguity detection scores (WLSUM and WSSUM scores) for pairs of conservation groups (preconservers, transitional, and conservers) was compared and evaluated using the nonparametric Mann-Whitney U-Tests. The z_u[1] scores obtained for nearly all comparisons were statistically significant at either the $p < .05$, $p < .01$, or $p < .001$ levels. (See Table 3.)

The distribution of conservation scores by nondetectors of ambiguity ($n = 25$) vs. all other ($n = 52$) ambiguity detectors was compared and evaluated using the nonparametric Mann-Whitney U-Tests. As we described earlier, a nondetector of ambiguity was a subject who obtained six consecutive incorrect items and for whom testing on ambiguity detection was discontinued. The z_u[1] score obtained for the comparison of distributions was significant ($z_u = -4.3406$, $p < .001$). That is, children who could not detect ambiguity obtained markedly lower conservation scores than children who could detect ambiguity.

In addition, conservation scores were subjected to Analysis of Variance with Lexical Ambiguity Detection as the major variable. For this analysis, lexical ambiguity detection scores were categorized

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[1]Mann-Whitney U-Tests corrected for tied ranks and expressed as normal deviates.

into three groups, as we described earlier: "nondetectors" achieved a WLSUM score of 0 ($n = 22$); "minimal" detectors obtained a WLSUM score within the range of 1-11 ($n = 17$); and "detectors" obtained a WLSUM score within the range of 13-24 ($n = 30$). The scores for the learning-disabled group were not included in this analysis. (Unless we indicate otherwise, learning-disabled children are included in the analysis.) The main effect of Lexical Ambiguity Detection Group was significant: $F\ (2, 66) = 24.41$, $p < .001$. Mean conservation scores were compared utilizing the Scheffé Test of Multiple Mean Comparisons. Significant differences were obtained for the following pairwise comparisons:

1. Nondetectors ($\bar{x} = 3.18$) vs. Minimal detectors ($\bar{x} = 6.12$); $p = .05$
2. Minimal detectors ($\bar{x} = 6.12$) vs. Detectors ($\bar{x} = 9.83$); $p = .01$
3. Nondetectors ($\bar{x} = 3.18$) vs. Detectors ($\bar{x} = 9.83$); $p = .001$

Again, this demonstrates that children who could not detect lexical ambiguities obtained markedly lower conservation scores than children who could detect ambiguities. The group of children with the best overall lexical ambiguity detection scores also have the best overall conservation scores. Apparently, the best ambiguity detectors and the nondetectors can be differentiated from a "middle" group--the "minimal" detectors, who fall between and are markedly different from the other two in conservation skill.

Finally, several Pearson product-moment correlations and Spearman rank order correlations were obtained between conservation and ambiguity detection skill. These appear in Tables 4 and 5. Generally, almost all of the correlation coefficients that were obtained between ambiguity detection skill (WLSUM or WSSUM) and Conservation were positive and moderately strong; some were low, indicating a definite but small relation between the variables. These findings provide direct support for the first hypothesis put forth. The relation between ambiguity detection skill and conservation is captured in the correlation coefficients that we cite below.

With all subjects considered, the Pearson product-moment correlation coefficient for WLSUM and Conservation was .67 ($p < .001$); for WSSUM and Conservation, it was .43 ($p < .001$). When learning-disabled children were not included in the analysis, the Pearson r for WLSUM and Conservation was .69 ($p < .001$) and for WSSUM and Conservation it was .46 ($p < .001$). When "nondetectors" of ambiguity and learning-disabled children were not included in the analysis, the Pearson r for WLSUM and Conservation was .59 ($p < .001$) and for WSSUM and Conservation it was .30 ($p < .02$).

The relation between conservation skill and ambiguity detection skill is demonstrated even more directly by the following data: As we see in Table 4, we obtained positive correlations between the variables when we partialed out Age. The Pearson r for Conservation and WLSUM was .53 ($p < .001$) and for Conservation and WSSUM, $r = .20$ ($p = .049$).

Most importantly, with Spearman correlations (for Conservation score and WLSUM or WSSUM) obtained within a grade, a substantial relation between Conservation and WLSUM score was demonstrated for first graders ($r = .50$; $p = .012$) and third graders ($r = .67$; $p = .024$); a positive relation was demonstrated between Conservation score and WSSUM score for the kindergarteners ($r = .28$, $p = .115$); first graders ($r = .32$, $p = .085$); and second graders ($r = .29$,

$\underline{p}$ = .109). (See Table 5.) (Spearman correlations were tabulated for scores within a grade because of the restricted sample size and the reduced probability of normally distributed scores.)

2. Segmentation skill is a predictor of conservation skill independent of age

The findings obtained provided support for this hypothesis. When individual achievements on the segmentation and conservation tasks were evaluated, conservation scores were categorized into three groups as described earlier. Segmentation scores were categorized arbitrarily by examining natural "breaks" in the distribution of scores. (See Table 6.) The data that represent individual achievements on these tasks support the claim that success in segmentation requires some conservation ability. In fact, no preconserver scored within the highest segmentation category. Most preconservers obtained relatively low segmentation scores. It is also the case that some true conservers did not excel in segmentation. Therefore, these findings suggest that conservation skill is not sufficient for success in segmentation.

In order to examine the relation between segmentation skill and conservation skill, several Pearson product-moment correlations and Spearman rank order correlations were tabulated. These appear in Table 7. The correlation coefficients obtained represent a statistically significant, substantial, and positive relation between the Segmentation and Conservation variables. This finding was obtained when all subjects were considered, when learning-disabled subjects were excluded, and when age was partialed out. Furthermore, a significant and substantial positive within-grade Spearman correlation was obtained for Segmentation and Conservation for first graders and third graders. (See Table 28.)

3. Ambiguity detection ability is a predictor of reading skill

The findings obtained provided support for this hypothesis. The scores obtained by each child on two reading measures--Word Attack and Passage Comprehension, along with ambiguity detection scores were tabulated. We were interested in understanding how the ambiguity detection skill relates to either the phonological decoding skill characteristic of the Word Attack subtest or the integrational skill characteristic of the Passage Comprehension subtest. Arbitrary categories were established for the reading measures by examining natural "breaks" in the distributions of scores. The data that represent individual achievements on these measures are represented in Tables 8 and 9. It is in these data that the relation between ambiguity detection and reading skill becomes most evident.

Generally, children with poor Word Attack and poor Passage Comprehension scores are poor ambiguity detectors. Further, many of our good ambiguity detectors are also good readers. However, exceptions to this are frequent. For example, although two non-reading children achieved scores in the highest lexical ambiguity detection categories, no non-reading child performed well on the structural ambiguity detection task. Also, while almost all of our best readers achieved WLSUM scores in the highest category, the best readers were evenly distributed throughout the range of WSSUM scores.

In addition to conservation scores, the distribution of reading scores for each of the five subtests for the "nondetectors" of ambiguity ($\underline{n}$ = 25) vs. all other ambiguity detectors ($\underline{n}$ = 52) was compared and evaluated using the nonparametric Mann-Whitney U-Tests. As in the analysis described earlier, a "nondetector" of ambiguity was a subject who obtained six consecutive incorrect items and for whom testing on ambiguity detection was discontinued. All of the z_u[1] scores obtained for the comparison of distributions were statistically significant with probabilities below .001. (See Table 10.) That is, children who could not detect ambiguity, obtained markedly lower reading scores than did children who could detect ambiguity.

Like conservation scores, reading scores were subjected to Analysis of Variance with Lexical Ambiguity Detection as the major variable. As in the analysis described earlier, we used the three categories of ambiguity detection scores: "nondetectors" for whom testing was discontinued because of six consecutive incorrect responses ($n = 22$); "minimal" detectors who obtained a WLSUM score within the range of 1-11 ($n = 17$); and "detectors" who obtained a WLSUM score within the range of 13-24 ($n = 30$). Scores for learning-disabled subjects were not included in this analysis. The main effect of the Lexical Ambiguity Detection Group was significant for each of our reading measures, Subtests 1-5. (See Table 11.)

When mean reading scores were compared using the Scheffé Test of Multiple Mean Comparisons, statistically significant differences were obtained between the mean reading scores for the pairwise comparisons listed in Table 12. This demonstrates once again that children who could not detect ambiguity obtained markedly lower reading scores than children who could detect ambiguity. The group

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[1]Mann-Whitney U-Tests corrected for tied ranks and expressed as normal deviates.

of children with the best overall lexical ambiguity detection scores also have the best overall reading scores. Furthermore, the best ambiguity detectors and the nondetectors could be differentiated from a "middle" group--the "minimal" detectors--on the basis of reading scores, as well. That is, the "middle" group falls between and is markedly different from the other two in reading skill as well as ambiguity detection and conservation skill.

Further evidence to support the hypothesis that ambiguity detection is related to reading skill can be found in the Pearson product-moment correlation coefficients that were obtained for ambiguity detection skill and reading. Most of the coefficients represent a significant, if not always substantial, relation between the two variables. (See Tables 13 through 16.)

4. Segmentation skill is a predictor of reading skill

The findings obtained provided support for this hypothesis. Our test of reading skill, which was the Woodcock Reading Mastery Test, yielded five subtest scores: Letter Identification (ST 1); Word Identification (ST 2); Word Attack (ST 3); Word Comprehension (ST 4); and Passage Comprehension (ST 5).

Several Pearson product-moment correlations were obtained between Segmentation scores and Reading scores. Almost all of the correlation coefficients obtained between Segmentation and Reading subtests were positive and moderately strong; a few were low, indicating a definite but small relation between variables. The Pearson coefficients, listed in Table 7, represent correlation coefficients for Segmentation and Reading subtests 1-5, when all subjects were considered.

The Pearson product-moment correlation coefficients for Reading scores and Segmentation scores that appear in Table 18 were obtained when learning-disabled children were not included in the analysis (n = 69).

The Pearson product-moment correlation coefficients listed in Table 19 represent the coefficients obtained when both learning-disabled children and children who could not detect ambiguity were not included in the analysis (n = 47).

Again, when Age is partialed out, we obtain positive correlations for Segmentation and Reading score. While these Pearson product-moment correlation coefficients represent a weaker relation, they represent a definite relation between the skills. (See Table 20.)

Finally, Spearman rank order correlation coefficients obtained within-grade for Woodcock Reading Mastery subtests and Segmentation scores were almost entirely significant, positive, and substantial. (The two exceptions were for Letter Identification scores and Segmentation for first graders and for Word Identification scores and Segmentation for kindergarteners.) (See Table 21.)

5. The ability to switch from one's initial interpretation of a lexically ambiguous sentence to the other possible interpretation is a predictor of ambiguity detection skill

The findings obtained provided support for this hypothesis. For many of these tabulations, separate categories were used for a "minimal" switcher, who obtained between 1-4 total switches; an "average" switcher, who obtained 5 total switches; and a "good" switcher, who obtained 6-8 total switches, out of eight possible switches. Also, the WLSUM scores and WSSUM scores were categorized as described previously.

Our findings for individual achievements on the switching and ambiguity detection measures are suggestive with regard to the relation between these skills. As can be seen in Table 22, the "good" switchers were almost always in the highest WLSUM score category. In contrast to this finding, the "good" switchers were distributed throughout the WSSUM score categories. Nevertheless, the child with the highest WSSUM score was also in the highest switching category. These findings suggest a closer relation between lexical ambiguity detection and switching skill than between structural ambiguity detection and switching skill.

In $\underline{t}$-tests that were performed on group data for comparing mean ambiguity detection scores obtained by the "minimal" switchers ($\underline{n} = 14$) vs. the "good" switchers ($\underline{n} = 13$) statistically significant differences were obtained for WLSUM score: $\underline{t}\ (25) = 3.3$, $\underline{p} = .003$. While the requirement for homogeneity of variances for each sample was met when comparing WLSUM scores, it was not met for WSSUM scores. Therefore, the $\underline{t}$-test findings when comparing mean WSSUM scores could not be used.

Given the heterogeneity of variances for the distributions of WSSUM scores, we employed the nonparametric Mann-Whitney U-Test findings. Nevertheless, the $\underline{z}$ score obtained when evaluating the distributions of WSSUM scores for "minimal" switchers vs. "good" switchers indicated that scores did not differ significantly between groups, although there was a trend in that direction.

The correlation data obtained for ambiguity detection and switching skill is consistent with our previous findings. That is, the positive Pearson coefficients of correlation obtained indicated a substantial relation between Total Switches and WLSUM score and a trend toward a definite but small relation between Total Switches and WSSUM score. (See Table 23.)

6. The ability to switch from one's initial interpretation of a lexically ambiguous sentence to the other possible interpretation is a predictor of conservation skill

The findings obtained supported this hypothesis, although the data indicated a relatively weak relation between the skills. For most of these measures, the same breakdown in "switching" skill scores was utilized.

An examination of individual achievements for the switching and conservation measures appears in Table 24. Because of the markedly different sample size for the preconserving ($\underline{n}$ = 5), transitional ($\underline{n}$ = 22), and conserving ($\underline{n}$ = 11) children who received the switching task, the frequencies have been transformed to percentages. Therefore, for this analysis, the entire group that received the switching task was dichotomized. Those who obtained 1-4 switches were considered "minimal" switchers. Those who obtained 5-8 switches were in the superior category. Percentages obtained in each cell indicate that while transitional children are approximately equally distributed between "minimal" switchers and "good" switchers (9/22 or 49% vs. 13/22 or 51% respectively), the preconservers were more frequently the "minimal" switchers (3/5 or 60%) and the conservers were more frequently the "good" switchers (8/11 or 73%).

In $\underline{t}$-tests that were performed to compare mean conservation scores obtained by the "minimal" switchers (1-4 switches) vs. the "good" switchers (6-8 switches) statistically significant differences were obtained at the $p = .05$ level: $t\ (25) = 2.06$.

Furthermore, the positive Pearson product-moment correlation coefficient ($r = .41$, $p = .005$) obtained for Conservation and the Total Switches measure, indicates a low to moderate relation between skills.

7. The ability to switch from one's initial interpretation of a lexically ambiguous sentence is a predictor of reading skill

The data obtained provided support for this hypothesis, although a relatively weak relation between skills was demonstrated. The findings for individual achievements in switching skill and several reading measures are presented in Table 25. While most "minimal" switchers are in the lowest Word Attack category, exceptions are frequent. While most of our "good" switchers are in the highest Passage Comprehension category, again exceptions are frequent.

In the t-tests that were performed comparing "minimal" and "good" switchers on mean reading scores for the various Woodcock subtests, we obtained a statistically significant value of t only for Subtest 5 (Passage Comprehension): $t\ (25) = 2.27$, $p = .032$.

In accordance with the findings described above, positive Pearson product-moment correlation coefficients obtained indicate a definite but small relation for Total Switches and ST 4 (Word Comprehension) and for Total Switches and ST 5 (Passage Comprehension) only. (See Table 26.)

8. More frequent switching occurs in the prior-context position as

compared to the post-context position

The data obtained do not provide support for this hypothesis. We did not discover a significant difference between prior-context and post-context conditions in the distributions of switching scores. Using the Wilcoxon Matched-Pairs Signed-Ranks Test, we obtained a z of .51, $p = .609$.

9. Grade comparisons and correlational data yielded developmental patterns for ambiguity detection, segmentation skill, conservation skill, and language scores

Grade comparisons

On Table 27, improvement can be noted in almost all instances of pairwise comparisons of adjacent-grade means within a particular category. When scores were subjected to an Analysis of Variance with Grade as the major variable, the main effect of Grade was significant for the following scores: WLSUM, WSSUM, Segmentation, Conservation, Grammatic Closure, Peabody, Woodcock Reading Mastery subtests 2-5. (See Table 28.)

Lexical ambiguity detection

Grade comparisons for lexical ambiguity detection scores indicate that the most robust difference was between first and second graders. This was the only significant difference evaluated by the highly conservative Scheffé Multiple Comparison of Means: The mean WLSUM score obtained by first graders ($\bar{x} = 7.05$) was significantly different from the mean WLSUM score obtained by second graders ($\bar{x} = 14.85$), $p < .001$. However, in t-tests that were performed on the data, for comparing mean WLSUM scores obtained by the various grades, this additional contrast was evaluated as statistically significant: kindergarteners ($\bar{x}$ = 2.35) vs. first graders ($\bar{x}$ = 7.05), t (38) = 2.41, p = .02. While third graders improve in their mean WLSUM score, no significant difference was obtained when the values of t were evaluated.

It should be noted that a definite trend toward a statistically significant difference between the distributions of WLSUM score obtained by second vs. third graders was demonstrated in the Mann-Whitney U-Tests: z_u[1] = 1.82, p = .069. It is probable that the small number of third graders accounts for the lack of a significant difference between groups.

Structural ambiguity detection

Substantial improvement was found for second and third graders in structural ambiguity detection scores. Using the Scheffé Test of Multiple Mean Comparisons, statistically significant differences between mean WSSUM scores were obtained for the following adjacent pairwise comparisons: first graders ($\bar{x}$ = 1.15) vs. second graders ($\bar{x}$ = 5.1), $p < .05$; and second graders ($\bar{x}$ = 5.1) vs. third graders ($\bar{x}$ = 9.67), $p < .05$.

Segmentation scores

Grade comparisons indicated that after first grade, no substantial improvement occurred in segmentation scores. With the Scheffé Test of Multiple Mean Comparisons, statistically significant differences between mean segmentation score were obtained only for

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[1]Mann-Whitney U-Tests corrected for tied ranks and expressed as normal deviates.

the comparison of kindergarteners' scores to any of the other groups (p = .001 level). That is, there were no statistically significant differences obtained among first, second, or third graders in their segmentation scores.

Conservation score

Findings indicated that substantial improvement in conservation scores occurred only from first to second grade. Using the Scheffé Test of Multiple Mean Comparisons, statistically significant differences were obtained between mean conservation score for the following adjacent pairwise comparison: first graders ($\bar{x}$ = 5.45) vs. second graders ($\bar{x}$ = 9.85), $p < .01$.

Grammatic Closure scores

Data obtained indicated improvement in Grammatic Closure scores for second graders only. The Scheffé Test of Multiple Mean Comparisons yielded statistically significant differences between mean Grammatic Closure scores for the following adjacent pairwise comparison: first graders ($\bar{x}$ = 21.05) vs. second graders ($\bar{x}$ = 26.2), $p < .01$.

Peabody Picture Vocabulary Test scores

Peabody scores improved steadily throughout grade levels beyond first grade. Using the Scheffé Test of Multiple Mean Comparisons, statistically significant differences were obtained between mean Peabody scores for the following adjacent pairwise comparisons: first graders ($\bar{x}$ = 71.0) vs. second graders ($\bar{x}$ = 89.15), $p < .001$; and second graders ($\bar{x}$ = 89.15) vs. third graders ($\bar{x}$ = 103.22), $p < .05$.

Woodcock Reading Mastery Test scores

Since we are interested in reading skills that are more sophisticated than "letter identification," we focused on reading subtests 2-5. Grade comparisons for these reading subtest scores indicated that the most substantial improvement occurred for second graders.

Word Identification (ST 2). When means were compared using the Scheffé Test of Multiple Mean Comparisons, statistically significant differences were obtained for the following adjacent pairwise comparisons: first graders ($\bar{x}$ = 33.2) vs. second graders ($\bar{x}$ = 85.05), $p < .001$; and kindergarteners ($\bar{x}$ = 8.3) vs. second graders ($\bar{x}$ = 85.05), $p < .05$.

Furthermore, the less conservative Mann-Whitney U-Tests yielded statistically significant differences in the distributions of ST 2 scores for second vs. third graders: z_u[1] = 2.4, p = .02.

Word Attack (ST 3). Using the Scheffé Test of Multiple Mean Comparisons, statistically significant differences were obtained between the following adjacent pairwise comparisons: first graders ($\bar{x}$ = 4.75) vs. second graders ($\bar{x}$ = 23.65), $p < .001$.

Also, with the less conservative Mann-Whitney U-Tests, statistically significant differences were obtained between the distributions of ST 3 scores for kindergarteners vs. first graders: z_u[1] = 2.17, p = .03. Findings indicated a trend toward a statistically significant difference between second and third graders: z_u = 1.72, p = .09. (The probable obstacle here, again, is the

[1]Mann-Whitney U-Tests corrected for tied ranks and expressed as normal deviates.

small sample size for third graders.)

Word Comprehension (ST 4). With the Scheffé Test of Multiple Mean Comparisons, a statistically significant difference was obtained between the following adjacent pairwise comparison: first graders ($\bar{x}$ = 5.8) vs. second graders ($\bar{x}$ = 21.8), $p < .001$.

Passage Comprehension (ST 5). Using the Scheffé Test of Multiple Mean Comparisons, statistically significant differences were obtained between mean ST 5 scores for the following adjacent pairwise comparisons: first graders ($\bar{x}$ = 7.45) vs. second graders ($\bar{x}$ = 31.4), $p < .001$; and second graders ($\bar{x}$ = 31.4) vs. third graders ($\bar{x}$ = 42.78), $p < .05$.

Correlational data on ambiguity detection, Conservation, and Peabody scores

In Tables 29-33, the Pearson product-moment correlation coefficients for (1) Peabody and ambiguity detection scores, (2) Conservation and ambiguity detection scores, and (3) Peabody and Conservation scores appear. While almost all coefficients represent substantial relations between scores, it may be noted that for each sample, the correlation between Conservation scores and WLSUM scores always exceeds the correlation between Peabody scores and Conservation scores.

Furthermore, for correlations tabulated within a grade, statistically significant correlations were never obtained for Peabody and Conservation score. For WLSUM score and Conservation score, though, statistically significant correlations for first and third graders were obtained. (See Table 33.)

Pilot data: Learning-disabled children

If we examine the mean scores obtained by the eight learning-disabled children in the pilot study, it appears that ambiguity detection scores, segmentation scores, conservation scores, as well as reading and language scores are markedly depressed. (See Table 27.)

CHAPTER V

DISCUSSION

The findings obtained in this investigation provided support for the following experimental hypotheses investigated:

1. Ambiguity detection ability is a predictor of conservation skill independent of age
2. Segmentation skill is a predictor of conservation skill independent of age
3. Ambiguity detection ability is a predictor of reading skill
4. Segmentation skill is a predictor of reading skill
5. The ability to switch from one's initial interpretation of a lexically ambiguous sentence is a predictor of ambiguity detection skill

Although the data indicated a weaker relation among the following skills, the data support these additional hypotheses:

6. The ability to switch from one's initial interpretation of a lexically ambiguous sentence is a predictor of conservation skill
7. The ability to switch from one's initial interpretation of a lexically ambiguous sentence is a predictor of reading skill

The data obtained do not provide support for the following hypothesis:

8. More frequent switching occurs in the prior-context position

as compared to the post-context position.

Previous studies have demonstrated that judgments of well-formedness and phonological segmentation reflect cognitive advancements. The findings of this study indicate that there is yet another metalinguistic skill that is dependent upon conservation skill: ambiguity detection. The reflective capacity which characterizes concrete operational thought is applied intentionally and deliberately by the child who detects an ambiguity. To judge a sentence to be ambiguous, the child must be capable of operating on language per se in a way that is decontextualized. Put differently, the child who is a conserver has the "mental flexibility" or "reversibility of thought" that is implicit in successful completion of the ambiguity detection task.

It appears that the ability to detect lexical ambiguities precedes the ability to detect structural ambiguities. This lack of uniformity in the development of lexical vs. structural ambiguity detection might very well reflect a discrepancy in the task requirements inherent in the two tasks. That is, detection of a lexical ambiguity requires awareness that the particular ambiguous word has two possible referents and, further, that this renders the particular sentence ambiguous.

While there was considerable improvement in ambiguity detection from kindergarten to third grade for both lexical and structural ambiguity detection, scores for lexical ambiguity detection far exceeded scores for structural ambiguity detection at every age level. Although sentences were matched in complexity and length for the lexical and structural ambiguity detection tasks, the detection of structural ambiguity provided a far more difficult task beyond kindergarten (when children began to be able to detect ambiguity).

Importantly, with a lexical ambiguity, the ambiguity is characteristic of a particular lexical item in the child's lexicon. Each of the two meanings have a concrete, directly perceptible, real-world representation. On the other hand, detection of a structural ambiguity requires an awareness of the existence of two possible structural analyses. That is, with the structural ambiguity, the ambiguity is characteristic of the more abstract syntactic structure of the sentence, rather than a particular lexical item.

Thus, the discrepancy in the performances of children on detection of lexical vs. structural ambiguities is most likely representative of a developmental progression for the acquisition of these forms. It is no surprise that detection of lexical ambiguity that requires access, retrieval, and integration of word meanings, albeit multiple word meanings, would be realized prior to detection of structural ambiguity that requires the more abstract analysis and re-analysis of syntactic representations.

Evidence has been provided for a relation between conservation ability and the detection of lexical ambiguities. The link is evidently independent of age, since substantial overlap in conservation skill was found across ages. Similarly, substantial differences in reading and conservation scores for groups of children differing in ambiguity detection skill cannot be attributed to age. That is, groups differing in ambiguity detection skill are also characterized by substantial overlap in age ranges.

The relation between conservation skill and ambiguity detection is highlighted if we examine the correlational data for ambiguity detection, Peabody, and Conservation scores. (See Tables 30-33.) Although substantial correlations were obtained between Peabody scores and ambiguity detection scores, it must be noted that the coefficients obtained consistantly represent a stronger relation for Conservation score and WLSUM score than for Conservation and Peabody score. The implication is that WLSUM score, in particular, reflects a cognitive-linguistic skill rather than simply a linguistic skill as does the Peabody score.

As reported earlier, positive Pearson correlations were obtained between ambiguity detection and Conservation when Age was partialed out. (See Table 4.) Furthermore, within-grade Spearman correlations revealed a substantial relation between these variables for first graders and third graders. (See Table 5.) Similar findings were obtained when Segmentation and Conservation scores were analyzed. That is, positive Pearson correlations between Segmentation and Conservation were obtained when Age was partialed out. (See Table 7.) Within-grade Spearman correlations revealed a substantial relation between these variables for first graders and third graders. (See Table 33.) Furthermore, when Age was partialed out, a significant and substantial positive Pearson correlation was obtained for Segmentation and lexical ambiguity detection. (See Table 32.) A significant and substantial within-grade Spearman correlation was obtained for Segmentation and lexical ambiguity detection only for first graders. (See Table 33.)

Given the relatively poor performance of kindergarteners in conservation, ambiguity detection, and segmentation, it is not surprising that significant positive correlations were not obtained at the kindergarten level. Importantly, among first graders, where the widest range of scores for conservation skill, ambiguity detection, and segmentation were obtained, significant and substantial positive correlations were demonstrated. For second graders, for whom a significant positive correlation was not demonstrated between conservation and ambiguity detection or between conservation and segmentation, conservation scores obtained were characterized by a more restricted range than for first graders. Most second graders obtained either fair or good scores when conservation was evaluated. Cases that would contribute to a lack of correlation between variables were most frequently children with moderate conservation skill (i.e., the "transitional" children) who were not yet good ambiguity detectors or segmenters. Rarely did we find these transitional conservers excelling in either ambiguity detection or segmentation. (When individual achievements were assessed overall, there were no preconservers who excelled in ambiguity detection and only one preconserver who excelled in segmentation.)

Although the variability of conservation scores for the nine third graders was also restricted, a substantial and positive within-grade Spearman correlation was obtained for ambiguity detection and conservation skill. Apparently, eight of the nine third graders tested, who obtained either "high transitional" or "conserving" scores on the conservation measure, also excelled in ambiguity detection. The one preconserver in the group of third graders tested was a minimal ambiguity detector.

The lack of statistical correlation for second graders might seem puzzling. That we had transitional children who were still poor ambiguity detectors or poor segmenters suggests that the reflective ability that underlies conservation, ambiguity detection, and segmentation may not be realized simultaneously within each domain. The Piagetian concept of "horizontal décalage" is sometimes invoked to explain a developmental phenomenon that is somewhat analogous. Children reportedly acquire conservation of substance, weight, and volume at different points in development. What, then, appears to be a lag in development when a cognitively-based skill is absent might more correctly be perceived as a temporal lag. That is, perhaps the skill has not yet been realized in the particular domain that is being evaluated.

Perhaps because of sampling error, examples of this phenomenon were not found among the nine third graders tested. However, examples of this phenomenon were found among the learning-disabled children that were tested. Five of the learning-disabled children tested were "transitional" conservers, who were either "nondetectors" or "minimal detectors" of ambiguity.

Thus, it can be concluded that the substantial positive correlations obtained between Conservation and ambiguity detection, between Conservation and Segmentation, and between Segmentation and lexical ambiguity detection when Age was partialed out and within-grade for first graders are not simply statistical accidents. Rather, it appears that the findings of this study complement the findings of Hakes (1980). That is, these results suggest a parallel in development of ambiguity detection, segmentation, and conservation that is independent of age. To excel in any of these domains the child must adopt a reflective mode that will enable him/her to correctly judge an ambiguity, to evaluate correctly a conservation problem or to analyze correctly a series of phonetic segments.

Can the child separate himself from the problem at hand and intentionally perform the necessary mental operations to see that different appearances might reflect a single quantity as in the conservation task? Can the child separate himself from the problem at hand and intentionally perform the necessary mental operations to see that different semantic representations or structural analyses can be linked to a single sentential ambiguity? Can the child adopt this reflective mode and segment a word or nonsense word into phonological units?

The data suggest that a single cognitive thread is necessary to the development of conservation, ambiguity detection, and segmentation. This is clearly demonstrated for our first graders who obtained a wide range of conservation scores. The data suggest, further, that this cognitive skill is not sufficient to predict success in ambiguity detection or segmentation. Support is provided primarily by the data tables that summarize individual achievements for ambiguity detection or segmentation within each of the conservation subgroups. (See Tables 1-3.) Preconservers never excelled in either metalinguistic domain. This suggests that an underlying cognitive prerequisite exists for successful metalinguistic judgments. However, some conservers never excelled in either metalinguistic domain. This finding supports the claim that the underlying cognitive skill is not sufficient for successful metalinguistic judgments.

Recent investigators of metalinguistic development have suggested that success on a conservation task does not require advancements that are specifically cognitive in nature. Rather, it has been claimed that successful conservation requires a skill in dealing with the decontextualized questions (i.e., a "metalinguistic" skill) that are presented within the conservation paradigm (Donaldson, 1978). At the present time, sufficient data have not been obtained to allow rejection of either theoretical formulation. Whether, in fact, this will occur remains to be seen.

Further reflection on the nature of the necessary cognitive skill for ambiguity detection is possible if the raw ambiguity detection scores (prior to the weighting that summarized spontaneously correct, verbally prompted, and picture prompted responses) for each of the conservation subgroups are examined. (See Table 2.) It appears that children with more conservation skill achieved markedly higher prompt scores than the preconservers. Apparently, the information provided by prompts was more accessible to the transitional or conserving child. Perhaps, this is indicative of the reflective mode that characterizes success in these domains.

Apparently, the cognitive and language skills measured in this study do not fully explain development of metalinguistic skills. Further evidence is provided in the scores for learning-disabled children. Conservation, Peabody, and Grammatic Closure scores obtained by the learning-disabled children are all approximately at the level of scores for first graders. However, the ambiguity detection task, in particular, requires a more sophisticated use of language than is available to these learning-impaired youngsters. These cognitive and linguistic measures do not provide sufficient information to explain the poor performance of these subjects.

The findings of this study further substantiate the link between reading and metalinguistic skills. Significant positive correlations were obtained for Segmentation and Woodcock Reading Mastery Subtest scores when Age was partialed out. (See Table 20.) Within-grade Spearman correlations were almost entirely significant, positive, and substantial. (See Table 21.)

Results indicate a substantial relation between ambiguity detection and reading skill as well. (See Tables 8 and 9.) The majority of poor readers (low Word Attack or Passage Comprehension scores) are poor or minimal ambiguity detectors, and many of the good ambiguity detectors are also good readers. Since almost all of the best readers excelled or did moderately well in lexical ambiguity detection, there appears to be a relatively strong association between lexical ambiguity detection and reading ability.

The child who can arrive at solutions to Piagetian tasks, explain sentential ambiguities, or appreciate the significance of (i.e., to "crack") the phonemic-orthographic code must adopt a reflective mode. As Hakes (1980) suggests, the ability to deal with language in isolation, to focus attention upon language per se, and to reflect upon it are hallmarks of metalinguistic development. The good reader must access his reflective skills when he masters the art of operating on the decontextualized language of the written text. According to Hakes, the relation between becoming metalinguistically competent and learning to read need not be simple and direct. However, it is the " . . . truly literate individual who is most likely to appreciate good metaphors, savor puns, notice ambiguities, and do all the other things that are most clearly indicative of metalinguistic ability" (p. 66).

It was intended that the design of the ambiguity detection task would improve upon methodology that had been used in previous studies. In the Kessel (1970) study of the development of ambiguity detection skill in children, investigators did not control for structural complexity, bias of sentences, or intonation contour. Nor did they eliminate oddly stated propositions. The Kessel study reports that most kindergarteners and first graders can detect both meanings of lexical ambiguities. Perhaps as a result of confounding variables, lexical ambiguity detection scores were artificially inflated. Shultz and Pilon (1973) made no attempt to pretest the availability of two meanings for the lexical ambiguities for subjects. Thus, lexical ambiguity detection scores appear to have been deflated with approximately 10% correct responding for first graders.

In preparing stimulus materials, lexical ambiguities were constructed that were matched to structural ambiguities in linguistic complexity. Bias estimates were obtained and only sentences with relatively balanced bias were used. An attempt was made to keep intonation contour as consistently neutral as possible. Finally, stimulus sentences were formed with propositions stated as clearly as possible. While vast differences were obtained between performances on lexical vs. structural ambiguity detection, it appears that, as predicted, children performed substantially better in this study than in the Shultz and Pilon study on lexical ambiguity detection. As predicted, less frequent detection of lexical ambiguities was obtained in this study than in the Kessel study.

Results of the word monitoring task used by Evans (1976) suggested a "continuity" in the processing of lexical ambiguities for preconservers, transitional, and conserving children, and comprehension and metalinguistic measures in this study provide additional information. When only first and second graders were examined in their ability to switch from their initial interpretation of a lexical ambiguity to the one suggested by the sentential context, it was found that the skill varied in accordance not only with conservation skill, but with ambiguity detection skill and reading skill. It appears then, as Evans suggested, that "realizing" an ambiguity and "switching" from one meaning to the other, are intimately related.

Contrary to the prediction of Frommer (1975), it appears that switching interpretations is more intimately related to ambiguity detection than to conservation skill; and, more specifically, switching appears to vary more in accordance with lexical ambiguity detection than with structural ambiguity detection. Furthermore, these findings suggest that switching ability is a predictor of reading skill. However, it appears that switching is related specifically to a "Passage Comprehension" skill rather than any other. That is, perhaps it is the integrational, interpretational aspects of switching that are essential to the use of contextual information in reading comprehension.

CHAPTER VI

SUMMARY AND CONCLUSIONS

This study has focused upon the relation among selected metalinguistic skills (ambiguity detection and segmentation), conservation skill, and reading achievement. These skills have been examined in children of several age groups and some learning-disabled children.

The data obtained provided answers to the empirical questions addressed. The major findings of this study can be generalized to the population of normal achievers in the five year old to eight year old range. Based on the data obtained, it can be concluded that there exists a single cognitive skill that characterizes successful conservation, ambiguity detection, segmentation and reading achievement. Individual achievements in the cognitive and metalinguistic domains indicate that this cognitive skill is necessary but not sufficient for the development of ambiguity detection and segmentation. For the population of learning-disabled children from which our sample was drawn, the relatively poor ambiguity detection performances obtained indicate further that the cognitive skill that underlies conservation ability is not sufficient to explain ambiguity detection.

While this investigation has provided answers to the empirical questions addressed, it has also provided an impetus for further study. Our cross-sectional design has implications with regard to how the various skills develop in children. However, a longitudinal study of these skills would provide further insight toward understanding the interdependence of skills.

Our findings indicated that all of the tested skills were depressed in our group of learning-disabled children. Certainly, a larger group of learning-disabled children might provide children that vary in type and severity of handicap. Furthermore, general learning deficits vs. specific reading disability was not differentiated within our group of learning-impaired youngsters. Our learning-impaired youngsters tested lower in language measures, as well. The extent to which these factors are related to the cognitive task, the reading tasks, and the metalinguistic tasks that we administered must not be overlooked.

Assuming these subject variables can be sorted out, perhaps the question of the developing interdependent skills and the individual needs of the reading-impaired youngster can be addressed more directly.

TABLE 1.--Numbers of children within each conservation category and within each ambiguity detection category

WLSUM	Preconservers n = 15	Transitional n = 45	Conservers n = 17
0	8	15	0
1-11	7	11	6
13-24	0	19	11

WSSUM	Preconservers n = 15	Transitional n = 45	Conservers n = 17
0	10	20	2
1- 6	5	16	10
7-13	0	6	4
16-17	0	3	1

TABLE 2.--Mean number correct for raw scores (unweighted) in ambiguity detection obtained by each conservation group (8 ambiguous sentences of each type were presented)

	Sentence type	Spontaneously correct	Verbally-prompted	Picture-prompted
preconservers n = 15	lexical	.07	.13	.87
	structural	-	.07	.60
transitional n = 45	lexical	1.90	1.02	1.44
	structural	-	.62	.87
conservers n = 17	lexical	3.18	1.35	2.29
	structural	.88	.35	1.60

TABLE 3.--*z*-scores obtained for Mann-Whitney U-Tests for pairwise comparisons of distributions of ambiguity detection scores for conservation groups

WLSUM x Conservation Code

	z_u[1]	2-tailed *p*
preconservers vs. transitional (n = 15) (n = 45)	2.89	$p = .004$
preconservers vs. conservers (n = 15) (n = 17)	4.69	$p < .001$
transitional vs. conservers (n = 45) (n = 17)	2.46	$p = .01$

WSSUM x Conservation Code

	z_u[1]	2-tailed *p*
preconservers vs. transitional (n = 15) (n = 45)	1.88 (trend)	$p = .0598$
preconservers vs. conservers (n = 15) (n = 17)	3.51	$p = .0005$
transitional vs. conservers (n = 45) (n = 17)	2.03	$p = .04$

[1]Mann-Whitney U-Tests corrected for tied ranks and expressed as normal deviates.

TABLE 4.--Pearson product-moment correlation coefficients for conservation scores and ambiguity detection skill

Sample	Conservation/WLSUM		Conservation/WSSUM	
	Pearson *r*	*p*	Pearson *r*	*p*
All subjects N = 77	.67	$p < .001$	.43	$p < .001$
Without learning-disabled subjects n = 69	.69	$p < .001$	.46	$p < .001$
Without the Non-detectors of ambiguity (n = 25) and the remaining learning-disabled children (n = 5) n = 47	.59	$p < .001$	.30	$p < .02$
Age partialed out without learning-disabled subjects n = 69	.53	$p < .001$	.20	$p = .049$

TABLE 5.--Spearman rank order correlation coefficients for conservation score and ambiguity detection skill obtained within a grade

Grade	Conservation/WLSUM		Conservation/WSSUM	
	Spearman r	p	Spearman r	p
kindergarten (n = 20)	.15	p = .26	.28	p = .115
first (n = 20)	.50	p = .012	.32	p = .085
second (n = 20)	-.05	p = .41	.29	p = .109
third (n = 9)	.67	p = .024	.07	p = .427

TABLE 6.--Numbers of children within each conservation category and within each segmentation category

Segmentation	Preconservers n = 15	Transitional n = 45	Conservers n = 17
0- 5	8	10	1
6-15	2	5	1
17-23	2	10	1
24-32	3	15	12
33-39	0	5	2

TABLE 7.--Pearson product-moment correlation coefficients for conservation scores and segmentation skill

Sample	Conservation/Segmentation	
	Pearson *r*	*p*
All subjects N = 77	.53	$p < .001$
Without learning-disabled subjects n = 69	.58	$p < .001$
Age partialed out without learning-disabled subjects n = 69	.39	$p = .001$

TABLE 8.--Numbers of children within each lexical ambiguity detection score category and within each Woodcock Reading Mastery subtest score category

	Word Attack		
WLSUM	0	1 - 25	28 - 50
0	19	4	0
1-11	12	7	4
13-24	2	15	14

	Passage Comprehension		
WLSUM	0	2 - 30	32 - 63
0	19	4	0
1-11	8	15	1
13-24	2	10	18

TABLE 9.--Numbers of children within each structural ambiguity detection score category and within each Woodcock Reading Mastery subtest score category

	Word Attack		
WSSUM	0	1 - 25	28 - 50
0	20	8	3
1- 6	14	12	6
7-13	0	5	5
16-17	0	0	4

	Passage Comprehension		
WSSUM	0	2 - 30	32 - 63
0	20	9	3
1- 6	9	15	7
7-13	0	5	5
16-17	0	0	4

TABLE 10--z_u[1] scores obtained for Mann-Whitney U-Tests for pairwise comparison of distributions of Woodcock Reading Mastery subtest scores for nondetectors of ambiguity vs. all others

Reading subtest		Nondetectors (n = 25) vs. All others (n = 52)
Letter Identification	(ST 1)	5.15***
Word Identification	(ST 2)	5.53***
Word Attack	(ST 3)	5.28***
Word Comprehension	(ST 4)	5.63***
Passage Comprehension	(ST 5)	5.82***

[1]Mann-Whitney U-Tests corrected for tied ranks and expressed as normal deviates.

*p < .05; **p < .01; ***p < .001; two tailed.

TABLE 11.--*F* table for Analysis of Variance performed on Woodcock Reading Mastery subtest scores with major variable--Lexical Ambiguity Detection skill (n = 69) (learning-disabled subjects excluded)

Reading subtest		Analysis of Variance
Letter Identification	(ST 1)	F (2, 66) = 16.52; $p < .001$
Word Identification	(ST 2)	F (2, 66) = 42.97; $p < .001$
Word Attack	(ST 3)	F (2, 66) = 19.69; $p < .001$
Word Comprehension	(ST 4)	F (2, 66) = 44.40; $p < .001$
Passage Comprehension	(ST 5)	F (2, 66) = 43.38; $p < .001$

TABLE 12.--Scheffé procedure comparing mean reading scores for pairwise comparisons of groups differing in ambiguity detection skill

Comparison	p
Subtest 1--Letter Identification	
1. Nondetectors ($\bar{x}$ = 28.32) vs. Minimal detectors ($\bar{x}$ = 33.12)	p = .05
2. Minimal detectors ($\bar{x}$ = 33.12) vs. Detectors ($\bar{x}$ = 37.60)	p = .05
3. Nondetectors ($\bar{x}$ = 28.32) vs. Detectors ($\bar{x}$ = 37.60)	p = .001
Subtest 2--Word Identification	
1. Nondetectors ($\bar{x}$ = 7.96) vs. Minimal detectors ($\bar{x}$ = 48.59)	p = .001
2. Minimal detectors ($\bar{x}$ = 48.59) vs. Detectors ($\bar{x}$ = 83.07)	p < .001
3. Nondetectors ($\bar{x}$ = 7.96) vs. Detectors ($\bar{x}$ = 83.07)	p = .001
Subtest 3--Word Attack	
1. Nondetectors ($\bar{x}$ = .05) vs. Detectors ($\bar{x}$ = 24.03)	p = .001
2. Minimal detectors ($\bar{x}$ = 11.12) vs. Detectors ($\bar{x}$ = 24.03)	p = .05
Subtest 4--Word Comprehension	
1. Nondetectors ($\bar{x}$ = .32) vs. Minimal detectors ($\bar{x}$ = 9.18)	p < .01
2. Minimal detectors ($\bar{x}$ = 9.18) vs. Detectors ($\bar{x}$ = 21.80)	p < .001
3. Nondetectors ($\bar{x}$ = .32) vs. Detectors ($\bar{x}$ = 21.80)	p < .001
Subtest 5--Passage Comprehension	
1. Nondetectors ($\bar{x}$ = .23) vs. Minimal detectors ($\bar{x}$ = 13.53)	p < .01
2. Minimal detectors ($\bar{x}$ = 13.53) vs. Detectors ($\bar{x}$ = 31.77)	p < .001
3. Nondetectors ($\bar{x}$ = .23) vs. Detectors ($\bar{x}$ = 31.77)	p < .001

TABLE 13--Pearson product-moment correlation coefficients for Woodcock Reading Mastery subtests 1-5 and ambiguity detection skill for all subjects ($N = 77$)

Reading subtest	Reading/WLSUM		Reading/WSSUM	
	Pearson r	p	Pearson r	p
Letter Identification (ST 1)	.55	$p < .001$	.46	$p < .001$
Word Identification (ST 2)	.75	$p < .001$	.60	$p < .001$
Word Attack (ST 3)	.64	$p < .001$	.57	$p < .001$
Word Comprehension (ST 4)	.75	$p < .001$	.60	$p < .001$
Passage Comprehension (ST 5)	.78	$p < .001$	.65	$p < .001$

TABLE 14.--Pearson product-moment correlation coefficients for Woodcock Reading Mastery subtests 1-5 and ambiguity detection without learning-disabled subjects ($n = 69$)

Reading subtest	Reading/WLSUM		Reading/WSSUM	
	Pearson r	p	Pearson r	p
Letter Identification (ST 1)	.59	$p < .001$	.48	$p < .001$
Word Identification (ST 2)	.77	$p < .001$	.61	$p < .001$
Word Attack (ST 3)	.65	$p < .001$	.57	$p < .001$
Word Comprehension (ST 4)	.76	$p < .001$	.61	$p < .001$
Passage Comprehension (ST 5)	.78	$p < .001$	.65	$p < .001$

TABLE 15.--Pearson product-moment correlation coefficients for Woodcock Reading Mastery subtests 1-5 and ambiguity detection skill when age is partialed out

Reading subtest	Reading/WLSUM		Reading/WSSUM	
	Pearson *r*	*p*	Pearson *r*	*p*
Letter Identification (ST 1)	.22	$p = .035$	.11	$p = .19$
Word Identification (ST 2)	.50	$p < .001$	.26	$p = .015$
Word Attack (ST 3)	.35	$p = .002$	.30	$p = .008$
Word Comprehension (ST 4)	.53	$p < .001$	.34	$p = .002$
Passage Comprehension (ST 5)	.53	$p < .001$	.36	$p = .001$

TABLE 16.--Pearson product-moment correlation coefficients for Woodcock Reading Mastery subtests 1-5 and ambiguity detection skill without learning-disabled and nondetectors of ambiguity

(n = 47)

Reading subtest	Reading/WLSUM		Reading/WSSUM	
	Pearson r	p	Pearson r	p
Letter Identification (ST 1)	.48	$p < .001$	.41	$p = .002$
Word Identification (ST 2)	.53	$p < .001$	.45	$p = .001$
Word Attack (ST 3)	.44	$p < .001$	.43	$p = .001$
Word Comprehension (ST 4)	.54	$p < .001$	.45	$p = .001$
Passage Comprehension (ST 5)	.59	$p < .001$	.51	$p < .001$

TABLE 17.--Pearson product-moment correlation coefficients for Woodcock Reading Mastery subtests 1-5 and segmentation for all subjects (N = 77)

Reading subtest		Pearson r	p
Letter Identification	(ST 1)	.55	$p < .001$
Word Identification	(ST 2)	.73	$p < .001$
Word Attack	(ST 3)	.62	$p < .001$
Word Comprehension	(ST 4)	.72	$p < .001$
Passage Comprehension	(ST 5)	.69	$p < .001$

TABLE 18.--Pearson product-moment correlation coefficient for Woodcock Reading Mastery subtests 1-5 and segmentation without learning-disabled subjects (n = 69)

Reading subtest		Pearson *r*	*p*
Letter Identification	(ST 1)	.61	*p* = .001
Word Identification	(ST 2)	.72	*p* = .001
Word Attack	(ST 3)	.62	*p* = .001
Word Comprehension	(ST 4)	.71	*p* = .001
Passage Comprehension	(ST 5)	.69	*p* = .001

TABLE 19.--Pearson product-moment correlation coefficients for Woodcock Reading Mastery subtests 1-5 and segmentation without learning-disabled and nondetectors of ambiguity (n = 47)

Reading subtest	Pearson *r*	*p*
Letter Identification (ST 1)	.52	$p < .001$
Word Identification (ST 2)	.61	$p < .001$
Word Attack (ST 3)	.55	$p < .001$
Word Comprehension (ST 4)	.64	$p < .001$
Passage Comprehension (ST 5)	.58	$p < .001$

TABLE 20.--Pearson product-moment correlation coefficients for Woodcock Reading Mastery subtests 1-5 and segmentation when age is partialed out

Reading subtest		Pearson *r*	*p*
Letter Identification	(ST 1)	.33	$p = .003$
Word Identification	(ST 2)	.52	$p < .001$
Word Attack	(ST 3)	.37	$p = .001$
Word Comprehension	(ST 4)	.50	$p < .001$
Passage Comprehension	(ST 5)	.41	$p < .001$

TABLE 21.--Spearman rank order correlation coefficients obtained within grade for Woodcock Reading Mastery subtests 1-5 and segmentation

	kindergarten n = 20	first grade n = 20	second grade n = 20	third grade n = 9	learning-disabled n = 8
Letter Identification (ST 1)	.39, p = .04	.12, p = .30	.44, p = .03	.96, p = .001	.25, p = .28
Word Identification (ST 2)	.36, p = .06	.51, p = .01	.57, p = .004	.75, p = .01	.58, p = .07
Word Attack (ST 3)	.50, p = .01	.52, p = .009	.57, p = .004	.72, p = .01	.78, p = .01
Word Comprehension (ST 4)	.50, p = .01	.43, p = .03	.67, p = .001	.90, p = .001	.80, p = .009
Passage Comprehension (ST 5)	.50, p = .01	.64, p = .001	.53, p = .008	.76, p < .001	.77, p = .01

TABLE 22.--Numbers of children within each ambiguity detection and within each switching category

	Number of switches		
WLSUM	1 - 4	5	6 - 8
0	3	2	1
1-11	8	4	2
13-24	3	5	10

	Number of switches		
WSSUM	1 - 4	5	6 - 8
0	6	4	5
1- 6	8	3	4
7-13	0	4	3
16-17	0	0	1

TABLE 23.--Pearson product-moment correlation coefficients for ambiguity detection and total switches

	Pearson *r*	*p*
WLSUM and Total Switches	.51	*p* = .001
WSSUM and Total Switches	.26	*p* = .061

TABLE 24.--Percentages of children within each conservation category and within each switching category

Switches	Preconservers	Transitional	Conservers
1 - 4	3/5 = 60%	9/22 = 49%	3/11 = 27%
5 - 8	2/5 = 40%	13/22 = 51%	8/11 = 73%

TABLE 25.--Numbers of children within each reading subtest category and within each switching category

Word Attack	Number of switches 1 - 4	5	6 - 8
0	3	2	1
1-25	8	4	2
28-50	3	5	10

Passage Comprehension	Number of switches 1 - 4	5	6 - 8
0	4	0	3
2-30	7	7	5
32-63	2	3	7

TABLE 26.--Pearson product-moment correlation coefficients for switching skill and Woodcock Reading Mastery subtests 1-5

Reading subtest		Pearson *r*	*p*
Letter Identification	(ST 1)	-.07	$p = .332$
Word Identification	(ST 2)	.25	$p = .065$
Word Attack	(ST 3)	.13	$p = .21$
Word Comprehension	(ST 4)	.31	$p = .03$
Passage Comprehension	(ST 5)	.37	$p = .01$

TABLE 27.--Mean and standard deviation of scores obtained by grades

	Conservation maximum = 12		WLSUM maximum = 24		WSSUM maximum = 24		Segmentation maximum = 42	
	$\bar{x}$	S.D.	$\bar{x}$	S.D.	$\bar{x}$	S.D.	$\bar{x}$	S.D.
kindergarteners (n = 20)	3.75	4.13	2.35	5.20	1.10	2.05	7.40	9.32
first graders (n = 20)	5.45	4.35	7.05	7.00	1.15	1.42	21.90	10.49
second graders (n = 20)	9.85	2.00	14.85	4.63	5.10	5.18	27.10	5.81
third graders (n = 9)	9.78	3.50	17.78	5.83	9.67	5.61	28.00	3.80
learning-disabled (n = 8)	5.38	3.62	3.88	4.12	2.13	2.36	13.63	11.19

TABLE 27.--Continued

	Grammatic Closure maximum = 33		Peabody maximum = 175		Word Attack maximum = 50		Word Comprehension maximum = 70		Passage Comprehension maximum = 85	
	$\bar{x}$	S.D.	$\bar{x}$	S.D.	$\bar{x}$	S.D.	$\bar{x}$	S.D.	$\bar{x}$	S.D.
kindergarteners (n = 20)	18.95	5.08	66.85	13.75	1.50	6.48	2.15	8.31	1.30	5.36
first graders (n = 20)	21.05	3.33	71.00	11.58	4.75	9.41	5.80	8.23	7.45	9.49
second graders (n = 20)	26.20	4.10	89.15	10.46	23.65	15.60	21.80	8.40	31.40	12.15
third graders (n = 9)	27.78	3.42	103.22	11.21	34.78	16.45	24.67	7.71	42.77	10.20
learning-disabled (n = 8)	19.75	2.60	75.25	6.01	7.38	9.09	5.38	6.99	6.63	6.41

TABLE 28.--Analysis of Variance with Grade as the major variable (n = 69) (learning-disabled subjects excluded)

Measure	df	F
WLSUM	3,65	23.75***
WSSUM	3,65	15.22***
Segmentation	3,65	23.28***
Conservation	3,65	12.35***
Grammatic Closure	3,65	15.78***
Peabody	3,65	27.17***
Word Identification (ST 2)	3,65	62.39***
Word Attack (ST 3)	3,65	24.64***
Word Comprehension (ST 4)	3,65	29.79***
Passage Comprehension (ST 5)	3,65	62.07***

***p < .001

TABLE 29.--Correlational data for all subjects (N = 77)

	Pearson r	p
Peabody/WLSUM	.71	$p < .001$
Peabody/WSSUM	.65	$p < .001$
Peabody/Conservation	.55	$p < .001$
Conservation/WLSUM	.67	$p < .001$
Conservation/WSSUM	.43	$p < .001$

TABLE 30.--Correlational data without learning-disabled and non-detectors of ambiguity (n = 47)

	Pearson r	p
Peabody/WLSUM	.55	$p < .001$
Peabody/WSSUM	.56	$p < .001$
Peabody/Conservation	.41	$p = .002$
Conservation/WLSUM	.58	$p < .001$
Conservation/WSSUM	.30	$p = .019$

TABLE 31.--Correlational data without learning-disabled (n = 69)

	Pearson *r*	*p*
Peabody/WLSUM	.74	$p < .001$
Peabody/WSSUM	.66	$p < .001$
Peabody/Conservation	.56	$p < .001$
Conservation/WLSUM	.69	$p < .001$
Conservation/WSSUM	.46	$p < .001$

TABLE 32.--Correlational data partialing out age

	Pearson *r*	*p*
Peabody/WLSUM	.48	$p < .001$
Peabody/WSSUM	.41	$p < .001$
Peabody/Conservation	.30	$p = .006$
Conservation/WLSUM	.53	$p < .001$
Conservation/WSSUM	.20	$p = .049$
Segmentation/Conservation	.39	$p = .001$
Segmentation/WLSUM	.45	$p < .001$

TABLE 33.--Spearman rank order correlation coefficients obtained within grade

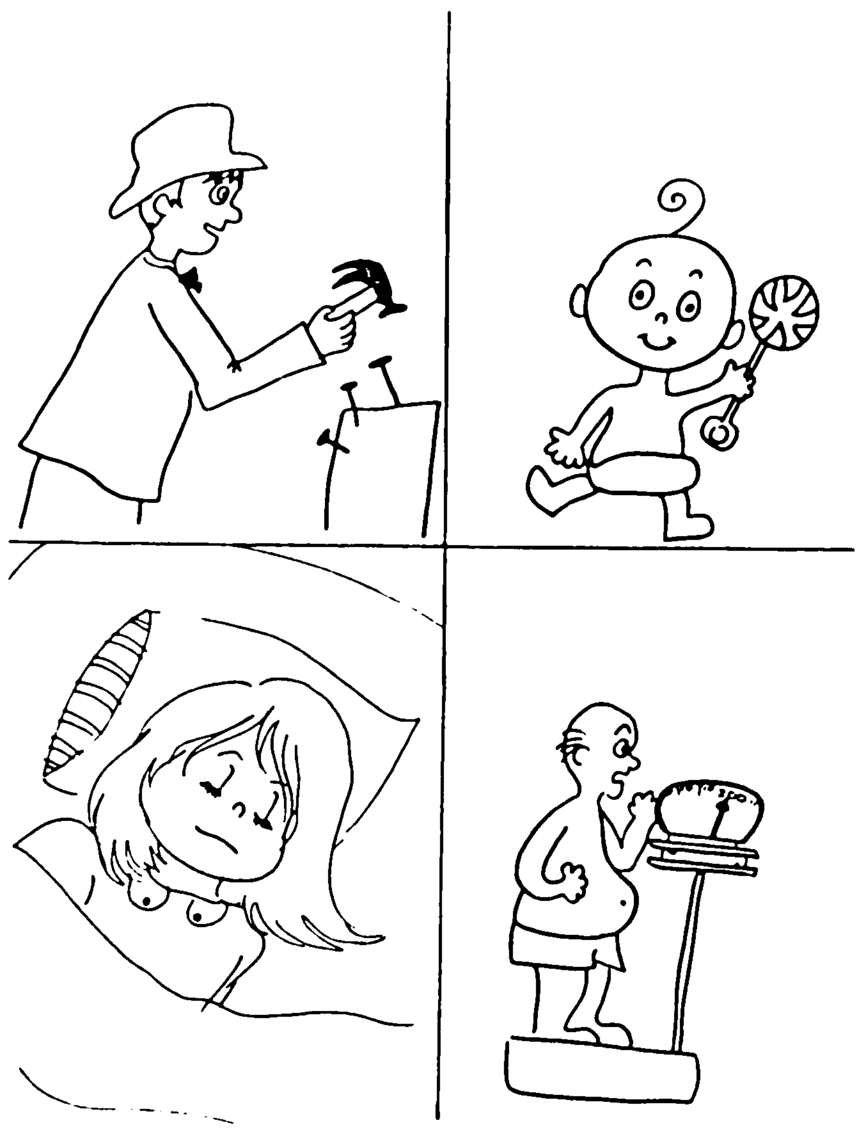
	kindergarten (n = 20)	first grade (n = 20)	second grade (n = 20)	third grade (n = 9)	learning-disabled (n = 8)
Peabody/WLSUM	.43, p = .03	.55, p = .006	.05, p = .41	.11, p = .39	-.26, p = .26
Peabody/ Conservation	.14, p = .28	.19, p = .21	.05, p = .42	.45, p = .12	.42, p = .15
WLSUM/ Conservation	.15, p = .26	.50, p = .012	-.05, p = .41	.67, p = .02	-.07, p = .437
Segmentation/ Conservation	.26, p = .138	.54, p = .007	.04, p = .44	.60, p = .04	-.22, p = .30
Segmentation/ WLSUM	.15, p = .26	.52, p = .01	.03, p = .45	.37, p = .16	.28, p = .25

APPENDIX A

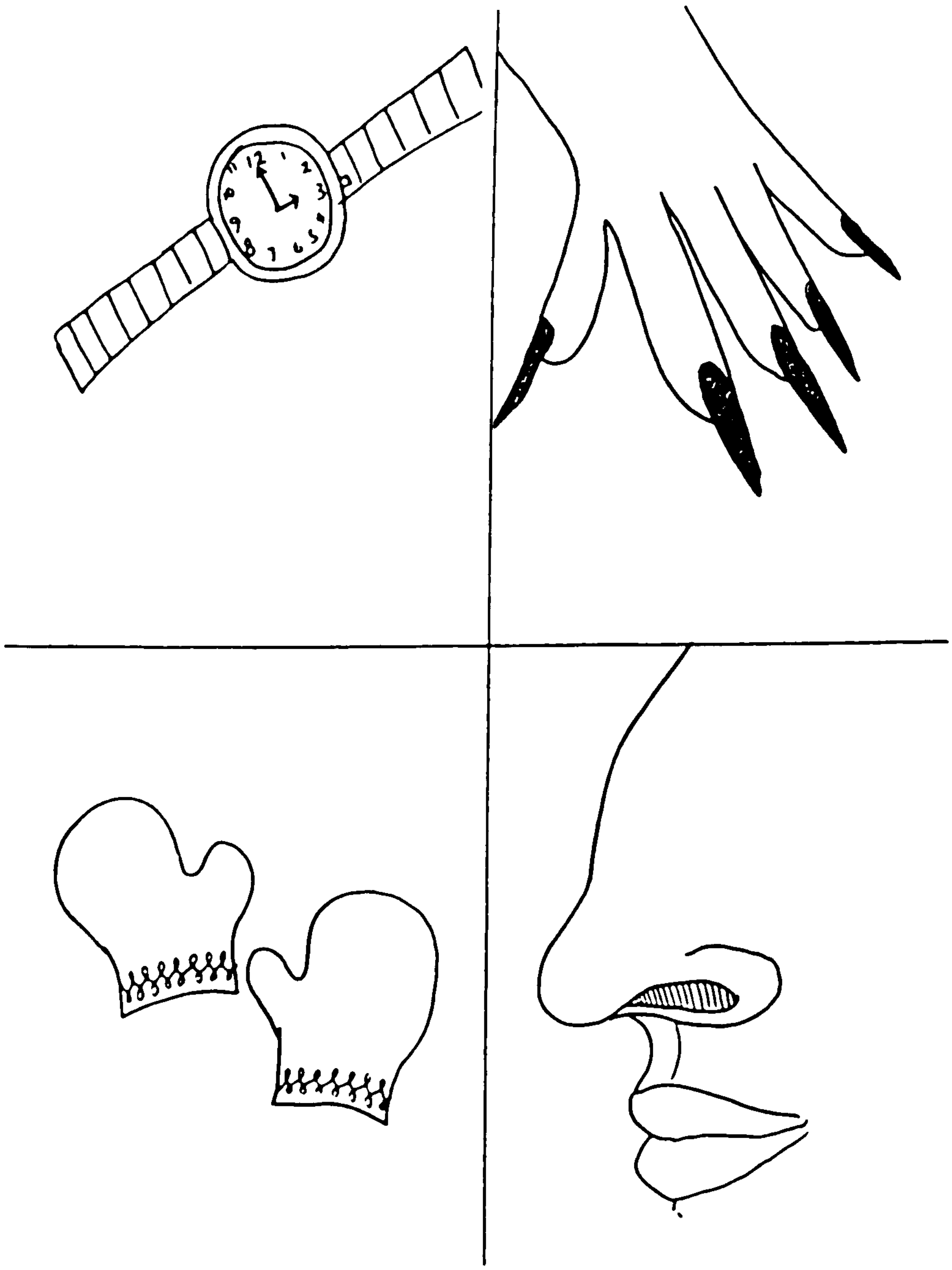
STIMULUS PICTURES FOR AMBIGUITY COMPREHENSION

PRE-TEST

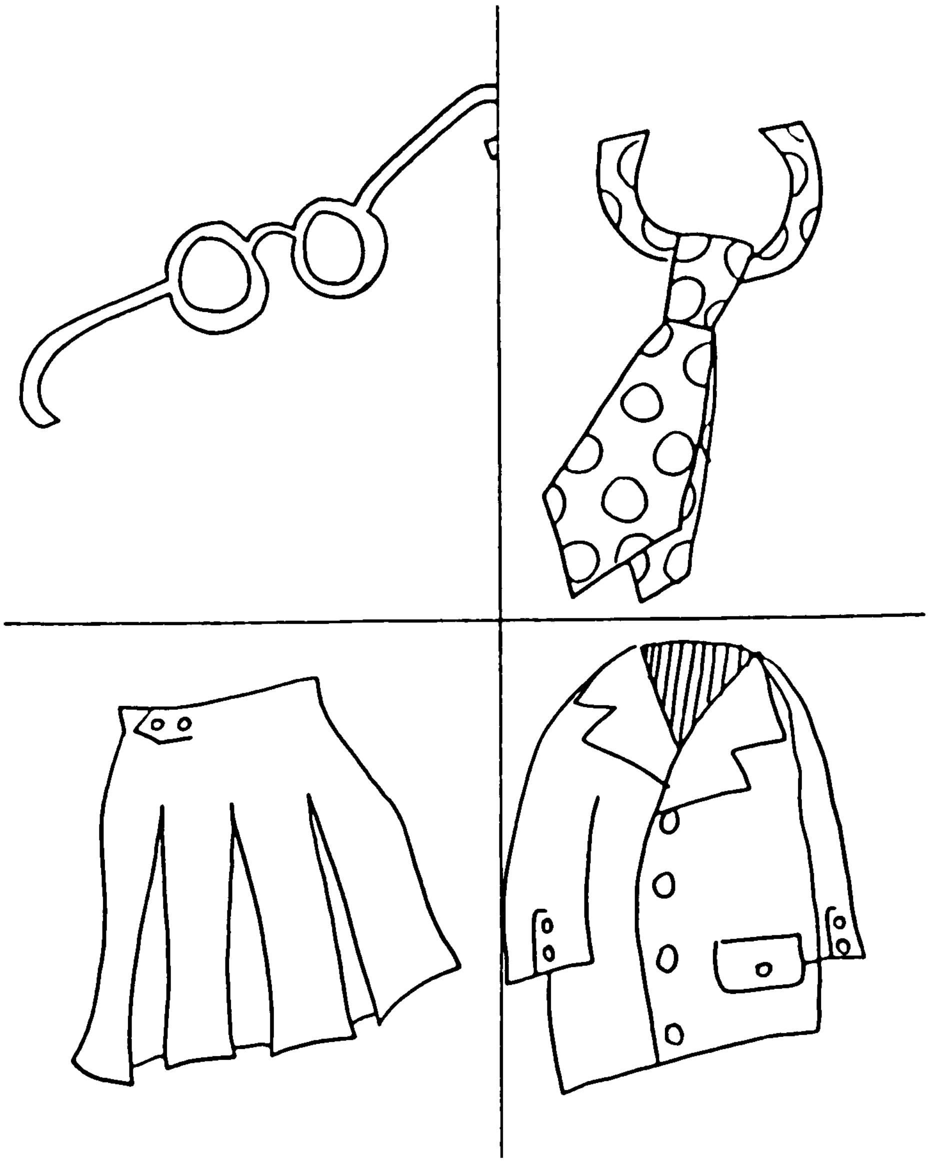
1. "Show me 'weight.'"



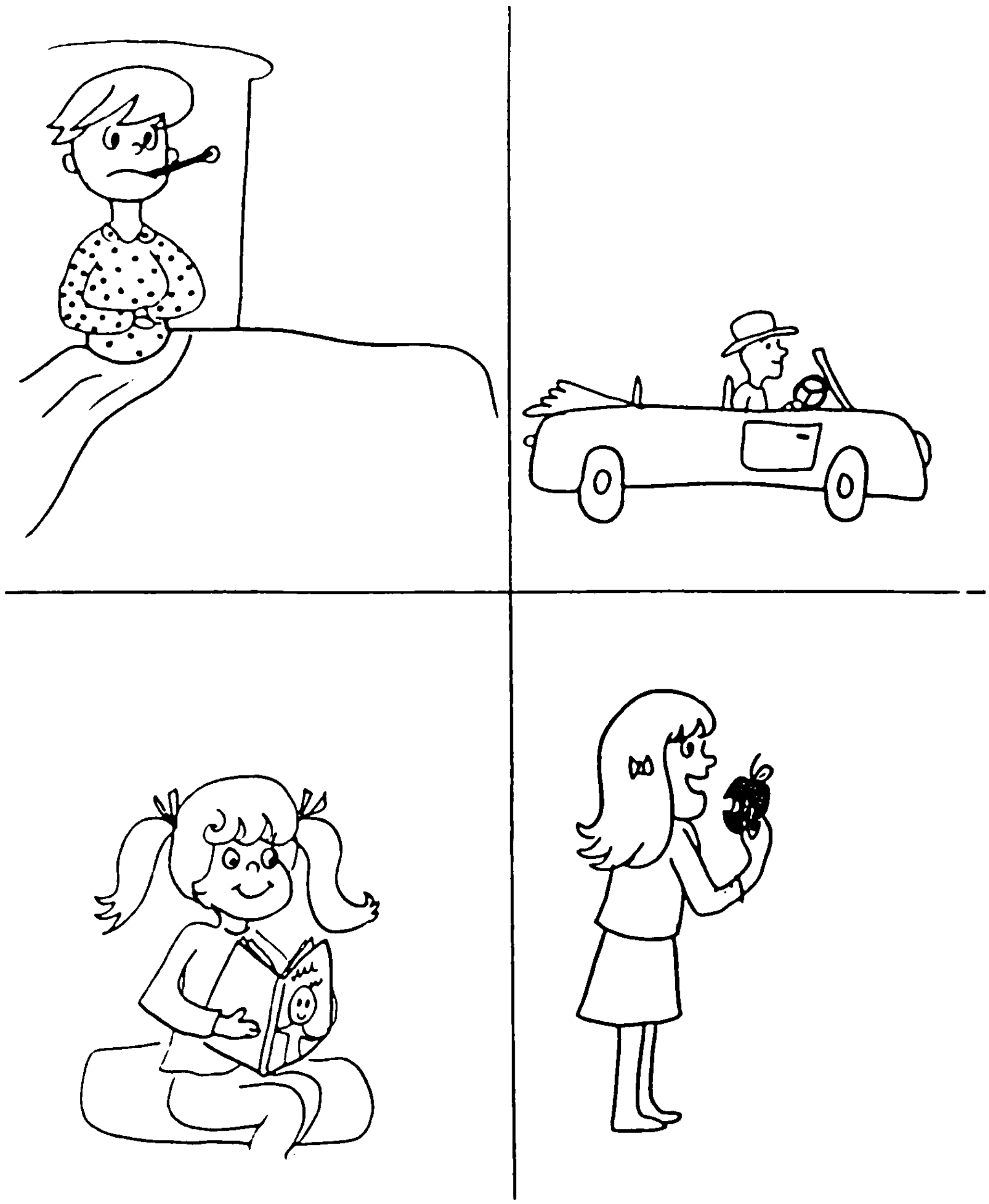
2. "Show me 'nails.'"



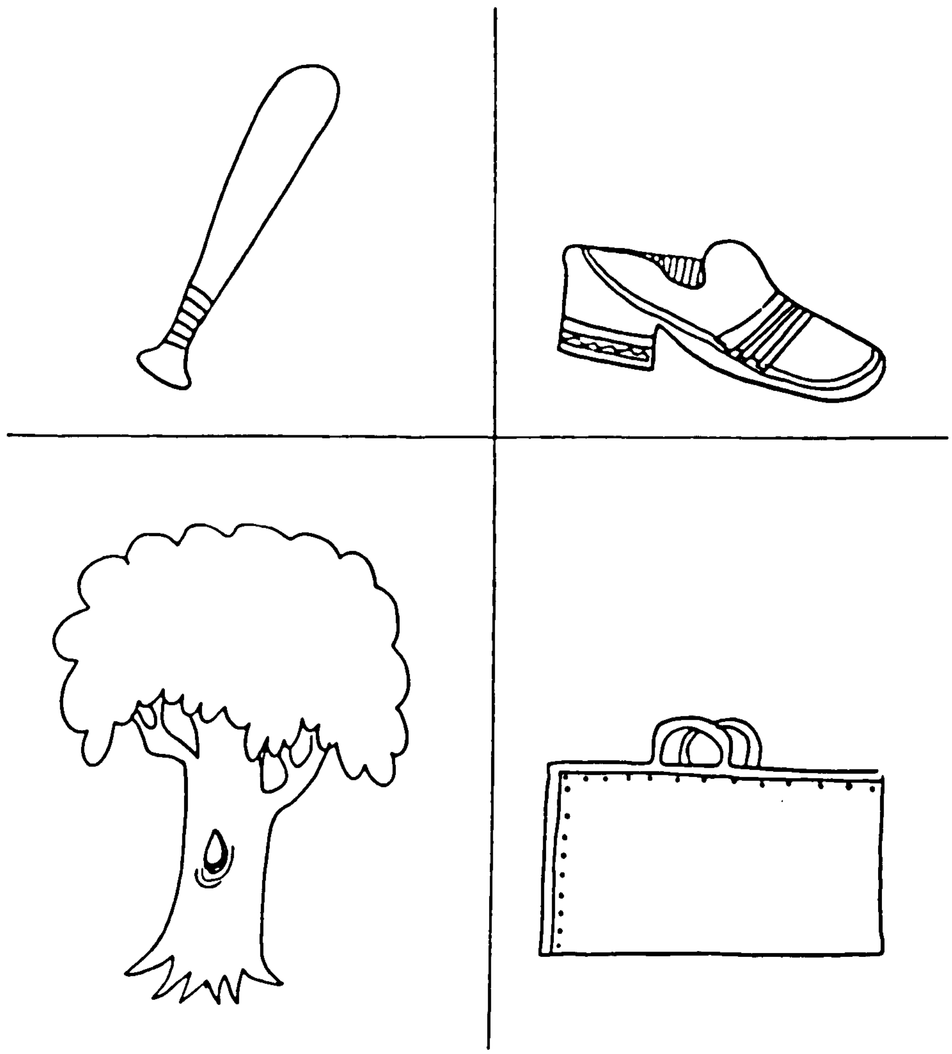
3. "Show me 'glasses.'"



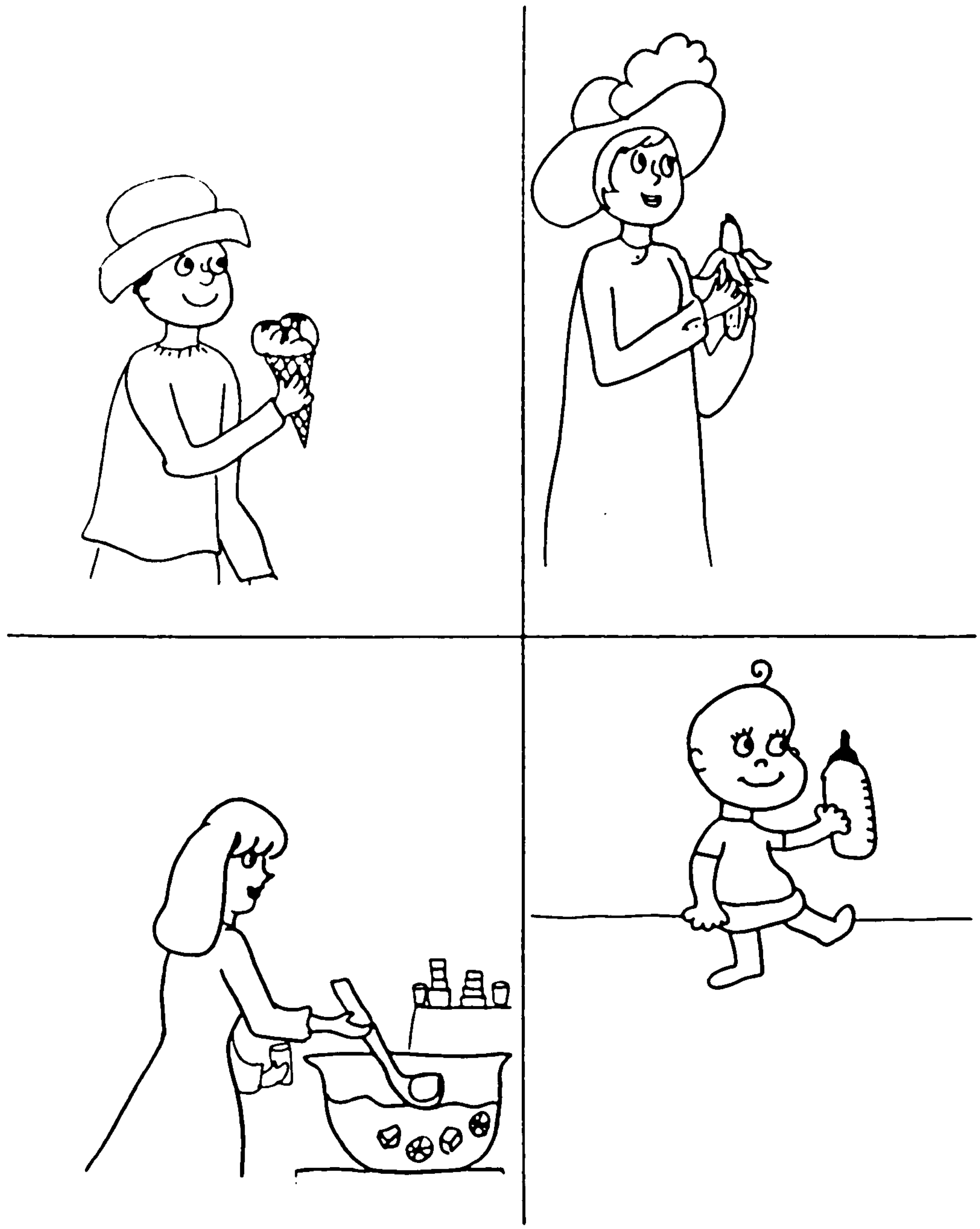
4. "Show me 'cold.'"



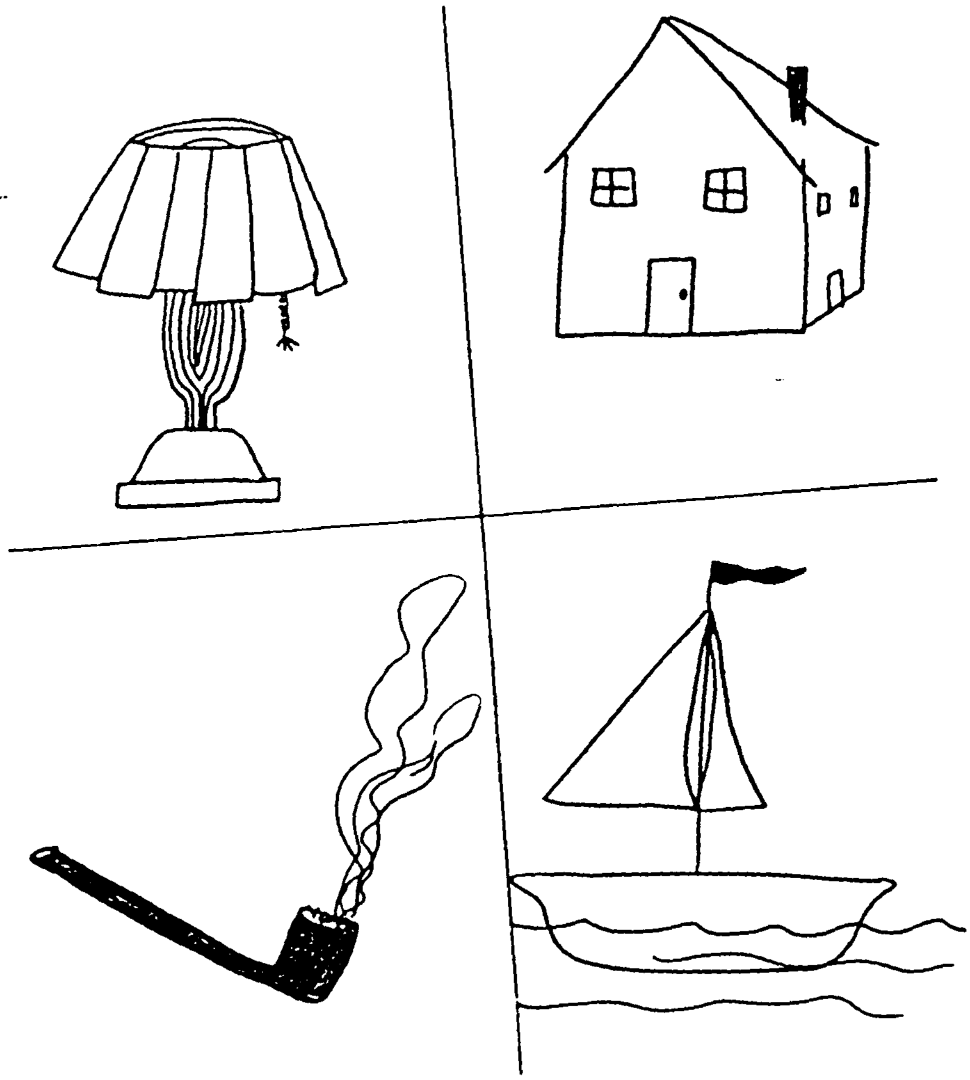
5. "Show me 'bat.'"



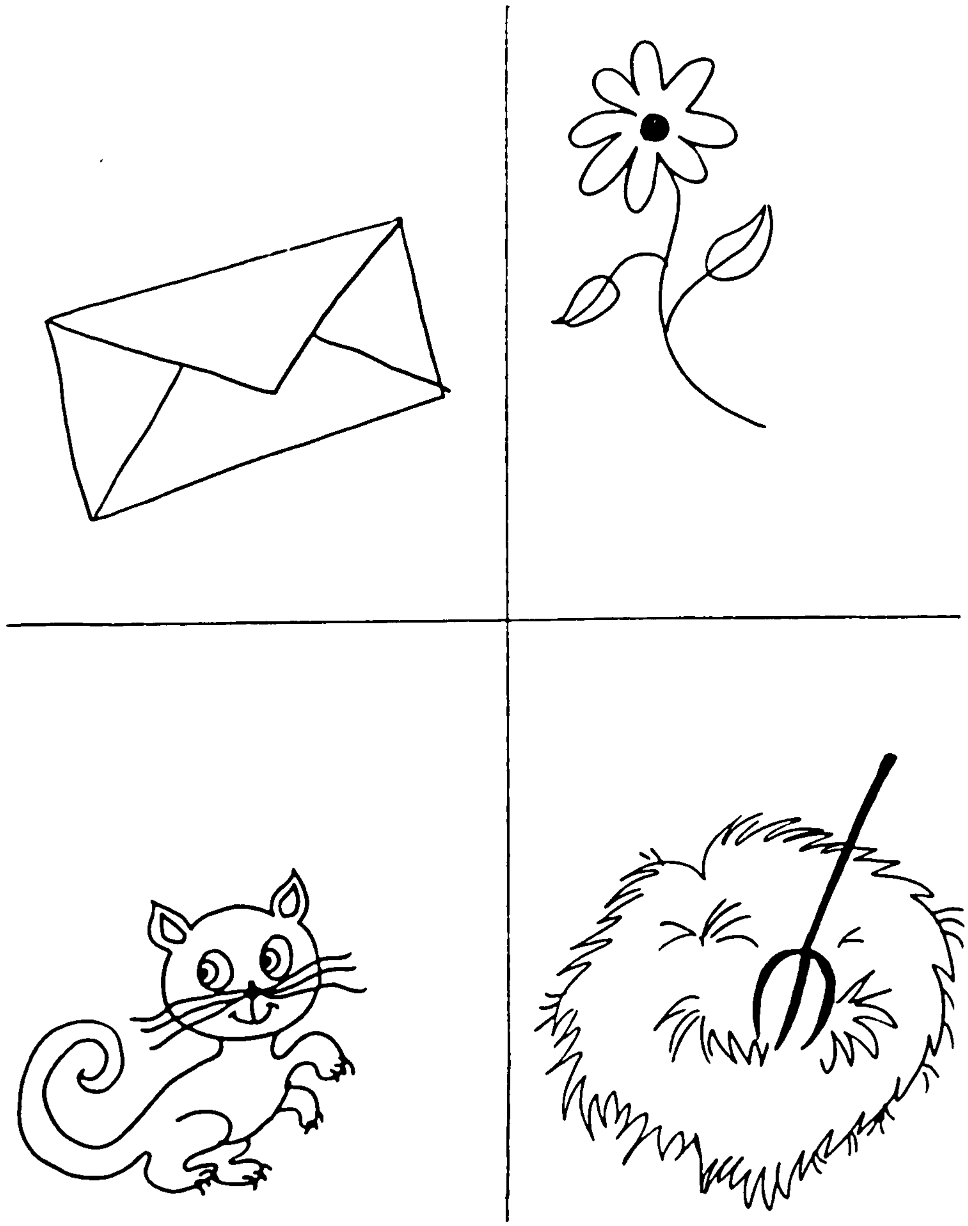
6. "Show me 'punch.'"



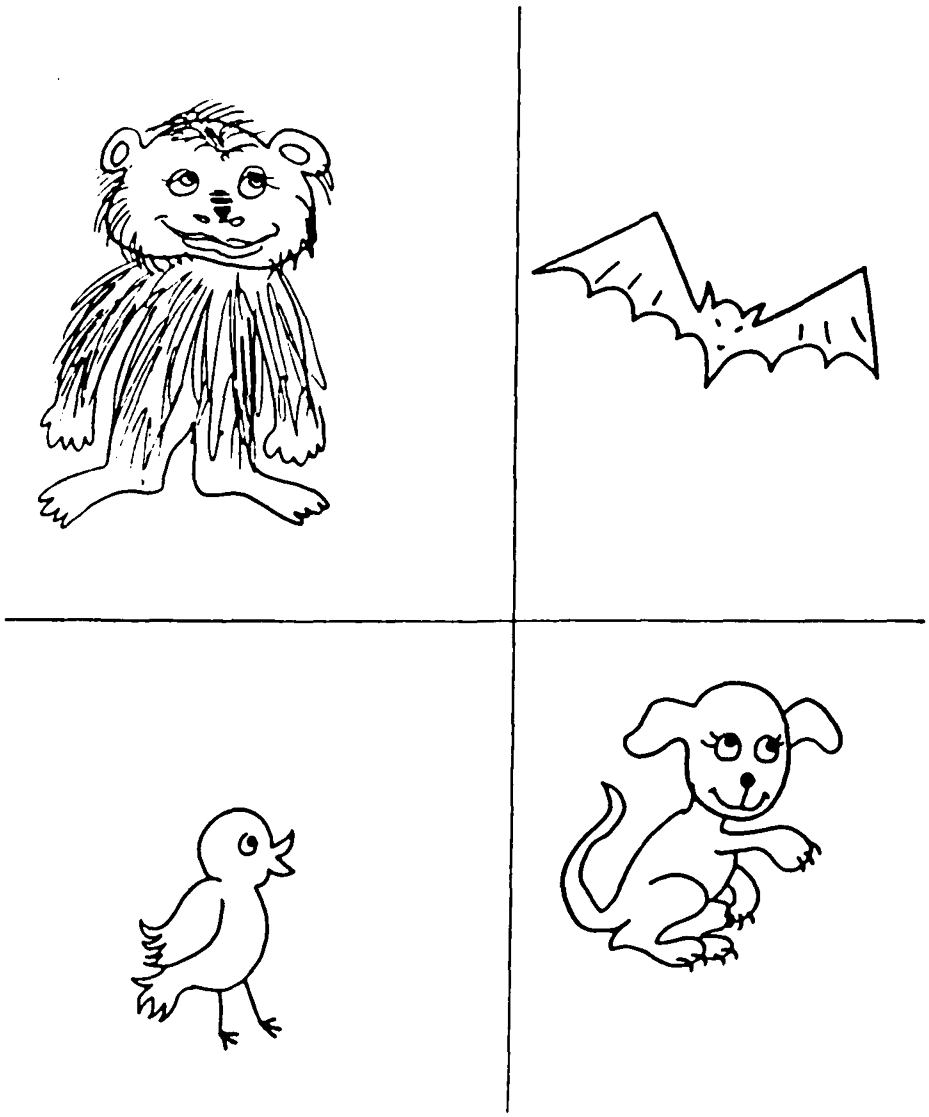
7. "Show me 'pipe.'"



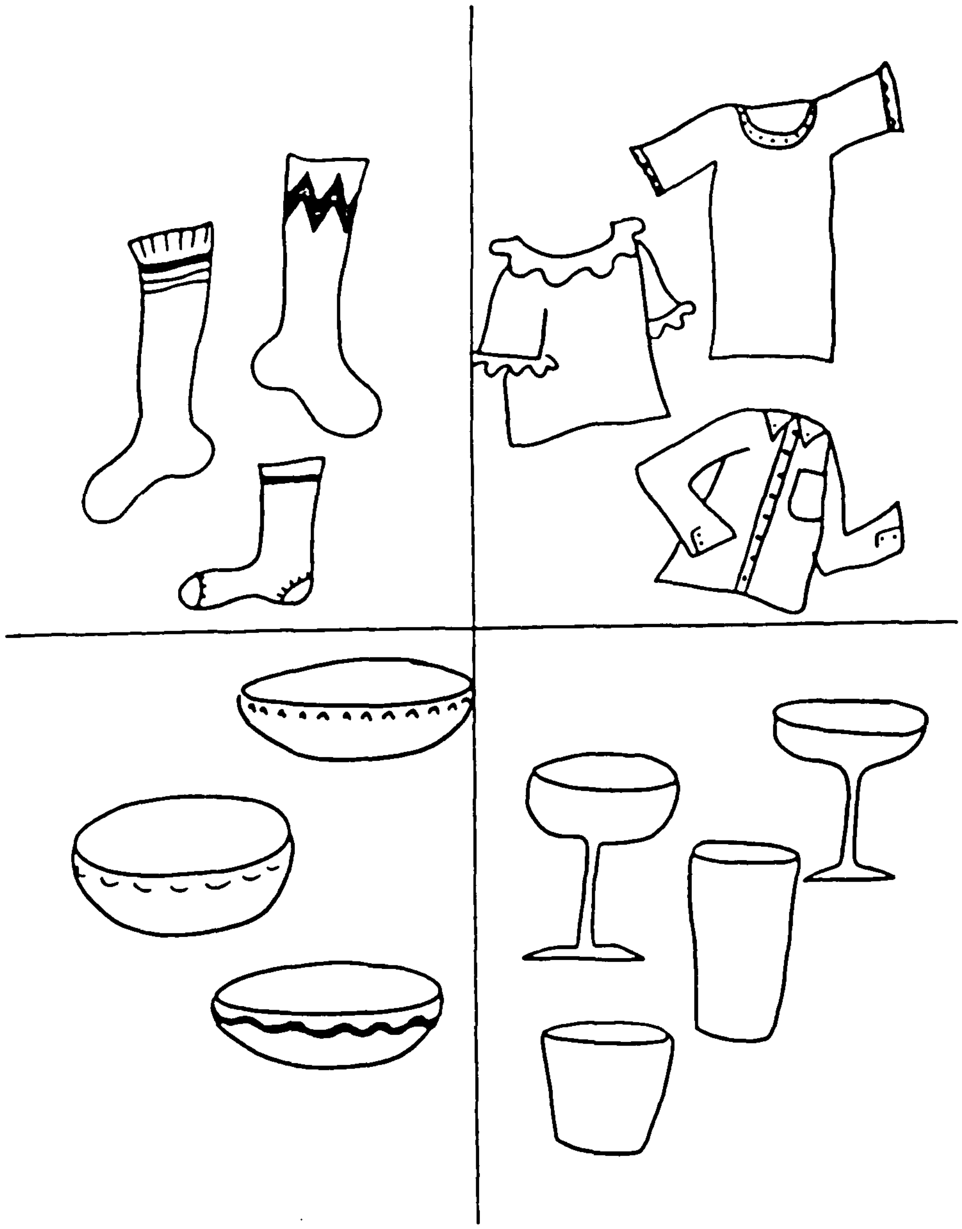
8. "Show me 'straw.'"



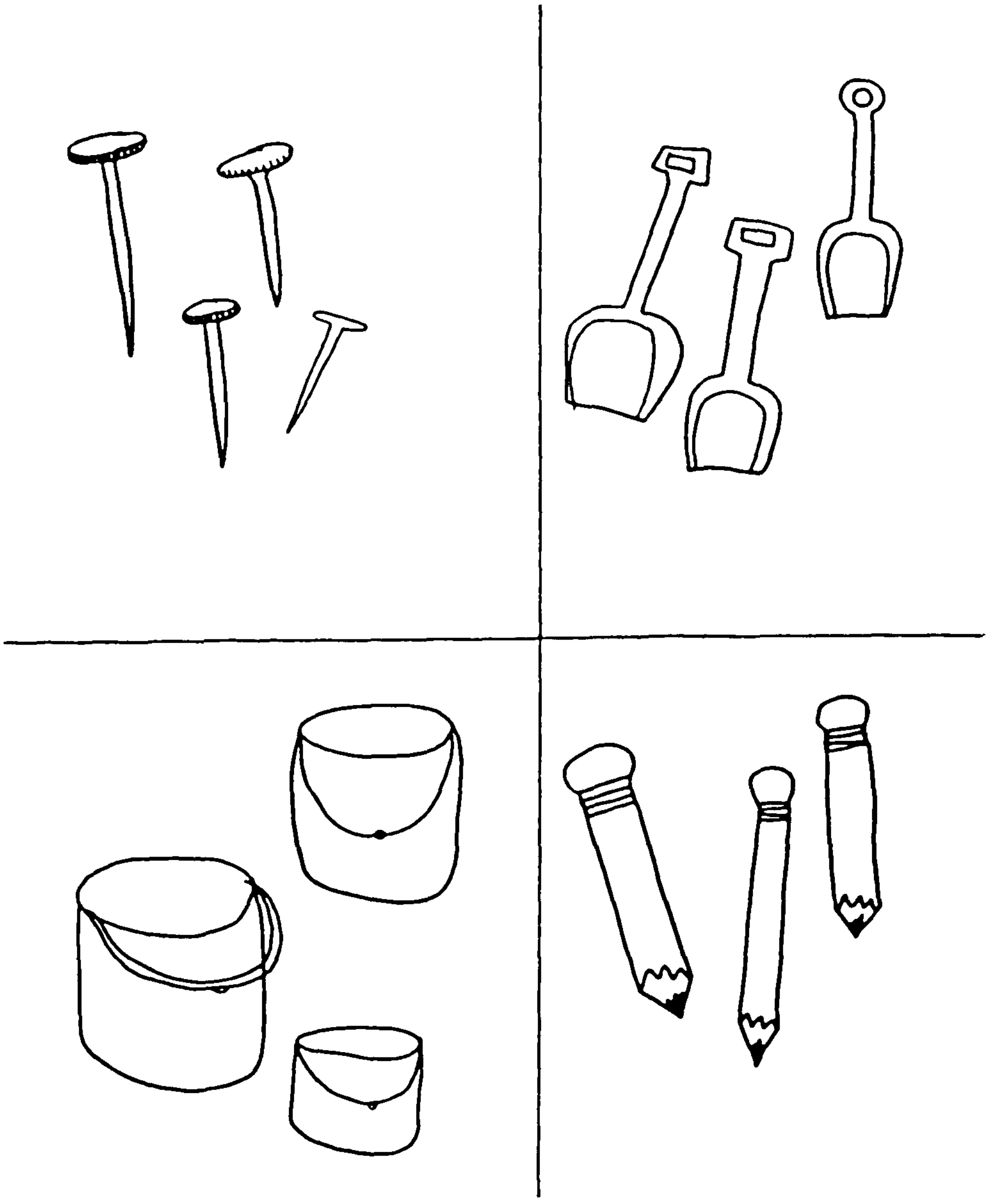
9. Show me 'bat.'"



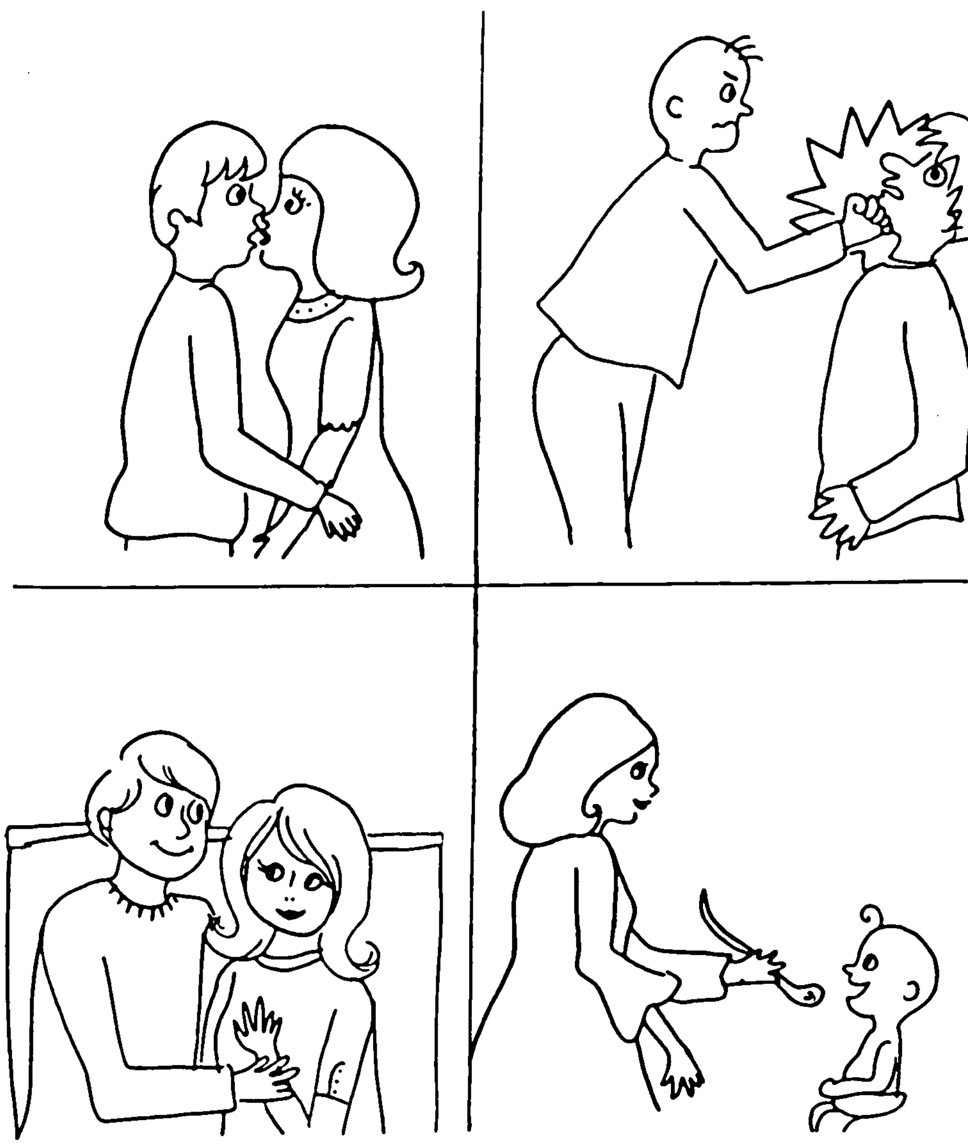
10. "Show me 'glasses.'"



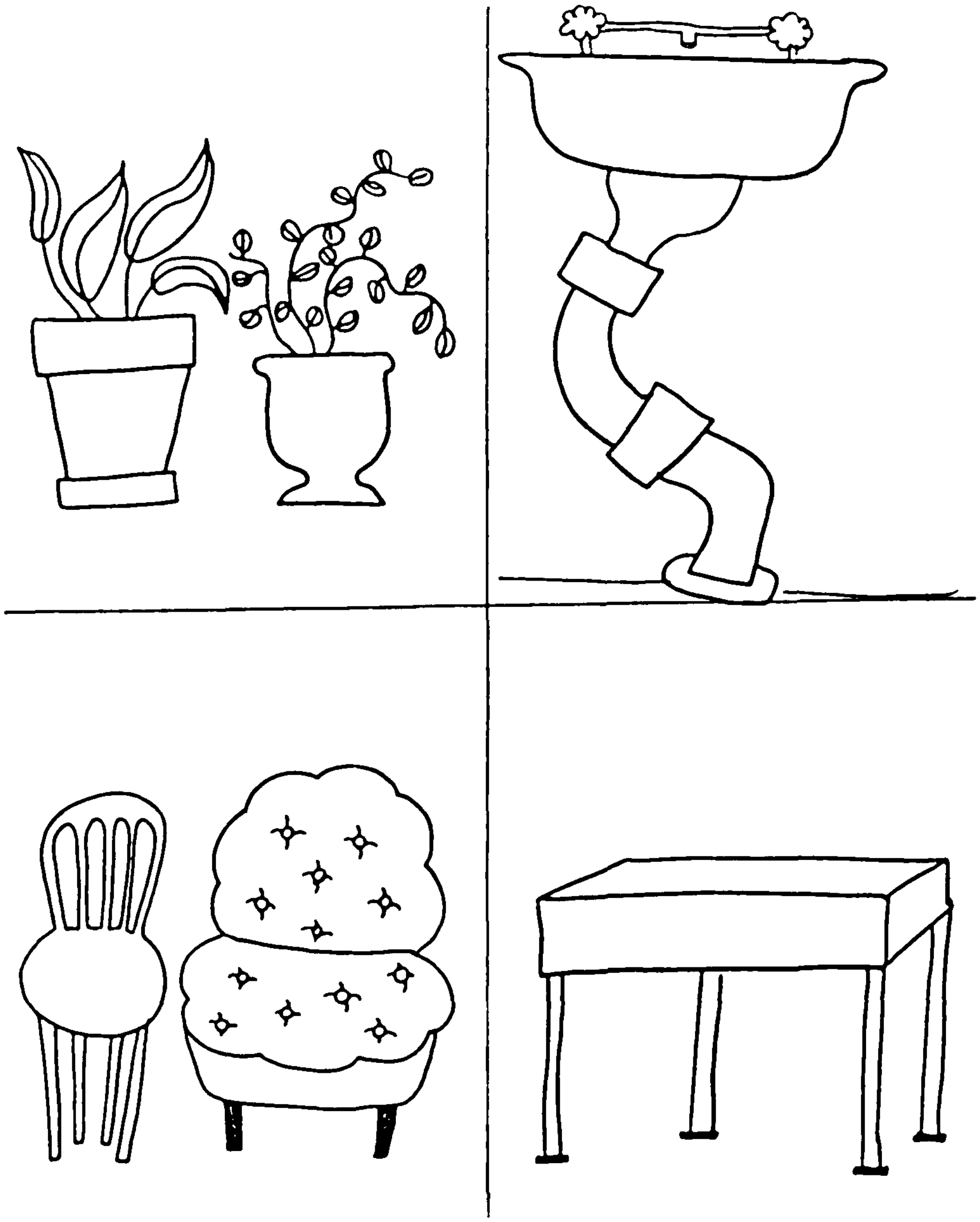
11. "Show me 'nails.'"



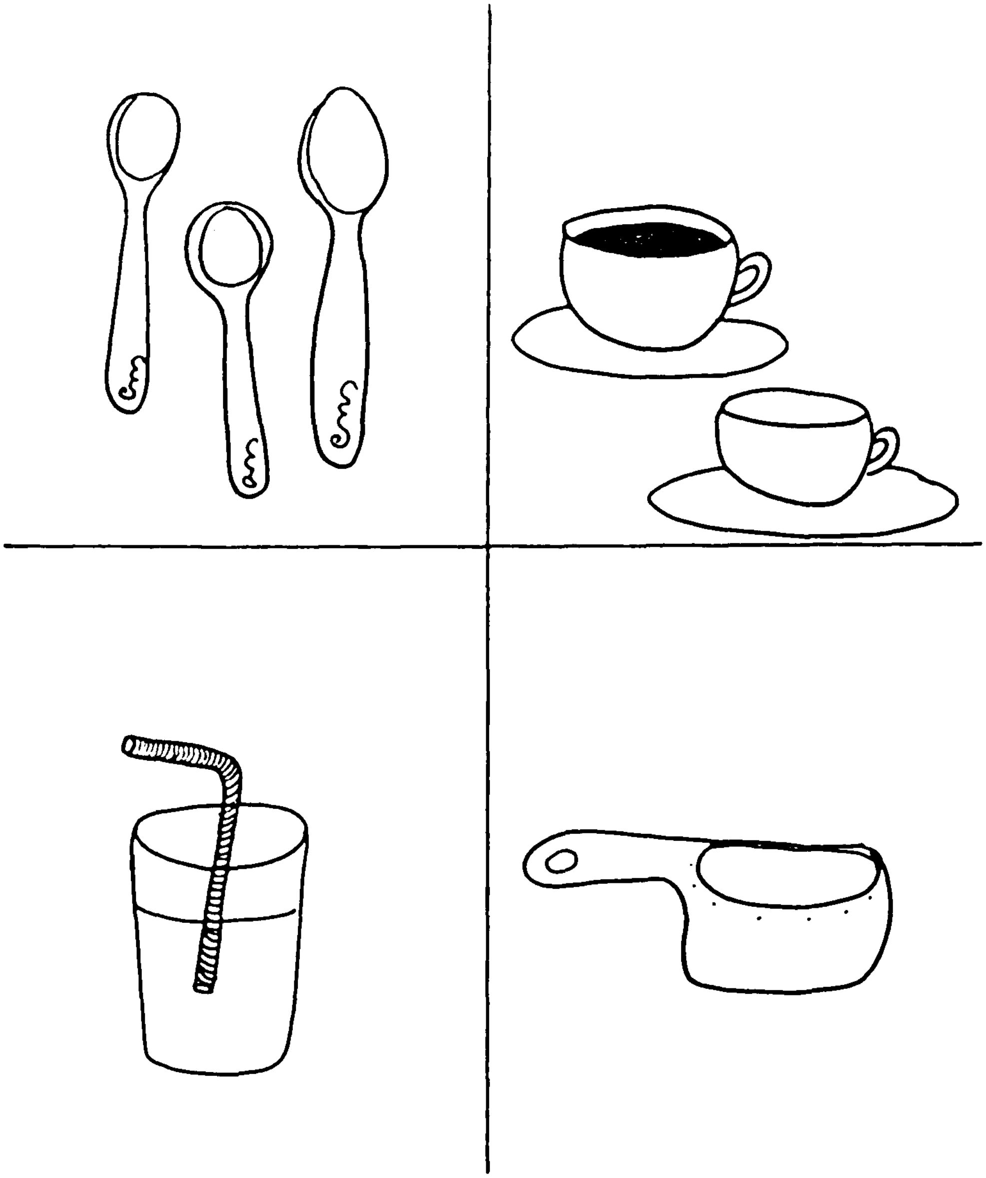
12. "Show me 'punch.'"



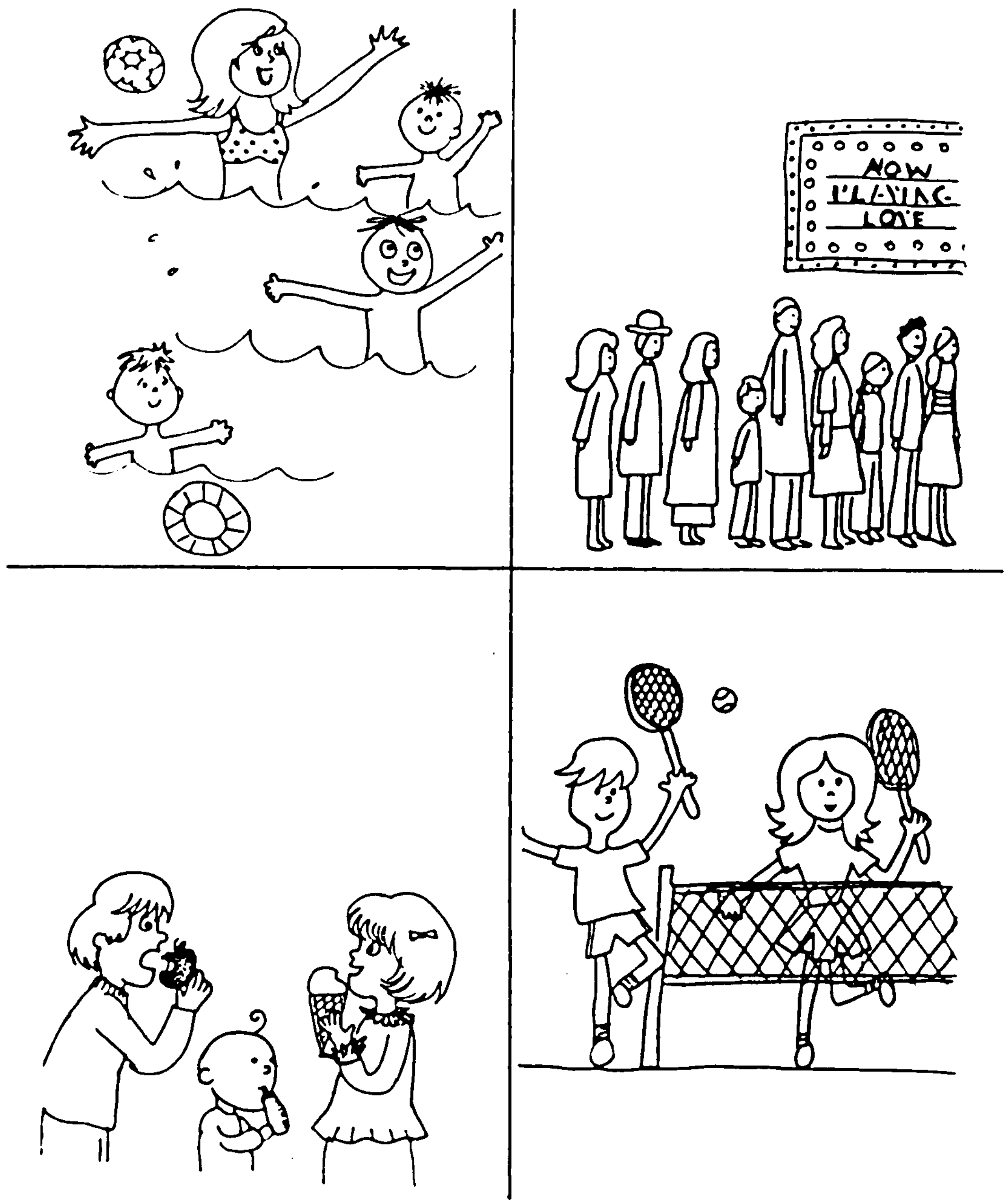
13. "Show me 'pipe."



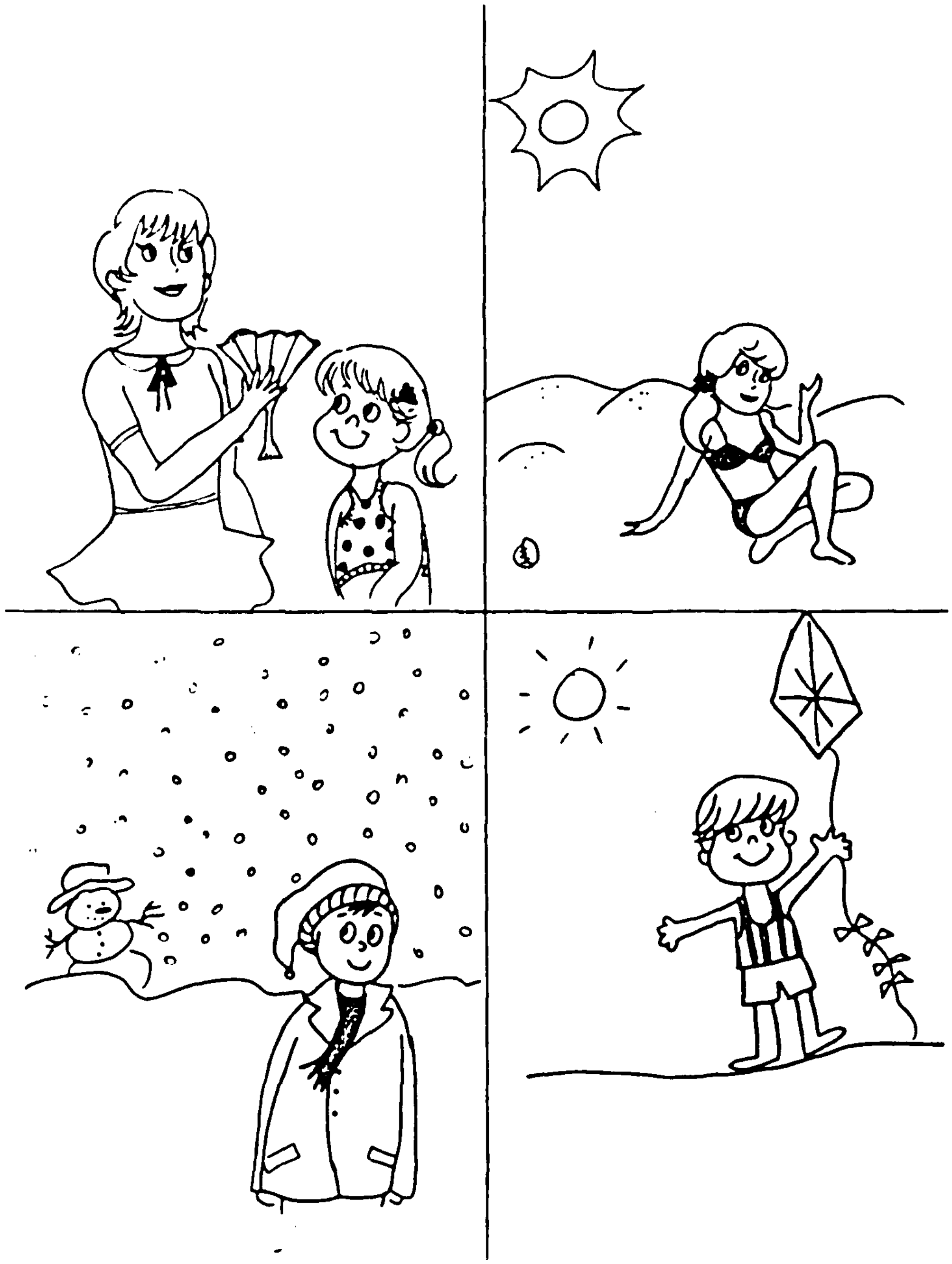
14. "Show me 'straw.'"



15. "Show me 'wait.'"



16. "Show me 'cold.'"



APPENDIX B

STIMULUS SENTENCES FOR AMBIGUITY DETECTION TASK

Practice Sentences

1. Everyone knows that flying planes can be dangerous. (structural ambiguity)

2. The cup is on the table in the livingroom. (unambiguous)

3. The children touched a horn that they saw. (lexical ambiguity)

4. When the children were jumping over each other, the boys were too fat to jump over. (structural ambiguity)

5. The man and lady wanted a very bright son/sun. (lexical ambiguity)

6. The train stopped on the tracks near the tree. (unambiguous)

Lexical Ambiguities

1. The children were told to stop because nails were making too many scratches on the furniture.

5. We saw the bat lying near the fence.

7. Peter felt terrible after the punch at the party.

12. The waitress became upset when the glasses fell on the floor and broke.

13. It was the cold that made Betty feel terrible.

16. The little boys told the cowboy that they loved playing with the straw that they found.

17. The man in the shop brought the pipe home in his car.

23. The lady was annoyed by her wait/weight in the doctor's office.

Structural Ambiguities

3. The fat soldier's wife always stood by the window.

6. The police were asked to stop smoking on the train.

8. The lady knew that the elephant was ready to lift.

9. The white dog's sweater needed to be cleaned.

15. The little girl tickled the cute little baby with the stuffed animal.

19. The sheriff caught the robber with the gun.

21. Everyone knew that the chicken was ready to eat.

24. The janitor was asked to stop the noisemaking in the hallway.

Unambiguous Sentences

2. The shiny ladies' shoes were always on the couch.

4. The children were asked to stop playing ball on the new grass.

10. The teachers were asked not to allow eating in the school.

11. The man saw the puppy with the four white paws.

14. The man almost ran over the doll with a car.

18. The tired little girl was ready to sleep.

20. The new car was ready to drive.

22. The happy baby's room had a crib in it.

APPENDIX C

VERBAL PROMPT QUESTIONS FOR AMBIGUITY DETECTION TASK

Below are the sentences with corresponding verbal questions in order of presentation.

(Day 2)

Practice Sentences

1. Everyone knows that flying planes can be dangerous.

   Who might be in danger?

2. The cup is on the table in the livingroom.

   What is on the table?

3. The children touched a horn that they saw.

   Where could the horn be from?

4. When the children were jumping over each other, the boys were too fat to jump over.

   Who couldn't jump?

5. The man and lady wanted a very bright son/sun.

   What could the son/sun look like?

6. The train stopped on the tracks near the tree.

   Where did the train stop?

Test Sentences

1. The children were told to stop because nails were making too many scratches on the furniture.

   What kind of nails were making scratches?

2. The shiny ladies' shoes were always on the couch.

   What was shiny?

3. The fat soldier's wife always stood by the window.

   Who was fat?

4. The children were asked to stop playing ball on the new grass.

   Who was playing ball on the grass?

5. We saw the bat lying near the fence.

   What did the bat look like?

6. The police were asked to stop smoking on the train.

   Who was smoking?

7. Peter felt terrible after the punch at the party.

   Why did the punch make Peter feel terrible?

8. The lady knew that the elephant was ready to lift.

   What was happening with the elephant?

9. The white dog's sweater needed to be cleaned.

   What was white?

10. The teachers were asked not to allow eating in the school.

    Who was eating in the school?

11. The man saw the puppy with the four white paws.

    Who had the four white paws?

12. The waitress became upset when the glasses fell on the floor and broke.

    What were the glasses for?

(Day 3)

13. It was the cold that made Betty feel terrible.

    Why did the cold make Betty feel terrible?

14. The man almost ran over the doll with a car.

    What almost happened?

15. The little girl tickled the cute little baby with the stuffed animal.

    Who had the stuffed animal?

16. The little boys told the cowboy that they loved playing with the straw that they found.

    What was the straw for?

17. The man in the shop brought the pipe home in his car.

    What was the pipe for?

18. The tired little girl was ready to sleep.

    Who was ready to sleep?

19. The sheriff caught the robber with the gun.

    Who had the gun?

20. The new car was ready to drive.

    What was ready to drive?

21. Everyone knew that the chicken was ready to eat.

    Who was ready to eat?

22. The happy baby's room had a crib in it.

    Who was happy?

23. The lady was annoyed by her wait/weight in the doctor's office.

    Why was the lady bothered by her wait/weight?

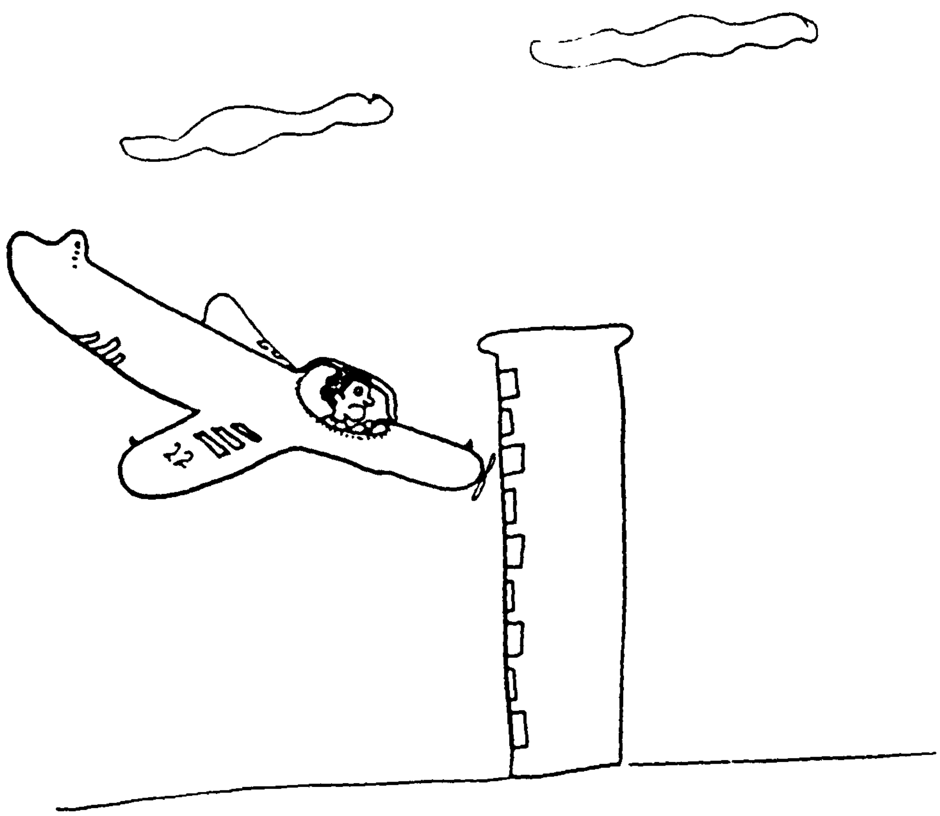
24. The janitor was asked to stop the noisemaking in the hallway.

    Who was making noise?

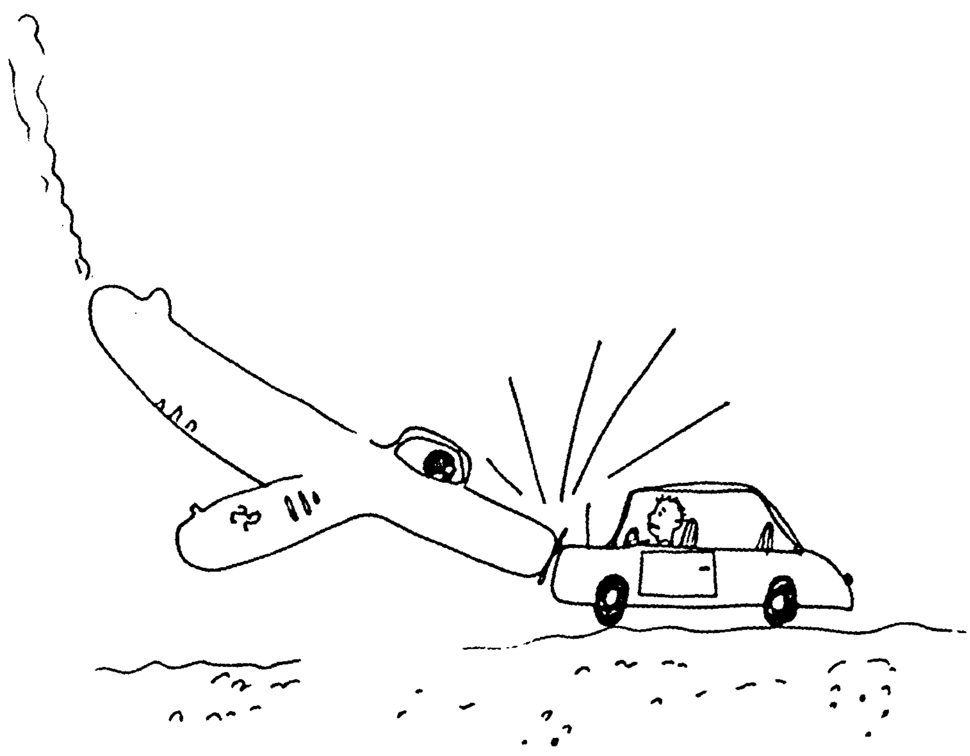
APPENDIX D

STIMULUS PICTURES FOR AMBIGUITY DETECTION TASK

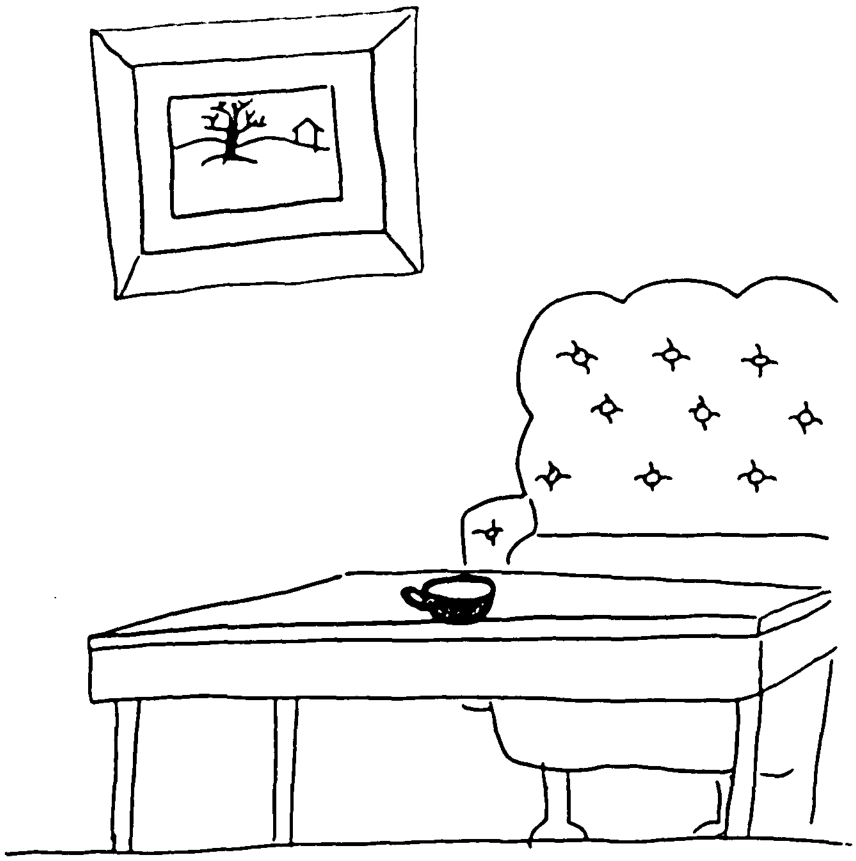
Practice Sentence 1(a): Structural Ambiguity



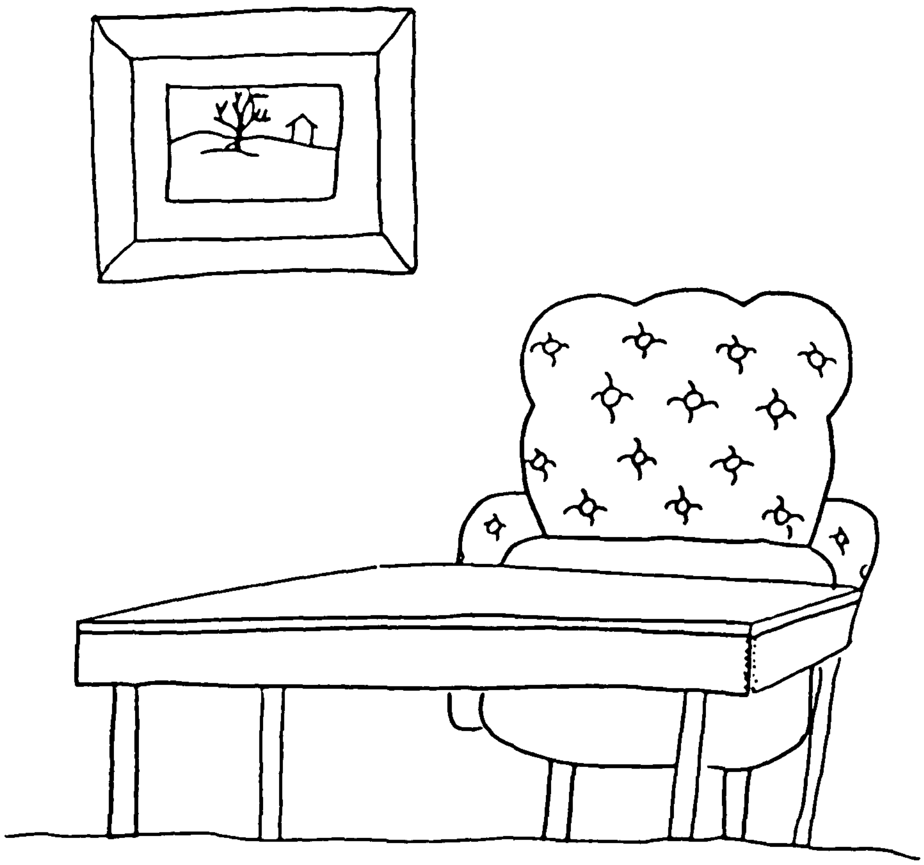
Practice Sentence 1(b): Structural Ambiguity



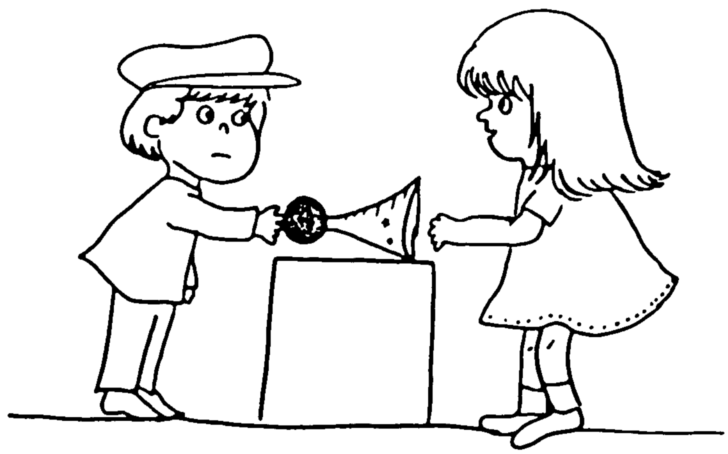
Practice Sentence 2(a): Unambiguous



Practice Sentence 2(b): Unambiguous

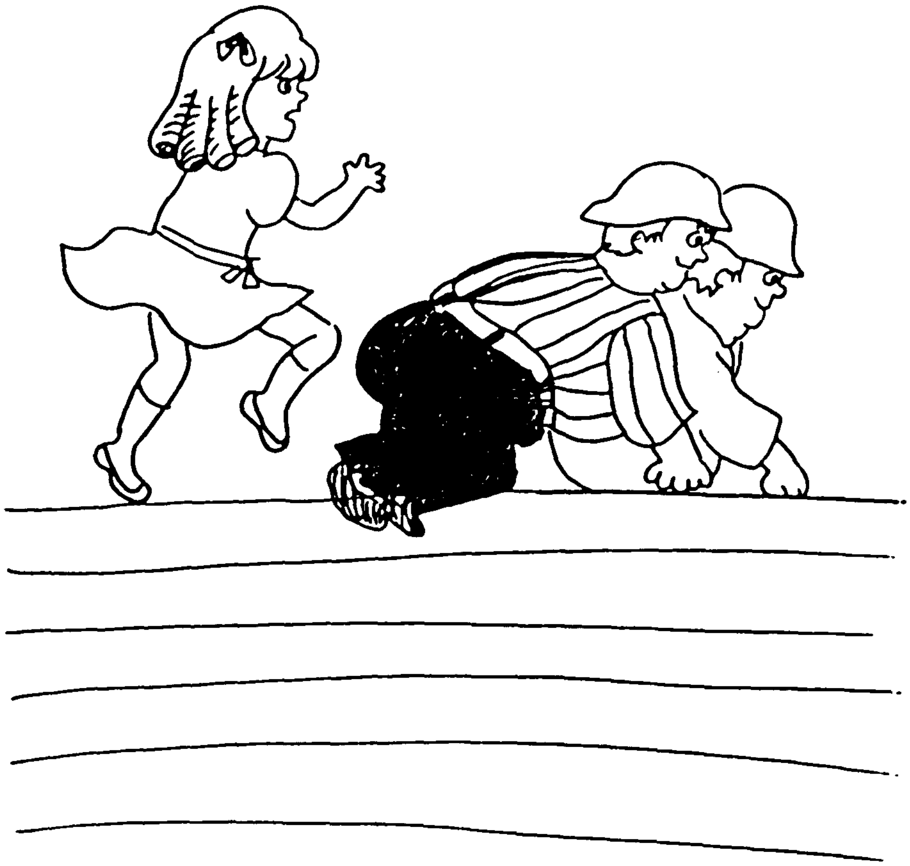


Practice Sentence 3(a): Lexical Ambiguity

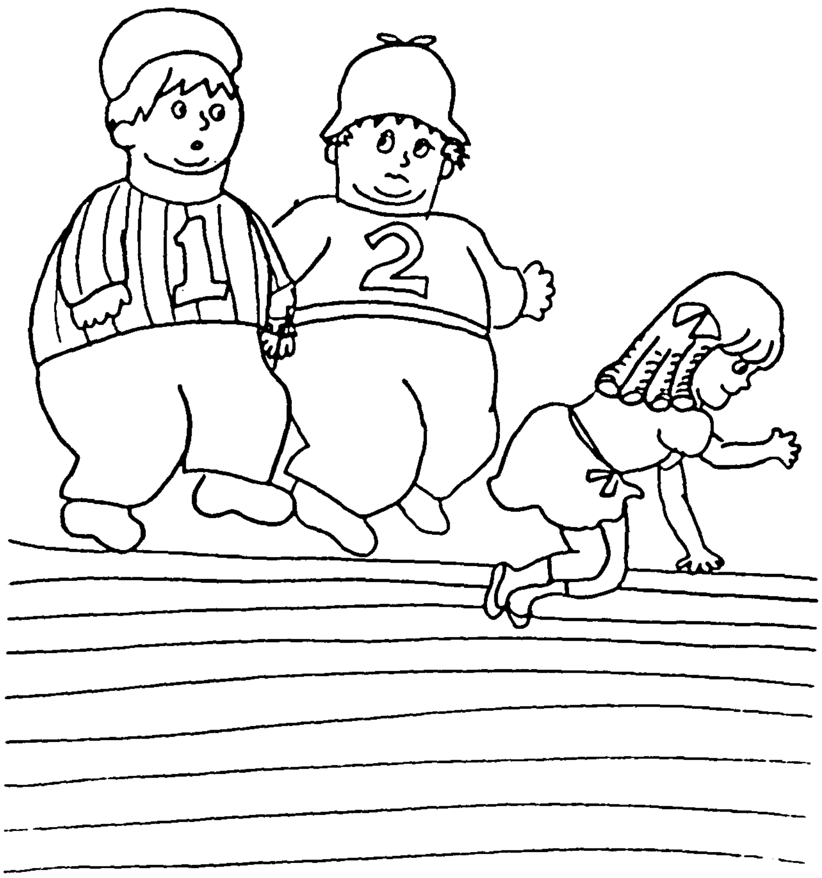


Practice Sentence 3(b): Lexical Ambiguity

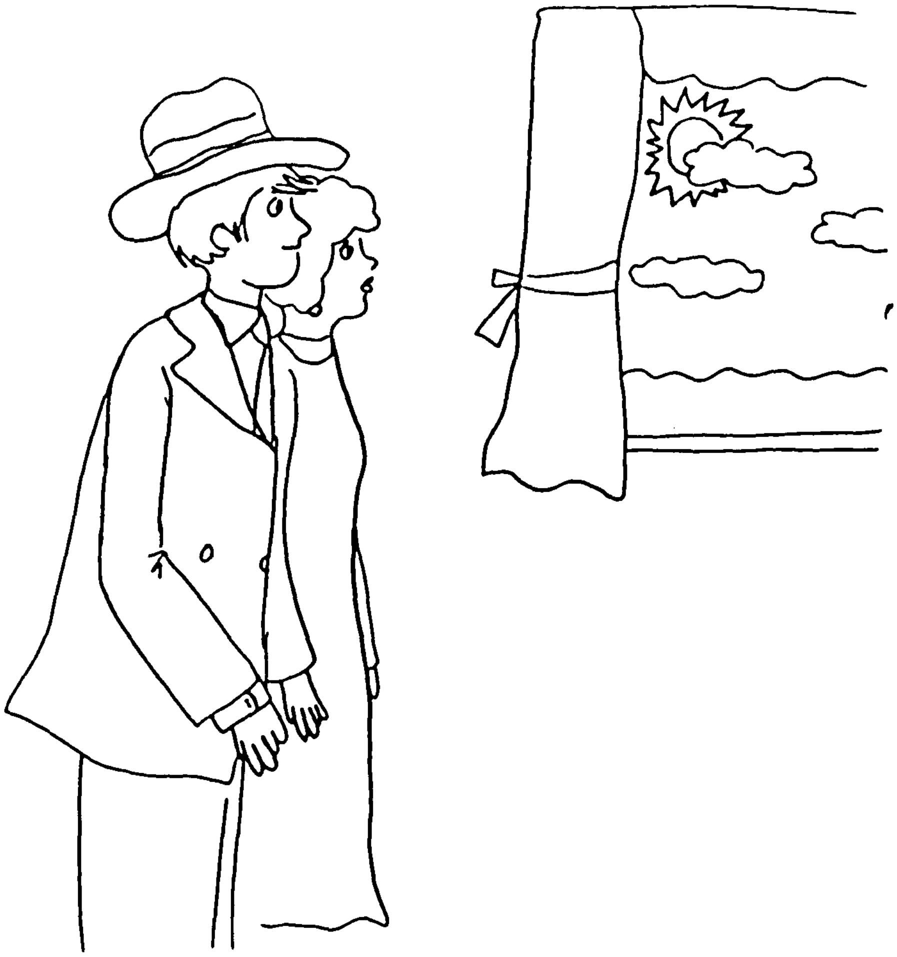
Practice Sentence 4(a): Structural Ambiguity



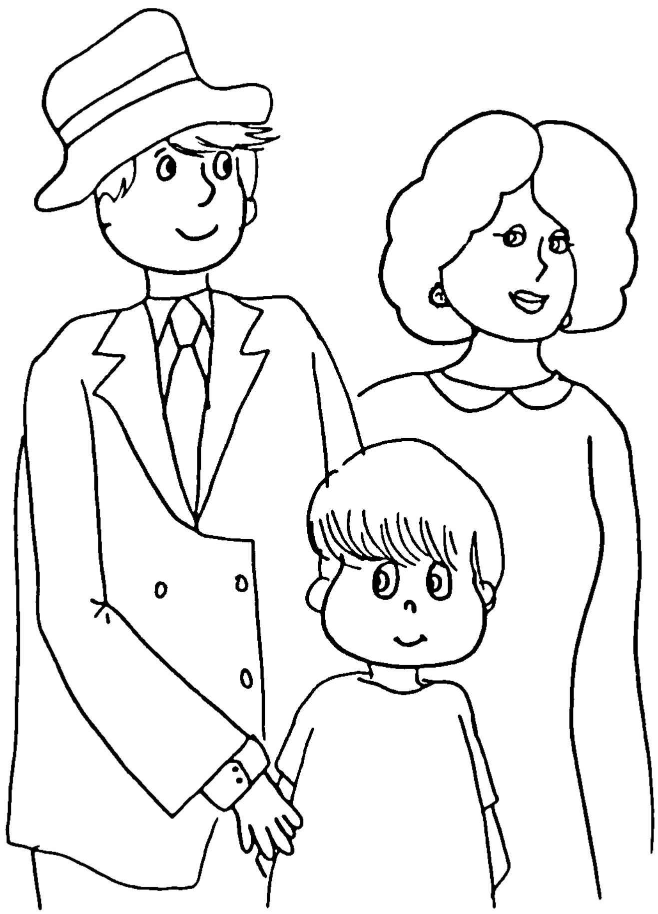
Practice Sentence 4(b): Structural Ambiguity



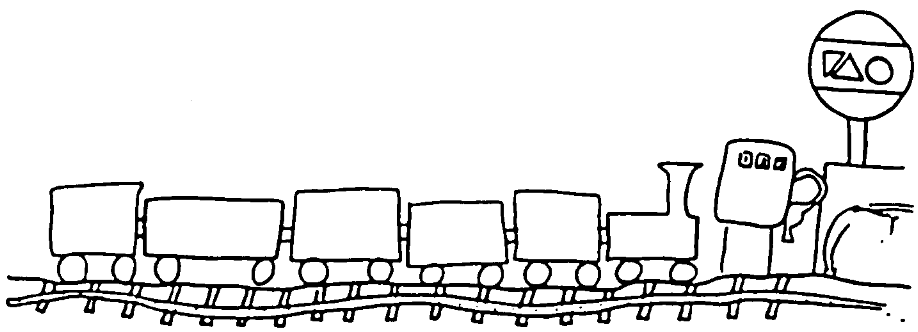
Practice Sentence 5(a): Lexical Ambiguity



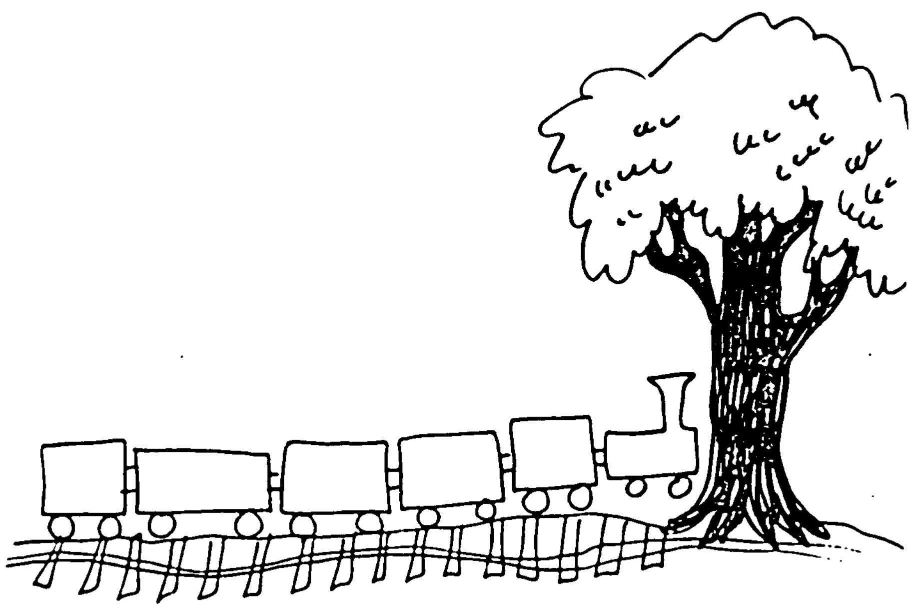
Practice Sentence 5(b): Lexical Ambiguity



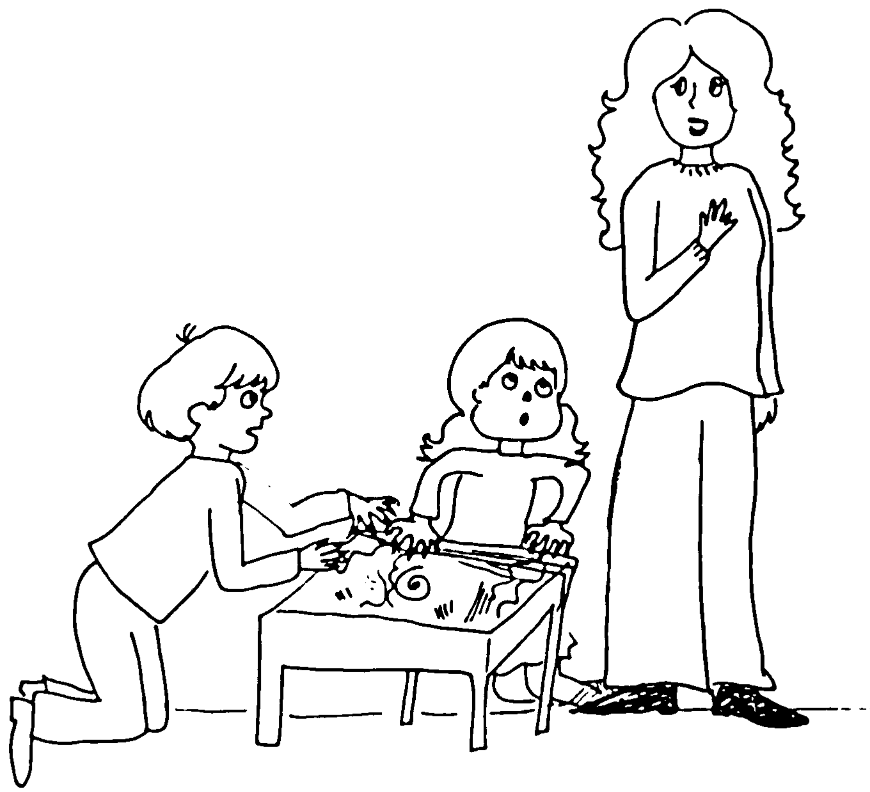
Practice Sentence 6(a): Unambiguous



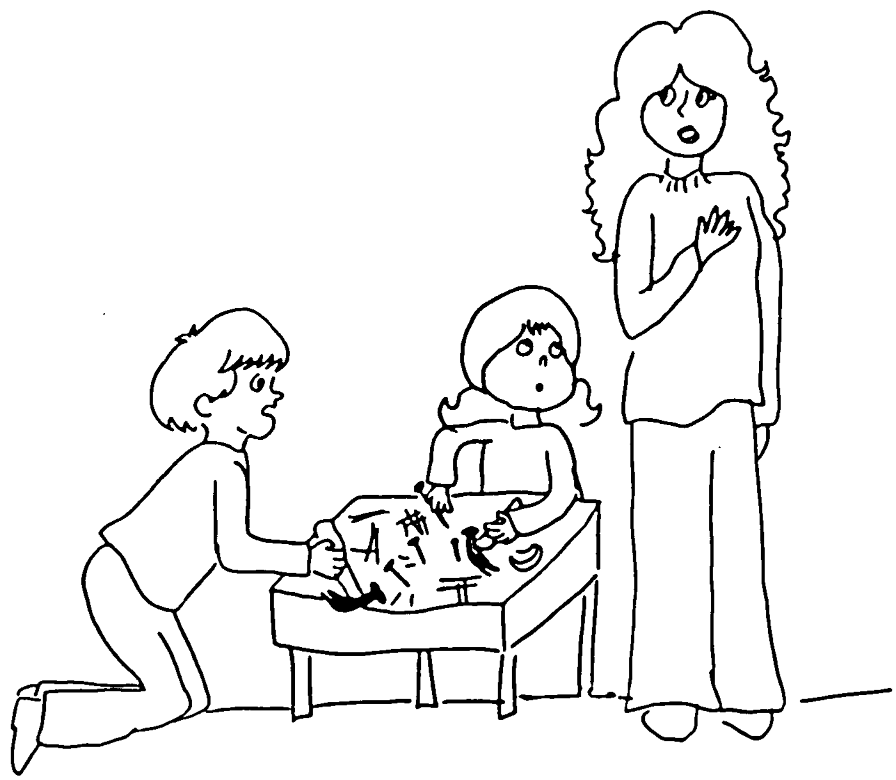
Practice Sentence 6(b): Unambiguous



1(a). Lexical Ambiguity

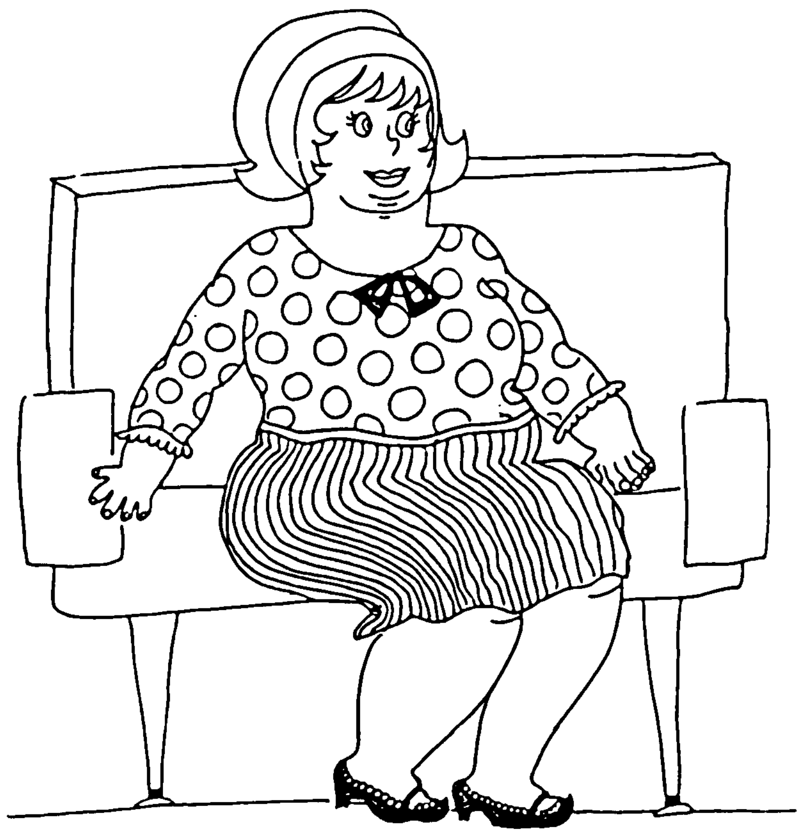


1(b). Lexical Ambiguity



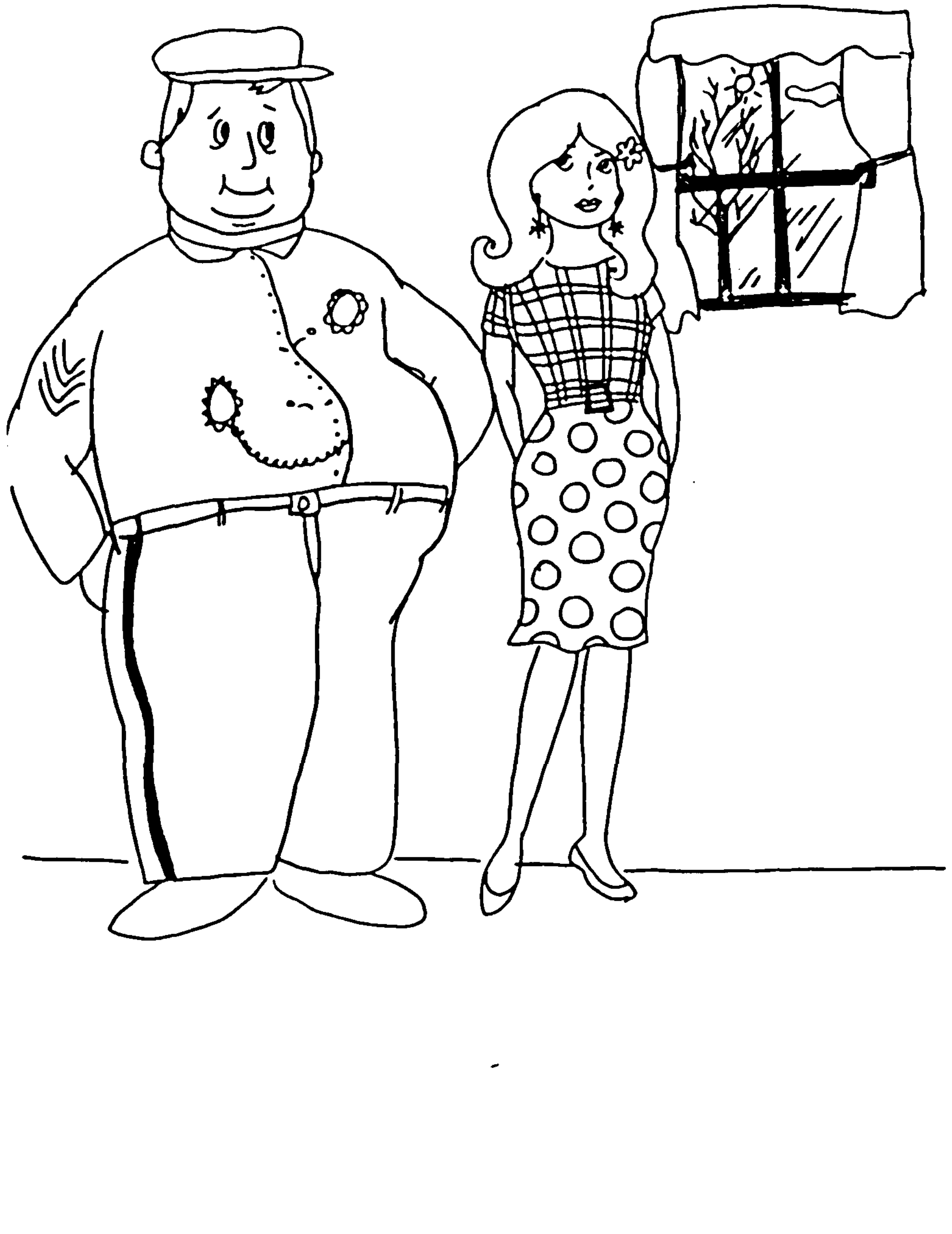
2(a). Unambiguous

2(b). Unambiguous

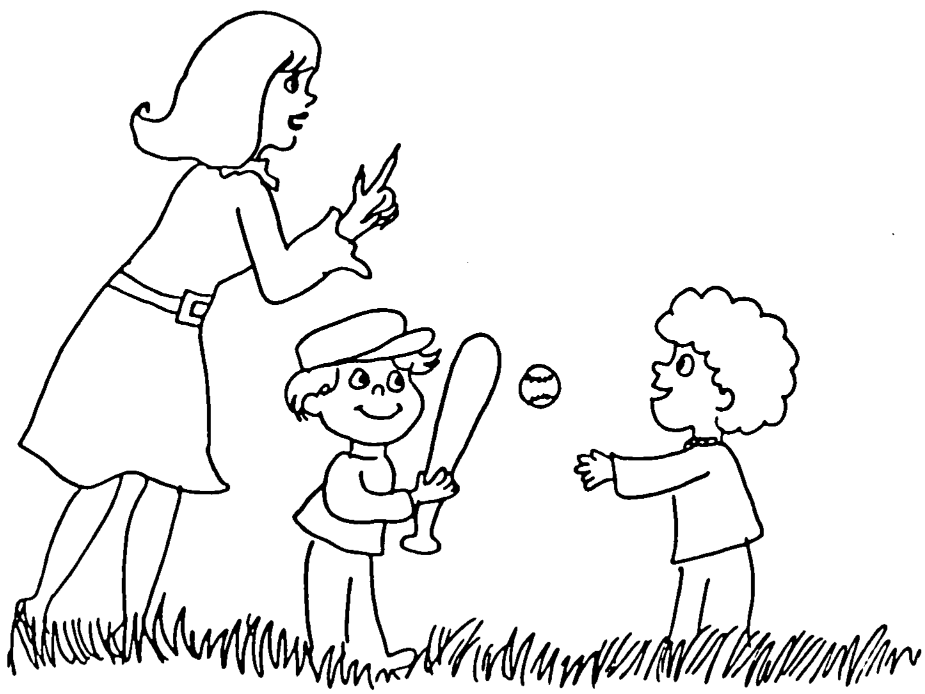


3(a). Structural Ambiguity

3(b). Structural Ambiguity

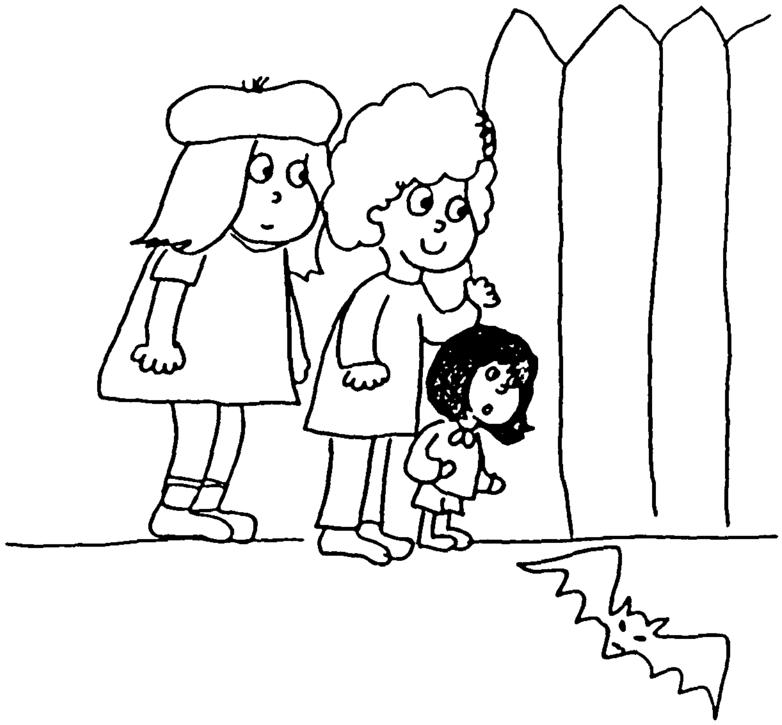


4(a). Unambiguous

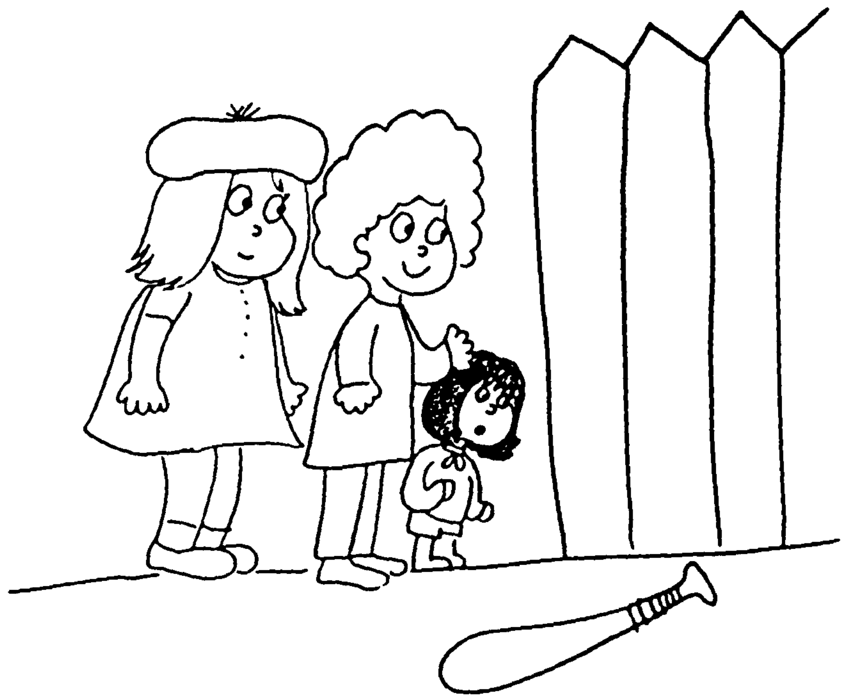


4(b). Unambiguous

5(a). Lexical Ambiguity



5(b). Lexical Ambiguity



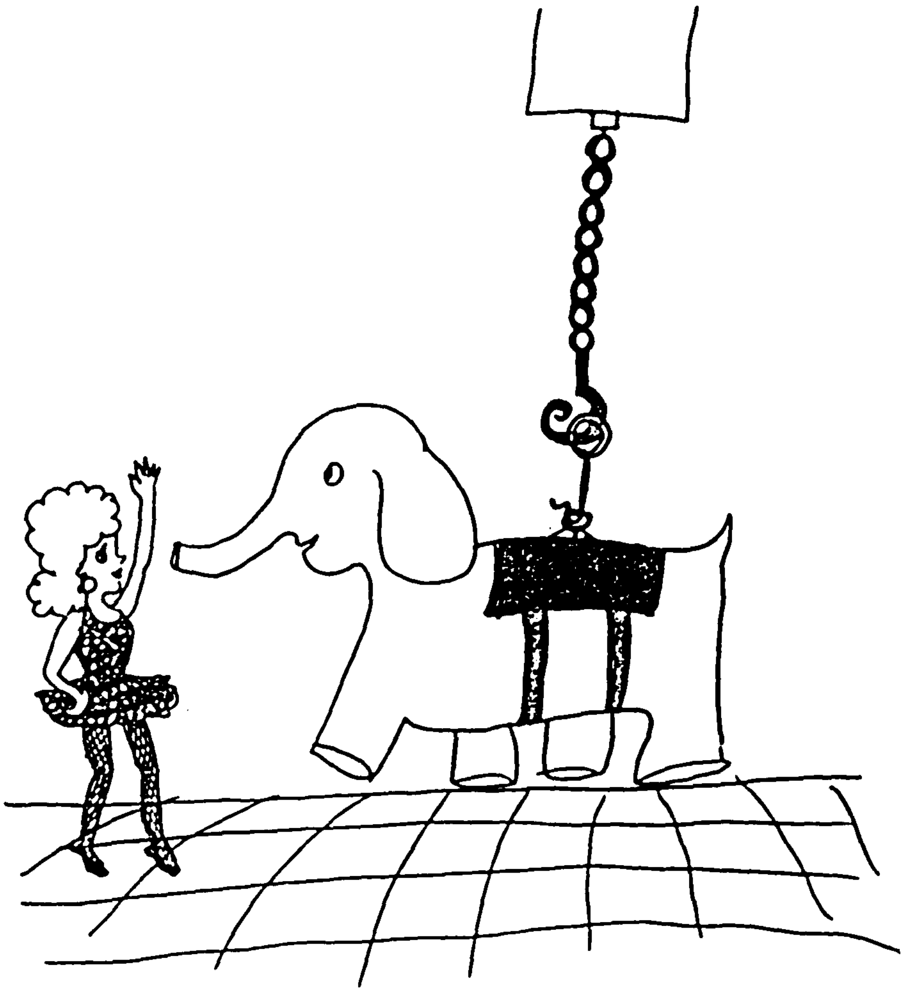
6(a). Structural Ambiguity

6(b). Structural Ambiguity

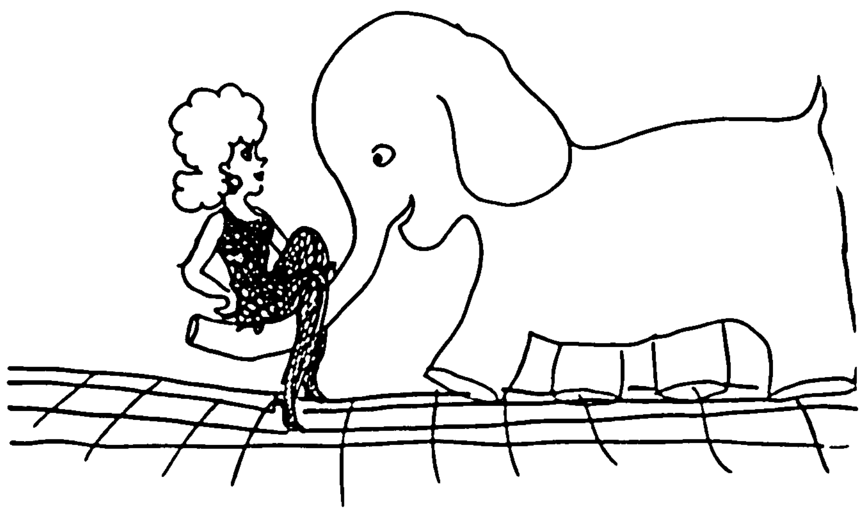
7(a). Lexical Ambiguity

7(b). Lexical Ambiguity

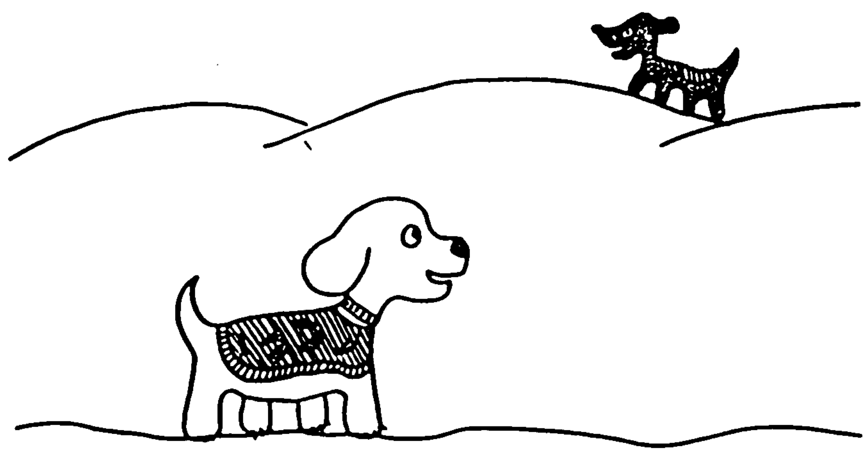
8(a). Structural Ambiguity



8(b). Structural Ambiguity

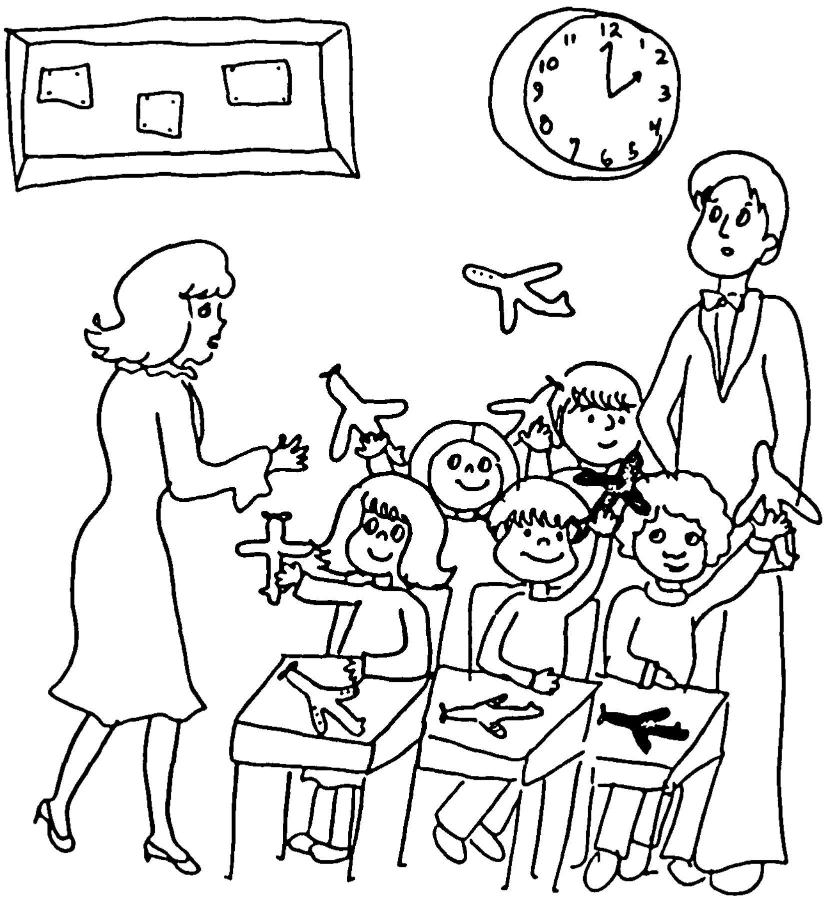


9(a). Structural Ambiguity

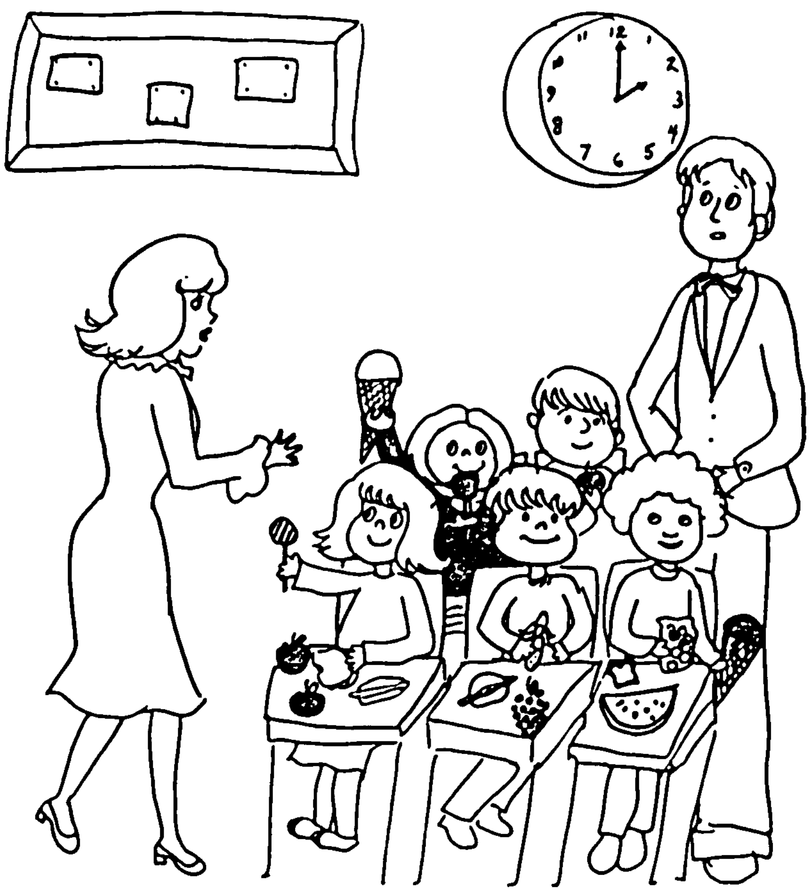


9(b). Structural Ambiguity

10(a). Unambiguous



10(b). Unambiguous



11(a). Unambiguous

11(b). Unambiguous

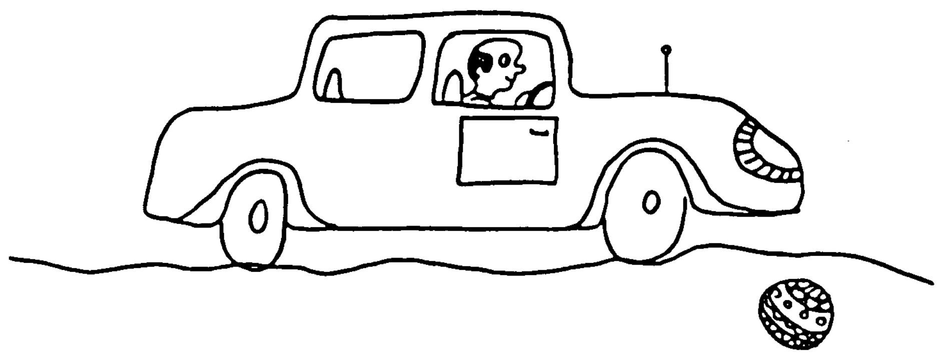
12(a). Lexical Ambiguity

12(b). Lexical Ambiguity

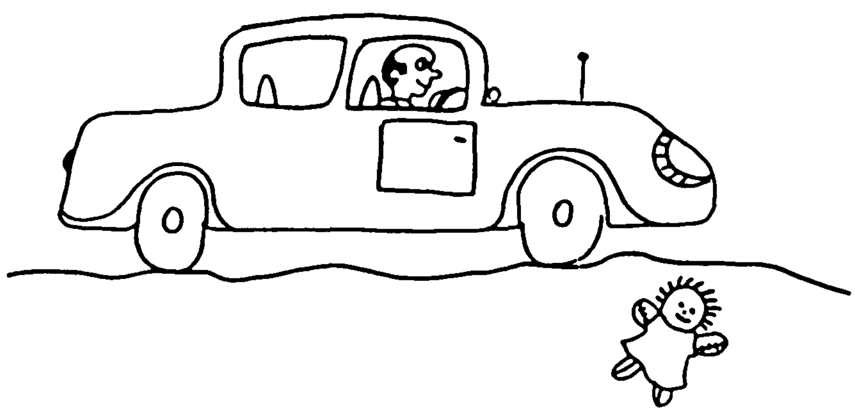
13(a). Lexical Ambiguity

13(b). Lexical Ambiguity

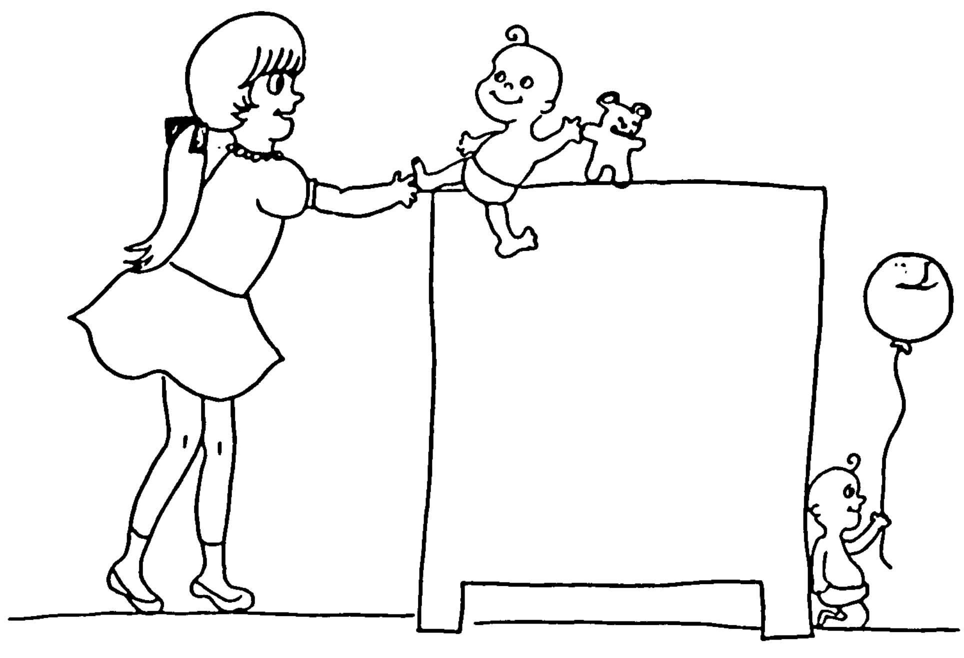
14(a). Unambiguous



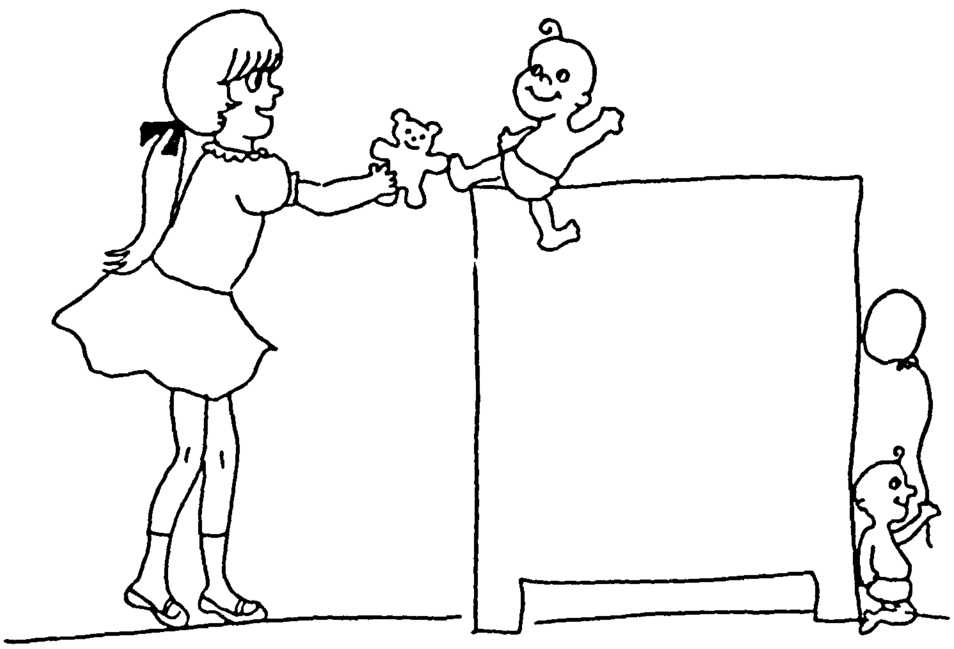
14(b). Unambiguous



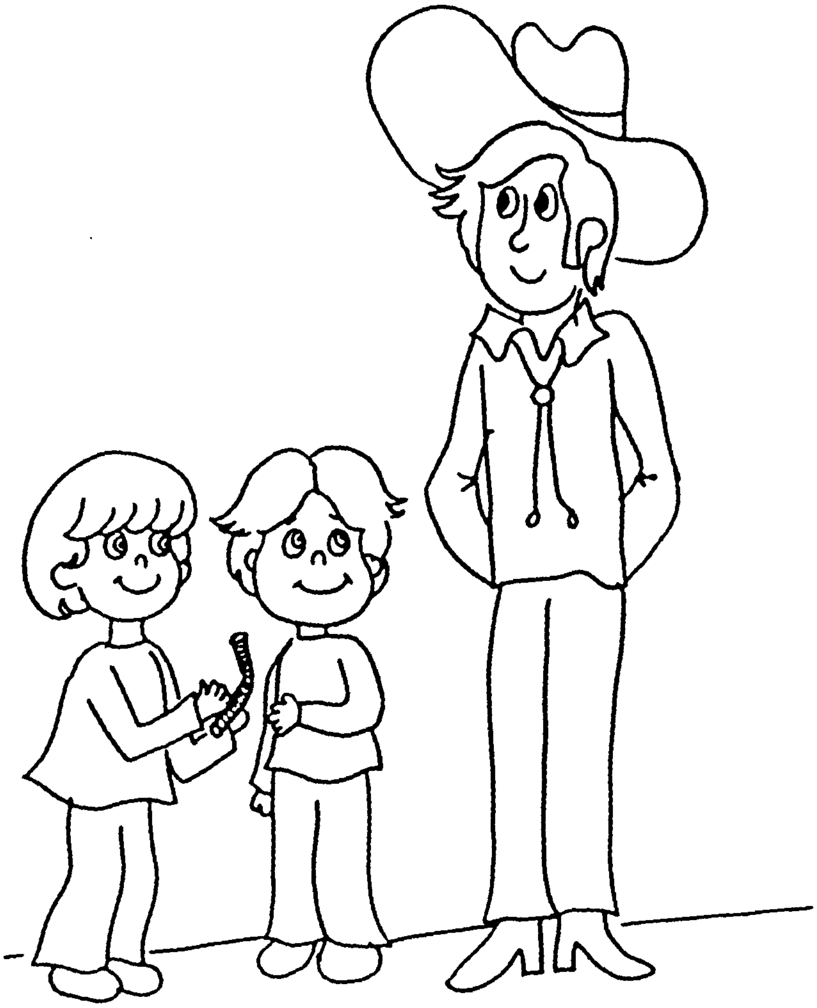
15(a). Structural Ambiguity



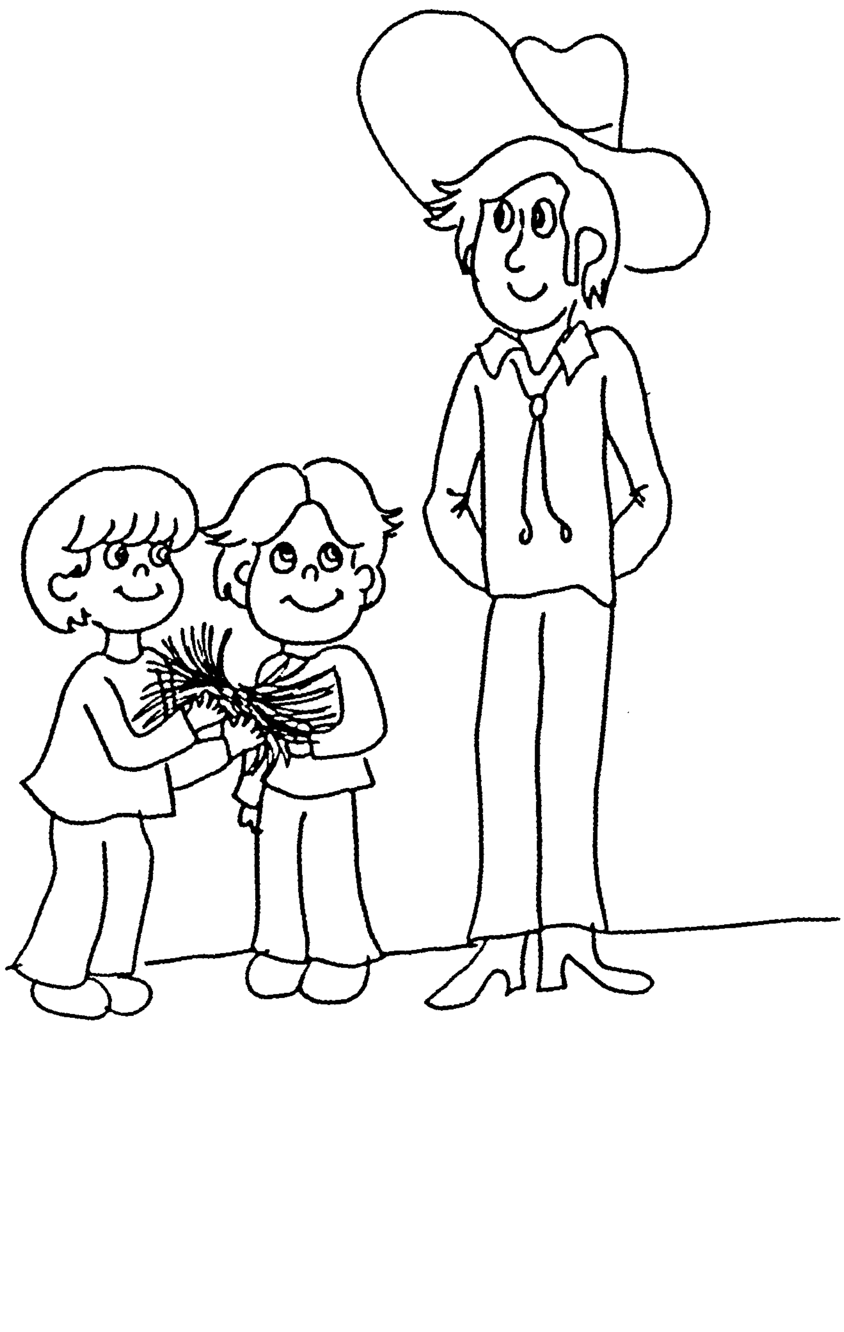
15(b). Structural Ambiguity



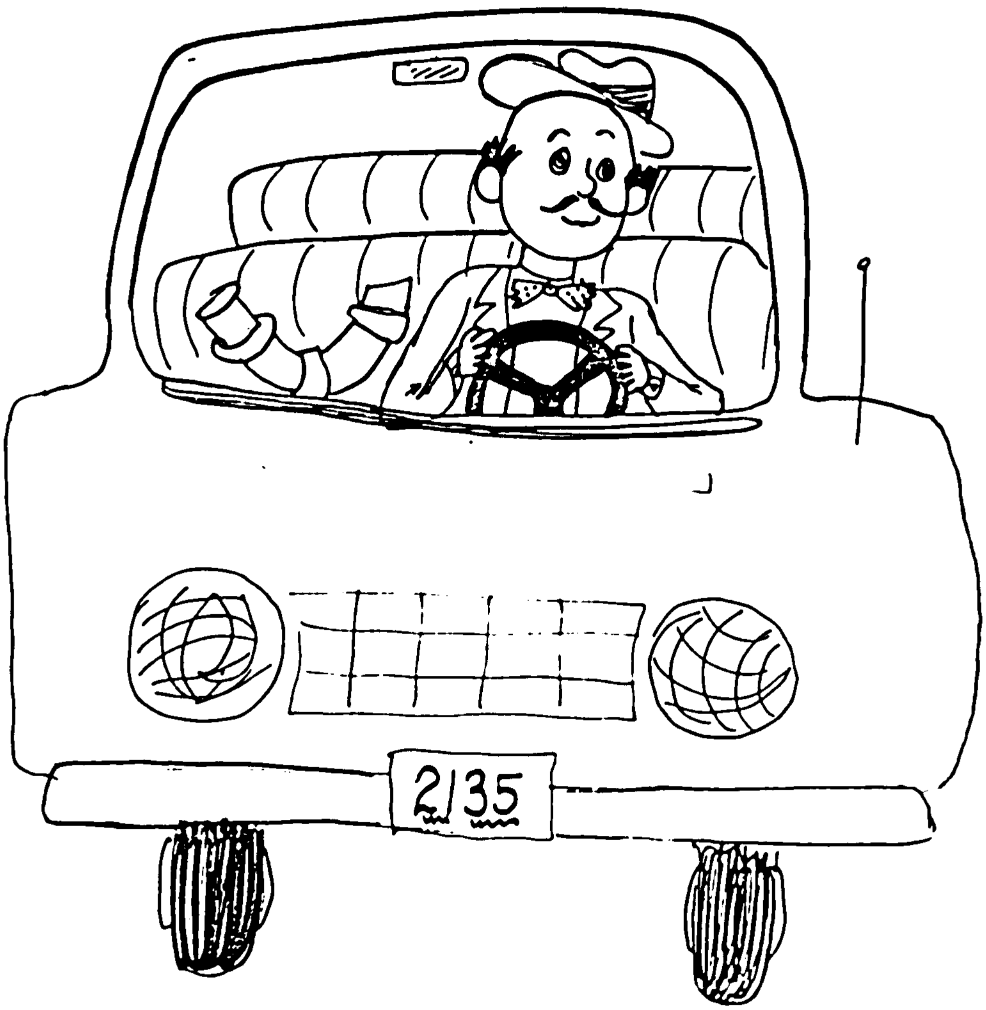
16(a). Lexical Ambiguity



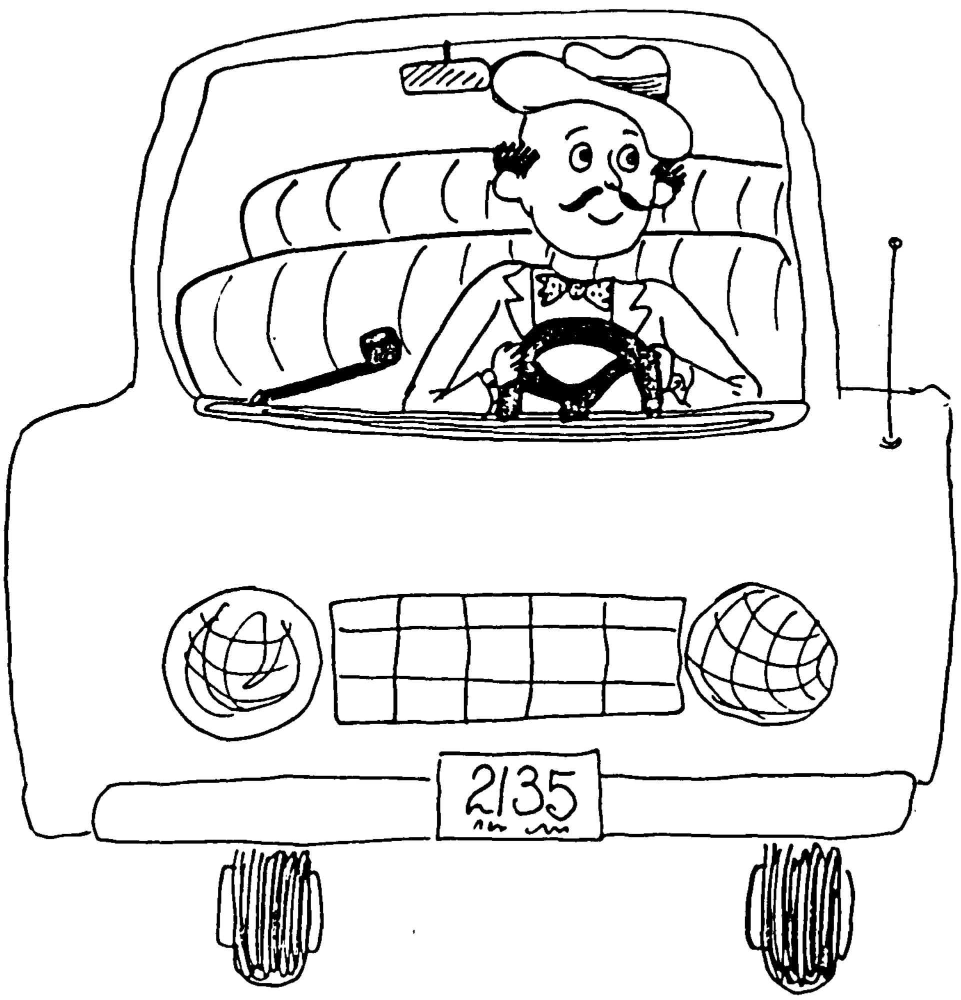
16(b). Lexical Ambiguity



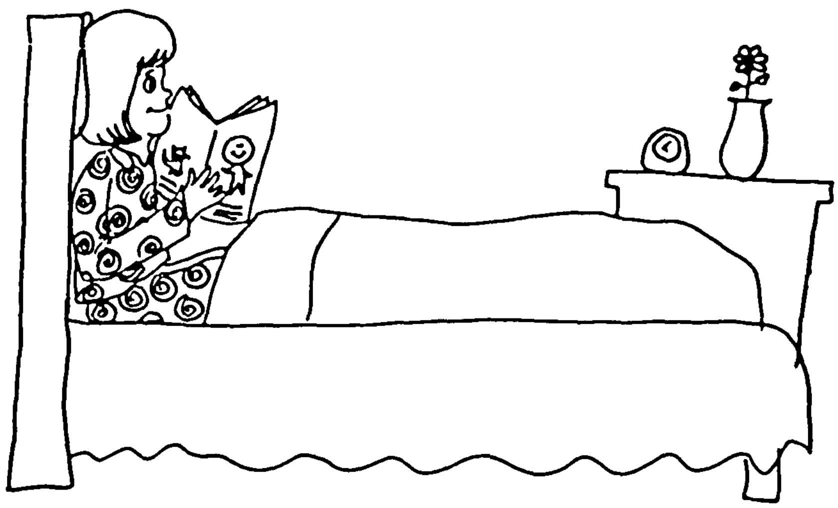
17(a). Lexical Ambiguity



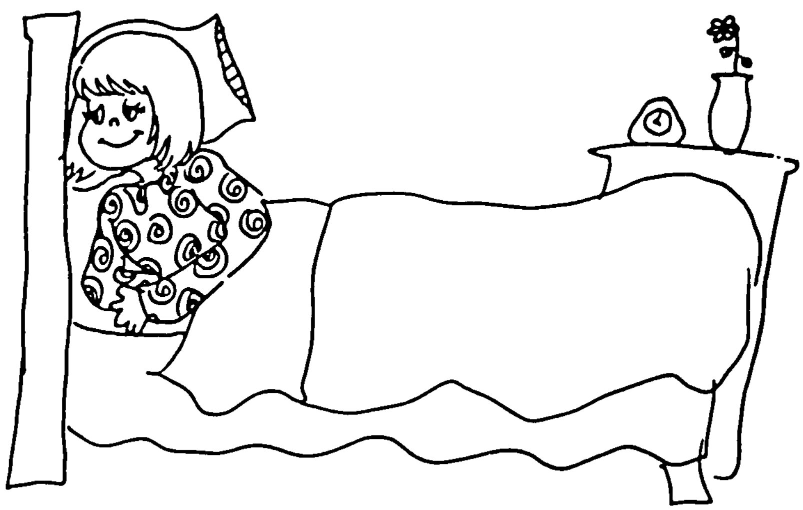
17(b). Lexical Ambiguity



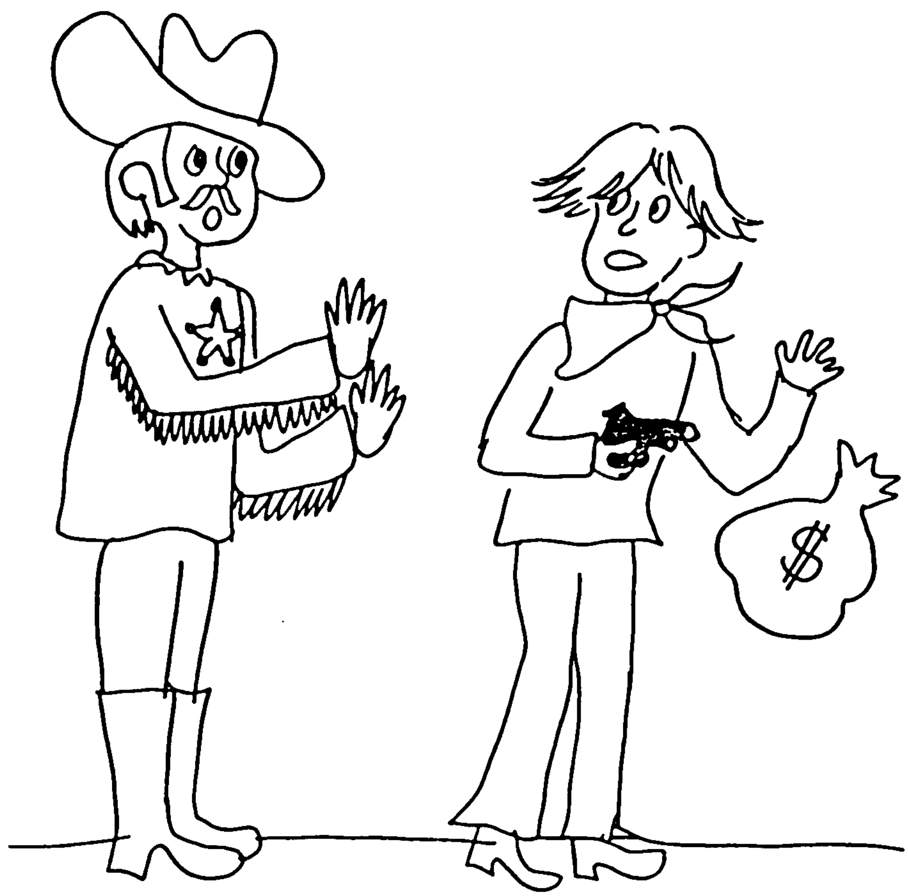
18(a). Unambiguous



18(b). Unambiguous

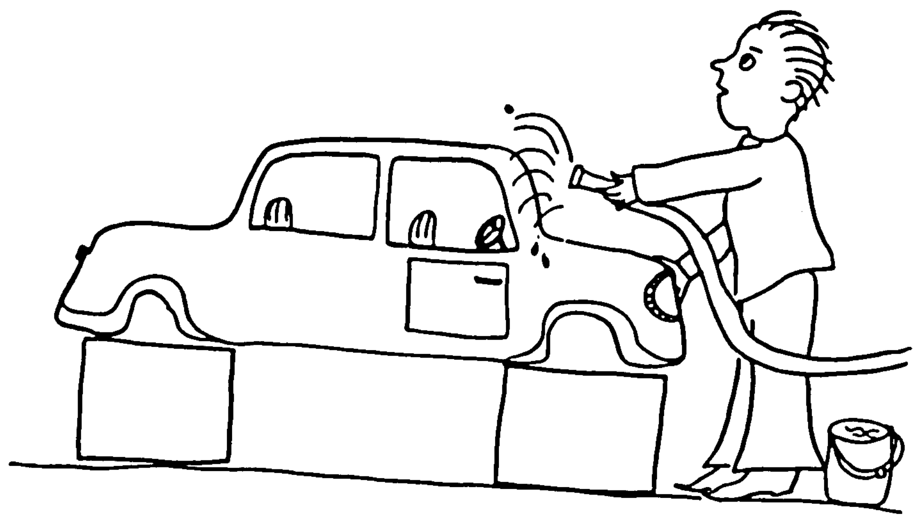


19(a). Structural Ambiguity

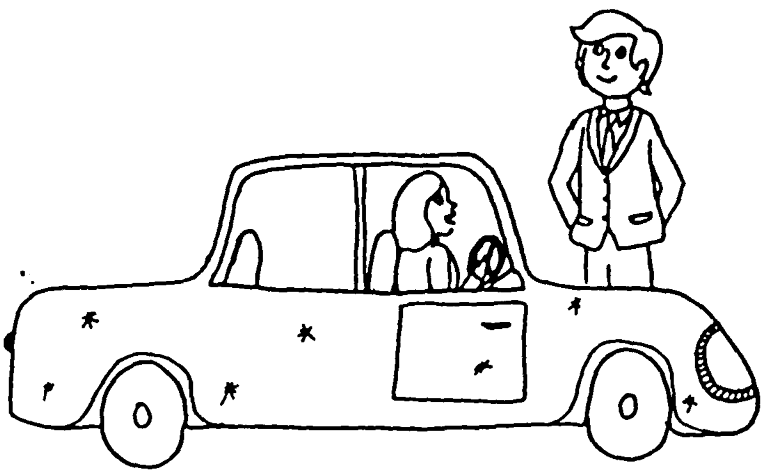


19(b). Structural Ambiguity

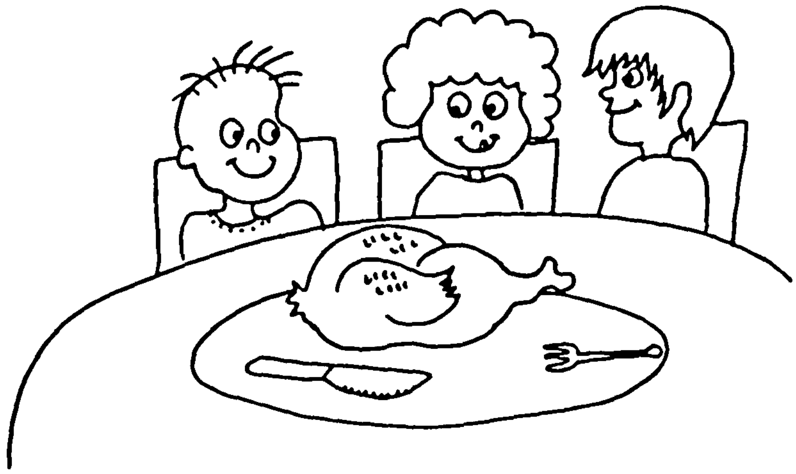
20(a). Unambiguous



20(b). Unambiguous

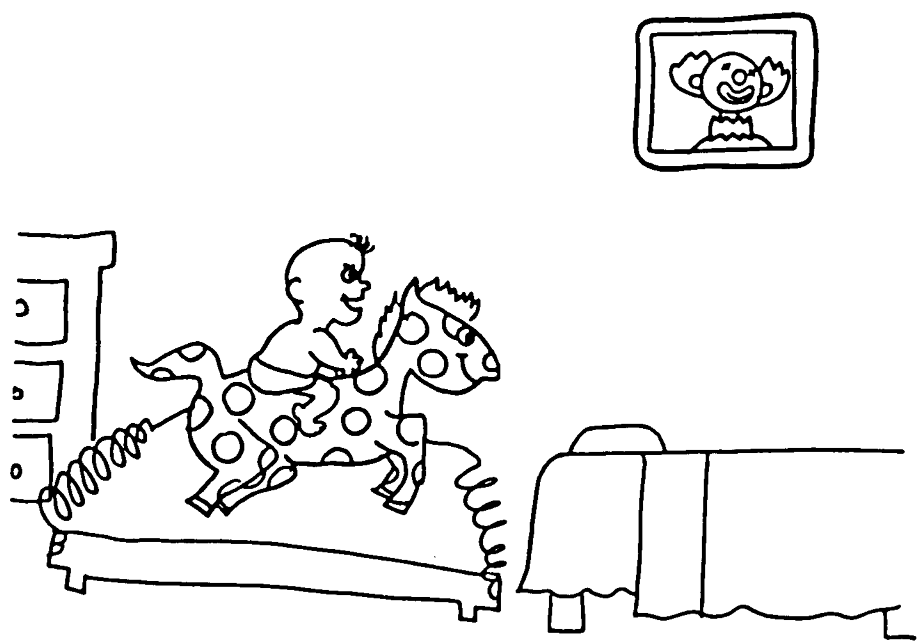


21(a). Structural Ambiguity

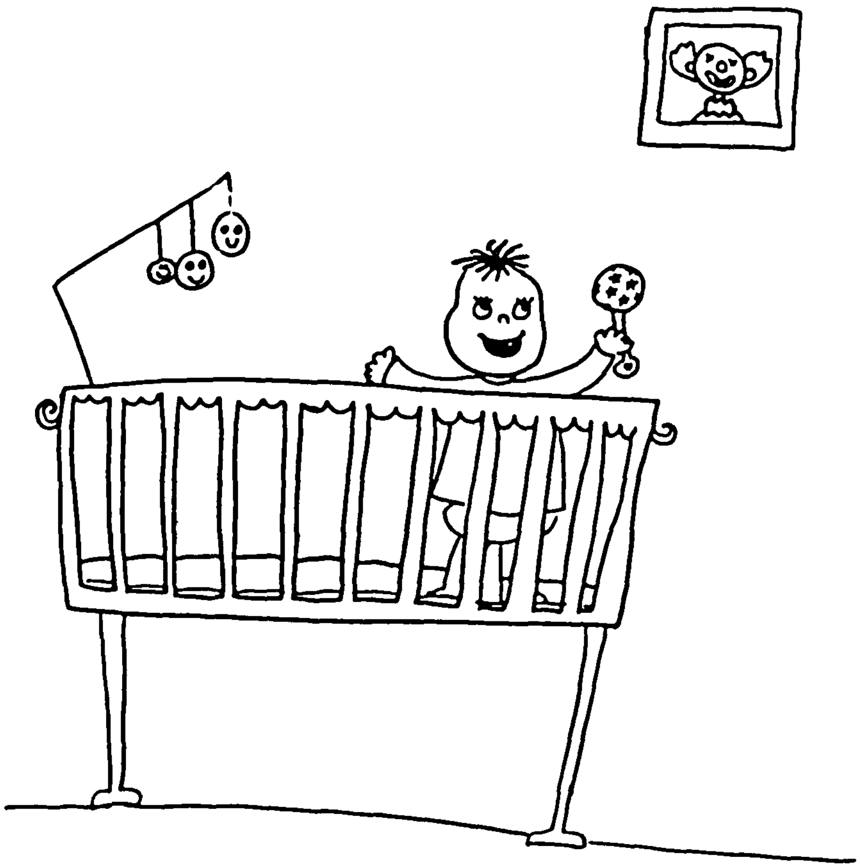


21(b). Structural Ambiguity

22(a). Unambiguous



22(b). Unambiguous

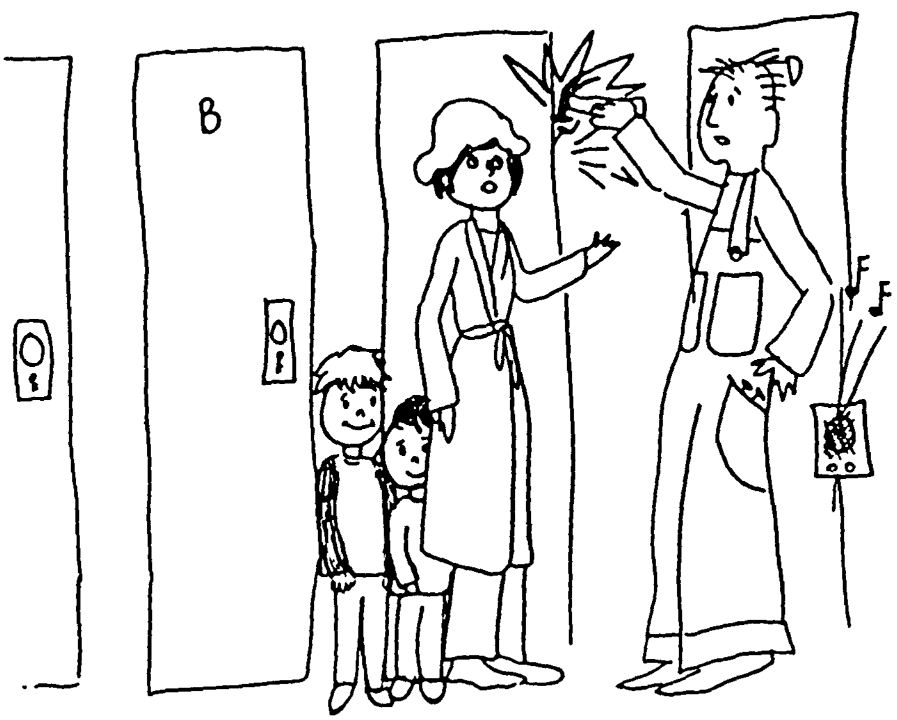


23(a). Lexical Ambiguity

23(b). Lexical Ambiguity

24(a). Structural Ambiguity

24(b). Structural Ambiguity



APPENDIX E

STIMULUS SENTENCES AND FOLLOW-UP QUESTIONS FOR SWITCHING TASK

Below are the stimulus sentences, context sentences, and follow-up questions used in the ambiguity switching task.

1. The baby was dirty and needed a bath. (filler)

   The mother put the baby in the tub that was filled with water. (context)

   a) What was the mother doing?

   b) What about the tub?

   c) What kind of tub was it?

2. The boys told the cowboy that they loved playing with the straw that they found. (lexical ambiguity)

   (drinking) The ranch hands had been sipping soda all afternoon.

   (cow) The ranch hands had been cleaning out the barn.

   a) What did the boys do?

   b) What about the straw?

   c) What kind of straw was it?

3. Peter felt terrible after the punch at the party. (lexical ambiguity)

   (physical) The children were fighting and were told to leave.

   (drink) Drinking or eating too much always makes him sick.

   a) What was the matter with Peter?

   b) What about the punch?

   c) What kind of punch was it?

4. The clowns saw the elephant running toward the fence. (filler)

Everybody in the circus was getting ready for the show. (context)

a) What did the clowns see?

b) What about the fence?

c) What kind of fence was it?

5. We saw the bat lying near the fence. (lexical ambiguity)

(baseball) The baseball game was fun to watch.

(flying) The haunted house scared the children.

a) What did we see?

b) What about the bat?

c) What kind of bat was it?

6. It was the cold that made Betty feel terrible. (lexical ambiguity)

(sick) She stayed in bed for three days.

(outside) She forgot to bring her heavy sweater.

a) What was the matter with Betty?

b) What about the cold?

c) What kind of cold was it?

7. The children were told to stop because nails were making too many scratches on the furniture. (lexical ambiguity)

(finger) Billy and Tommy were tapping on the table.

(hammer) Billy and Tommy were playing with a hammer.

a) What were the children doing?

b) What about the nails?

c) What kind of nails were they?

8. The children were building a tower out of blocks and the cat knocked it down. (filler)

Pets can be a nuisance when children want to play. (context)

a) What were the children doing?

b) What about the tower?

c) What kind of tower was it?

9. The lady was annoyed by her wait/weight in the doctor's office. (lexical ambiguity)

(weight) The diet did not seem to be working.

(wait) It was five o'clock and her appointment was at six.

a) What happened with the lady?

b) What about the wait/weight?

c) What kind of wait/weight was it?

10. The waitress became upset when the glasses fell on the floor and broke. (lexical ambiguity)

(drinking) The customers were thirsty and wanted something to drink.

(wearing) She couldn't read the price on the menu.

a) What happened with the waitress?

b) What about the glasses?

c) What kind of glasses were they?

11. The man brought the pipe home in his car. (lexical ambiguity)

(smoke) He wanted to try out his new tobacco.

(sink) He hoped the plumber would fix the leak.

a) What did the man do?

b) What about the pipe?

c) What kind of pipe was it?

12. The little boy saw the puppy and wanted to buy it. (filler)

Many children love to play with baby animals. (context)

a) What did the boy see?

b) What about the puppy?

c) What kind of puppy was it?

BIBLIOGRAPHY

Bates, E., Benigni, L., Bretherton, I., Camaioni, L., & Volterra, V. From gesture to the first word: On cognitive and social prerequisites. In M. Lewis & L. A. Rosenbaum (Eds.), Interaction, conversation, and the development of language. New York: Wiley, 1977.

Beilin, H. Studies in the cognitive basis of language development. New York: Academic Press, 1975.

Bever, T. G., Garrett, M. F., & Hurtig, R. Ambiguity increases complexity of perceptually incomplete clauses. Memory and Cognition, 1973, 1, 279-286.

Brekke, B. W., Williams, J. D., & Harlowe, S. D. Conservation and reading readiness. Journal of Genetic Psychology, 1973, 133-138.

Briggs, C., & Elkind, D. Cognitive development in early readers. Developmental Psychology, 1973, 9(no. 2), 279-280.

Brown, R. A first language: The early stages. Cambridge, Mass.: Harvard University Press, 1973.

Cairns, H. S. Ambiguous sentence processing. Unpublished doctoral dissertation, University of Texas at Austin, 1970.

Cairns, H. S. Psycholinguistics: A cognitive view of language. New York: Holt, Rinehart, and Winston, 1976.

Chomsky, N. Syntactic structures. The Hague: Mouton & Co., 1957.

Chomsky, N. Aspects of the theory of syntax. Cambridge, Mass.: M.I.T. Press, 1965.

Clark, E. Awareness of language: Some evidence from what children say and do. In A. Sinclair, R. J. Jarvella, & W. J. M. Levelt (Eds.), The child's conception of language. New York: Springer-Verlag, 1978.

DeVries, R. Relationships among Piagetian, I.Q., and achievement assessments. Child Development, 1974, 45, 746-756.

Donaldson, M. Children's minds. New York: W. W. Norton & Company, 1978.

Evans, J. S. Childrens comprehension and processing of ambiguous words in sentences. Unpublished doctoral dissertation, University of Texas at Austin, 1976.

Foss, D. J., Bever, T. G., & Silver, M. The comprehension and verification of ambiguous sentences. Perception and Psychophysics, 1968, 4, 304-306.

Foss, D. J., & Jenkins, C. Some effects of context on the comprehension of ambiguous sentences. Journal of Verbal Learning and Verbal Behavior, 1973, 12, 577-589.

Frommer, M. S. The influence of linguistic context on the processing of lexically ambiguous sentences by four, six, and eight year old children. Unpublished doctoral dissertation, Columbia University, 1975.

Gindes, M. The development of metalinguistic knowledge and its relation to reading acquisition. Paper presented at the Conference on the Language of the Young Child: Frontiers of Research, Brooklyn College of the City University of New York, 1980.

Gleitman, L. R., Gleitman, H., & Shipley, E. F. The emergence of the child as grammarian. Cognition, 1972, 1, 137-164.

Goldschmid, M. L., & Bentler, P. M. Instruction manual--Concept assessment kit: Conservation. San Diego: Educational and Industrial Testing Service, 1968.

Greenfield, P. M., & Smith, J. H. The structure of communication in early language development. New York: Academic Press, 1976.

Hakes, D. The development of metalinguistic abilities in children. New York: Springer-Verlag, 1980.

Hakes, D. The development of metalinguistic abilities: What develops? In S. A. Kuczaj II (Ed.), Language development: Language, thought, and culture. New York: Lawrence Erlbaum Associates, 1982.

Hirsh-Pasek, K., Gleitman, L. R., & Gleitman, H. What did the brain say to the mind? A study of the detection and report of ambiguity by young children. In A. Sinclair, R. J. Jarvella, & W. J. M. Levelt (Eds.), The child's conception of language. New York: Springer-Verlag, 1978.

Jewell, A. P. Metalinguistic awareness and conservation: Their relationship, development, and use as predictors of reading achievement. Unpublished doctoral dissertation, University of Maryland, 1978.

Johns, J. L. Metalinguistic awareness: Its growth and relationship to reading achievement. Research paper presented at the Twenty-fourth Annual Convention of the International Reading Association, Atlanta, April 25, 1979.

Keil, F. Development of the ability to perceive ambiguities: Evidence for the task specificity of a linguistic skill. Journal of Psycholinguistic Research, 1980, 9, 219-229.

Kessel, F. S. The role of syntax in children's comprehension from ages six to twelve. Society for Research in Child Development Monograph (Vol. 35, No. 6). Chicago: University of Chicago Press, 1970.

Levelt, W. J. M., Sinclair, A., & Jarvella, R. J. Causes and functions of linguistic awareness in language acquisition: Some introductory remarks. In A. Sinclair, R. J. Jarvella, & W. J. M. Levelt (Eds.), The child's conception of language. New York: Springer-Verlag, 1978.

Liberman, I. Y., Shankweiler, D., Fischer, F. W., & Carter, B. Explicit syllable and phoneme segmentation in the young child. Journal of Experimental Child Psychology, 1974, 18, 201-212.

Liberman, I. Y., Shankweiler, D., Liberman, A.M., Fowler, C., & Fischer, F. W. Phonetic segmentation and recoding in the beginning reader. In A. S. Reber & D. L. Scarborough (Eds.), Toward a psychology of reading. Hillsdale, N.J.: Lawrence Erlbaum Associates, 1977.

Lunzer, E. A., Dolan, T., & Wilkinson, J. E. The effectiveness of measures of operativity, language, and short-term memory in the prediction of reading and mathematical understanding. British Journal of Educational Psychology, 1976, 46, 295-305.

Lunzer, E. A., Wilkinson, J. E., & Dolan, T. The distinctiveness of operativity as a measure of cognitive functioning in five year old children. British Journal of Educational Psychology, 1976, 46, 280-294.

MacKay, D. G. To end ambiguous sentences. Perception and Psychophysics, 1966, 1, 425-436.

MacKay, D. G., & Bever, T. G. In search of ambiguity. Perception and Psychophysics, 1967, 2, 193-200.

Peters, A. M., & Zaidel, E. The acquisition of homonymy. Cognition, 1980, 8, 187-207.

Rozin, P., Bressman, B., & Taft, M. Do children understand the basic relationship between speech and writing? The mow-motorcycle test. Journal of Reading Behavior, 1974, 6, 327-334.

Shultz, T. R., & Pilon, R. Development of the ability to detect linguistic ambiguity. Child Development, 1973, 44, 728-733.

Sinclair, H. Conceptualization and awareness in Piaget's theory and its relevance to the child's concept of language. In A. Sinclair, R. J. Jarvella, & W. J. M. Levelt (Eds.), The child's conception of language. New York: Springer-Verlag, 1978.

Tager-Flusberg, H., & Smith, C. Metalinguistic awareness in preschool children: A preliminary report. Paper presented at the Conference on the Language of the Young Child: Frontiers of Research, Brooklyn College of the City University of New York, 1980.

Taylor, N. E. Developmental aspects of linguistic awareness and its relationship to reading achievement at first and second grade. Washington, D.C.: Catholic University, 1976. (ERIC Document Reproduction Service No. ED 143 008)

Taylor, N. E. The effects of written language awareness on first grade achievement. Paper presented at the Annual Meeting of the Educational Research Association, Los Angeles, Calif., April 13-17, 1981.

Woodcock, R. W. Instruction manual--Woodcock reading mastery tests. Minnesota: American Guidance Service, Inc., 1973.