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FORM AND FUNCTION AS A BASIS FOR REFERENTIAL
DEVELOPMENT IN CHILDREN.

IOWA STATE UNIVERSITY, PH.D., 1979

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Form and function as a basis for
referential development in children

by

Ferol Schricker Menzel

A Dissertation Submitted to the
Graduate Faculty in Partial Fulfillment of
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INTRODUCTION

The role of sensory-motor activity as described by Piaget (1952) has been a focus of attention of researchers looking for the origin of intelligent behavior. The question is whether sensory-motor experience or action is basic to representation as Piaget suggests. Thus far efforts to answer the question have involved the study of object investigation (sensory-motor activity) in relationship to object search (Gratch, 1975). Schofield and Uzgiris (1969), for example, examined the way children handled five objects and related this to the child's level of object permanence. Although they found a developmental relationship between manipulation and object permanence, they were unable to state that manipulation was crucial to the development of object permanence (Gratch, 1975).

Sinclair (1970) suggests that representation may be studied outside the context of the object permanence problem. He sees "make believe", problem solving and language as other sources of representational behavior. This is particularly true of language development as evidenced by the increased interest in linking language to a sensory-motor base (Bloom, 1973; Clark, 1973, 1977; Gratch, 1975; Nelson, 1973a, 1973b, 1974; Morehead & Morehead, 1974; Rodgon, Jankowski & Alenskas, 1976 and Slobin, 1972).

Sinclair (1970) argues that language (a form of representation) has its roots in the preverbal sensory-motor period where a system of schemes are formed. It is the child's constant interactions with objects and people and his organization and reorganization of these interactions

which eventually leads the child to the mental constructs to which he attaches words.

Thus Sinclair (1970) suggests the appearance of the child's first word does not seem to be a solitary phenomenon set off by a biological clock nor can it be accounted for by a simplistic associationistic explanation. Rather, the word or first representation appear to be based on preverbal sensory-motor experience and the resulting mental organization.

Assuming that language develops out of sensory-motor experience, it is of interest to examine the process by which this may occur. In addition, when referring to the study of language development, it is necessary to identify what part of language is to be studied. In this study, attention will be focused on word meaning referred to in psycholinguistic literature as lexical development. It has been well-documented that nouns used in reference to objects is an early language production skill (Bloom, 1973). The referential use of words, apart from syntactic use of words, partially reflects this lexical development and may well lead us to understand the child's mental organization. How, for example, does the child match his image or experience with the animal dog to the word dog? It is the child's early referential use of words that has been studied to determine preverbal mental organization.

Two contrasting theories attempt to account for the development of word meaning or lexical development. Both theories acknowledge sensory-motor experience as an ingredient of lexical acquisition but the role of sensory-motor experience differs between the two explanations.

The first theory is Clark's semantic features hypothesis. She draws a parallel between the process of language development and Gibson's (1969) distinctive features hypothesis. Clark (1973) explains that the child moves from attention to individual features, to attention to configuration or structured relations between features. She suggests initially the child derives semantic features from salient perceptual cues. Thus the shape of a ball (round) may initially be the salient feature for the child and the word ball becomes associated with roundness. As the child develops linguistically he will learn which perceptual features play a linguistic role and which do not. Thus early words may be used incorrectly or be overextended. For example, the word "ball" may be overextended and used to refer to other round objects until the child learns that roundness is only one defining feature.

Clark (1973) depends partially on the phenomenon of overextension to support the semantic features hypothesis. She states there is sufficient evidence that children overextend word meaning on the basis of shape or configuration more often than on size, movement or other features. Thus Clark is suggesting that children must learn each feature or combination of features associated with the adult meaning of a word. In addition, errors made in word use may be due to a lack of feature discrimination.

The features of which Clark (1973, 1974) speaks are derived predominantly from the perceptual input to the child in the form of visual, tactual, olfactory and auditory percepts. From a study of overextension in early word acquisition, Clark (1973) suggests that overextensions based primarily on shape but also on size, sound, taste and texture are possible. Thus it is the attention to single features (roundness)

followed by the grouping of other perceptual characteristics (size, color, movement) which finally lead to a word meaning comparable to that of adults.

Clark (1973) does not deal with the child's internal mental structures nor does she account for the mental process the child uses to restructure features into bundles. In the conclusion of her paper she suggests further research in the area of a priori concepts, a possible hierarchy of features and a study of the way overextensions are eventually restricted to correspond to adult meaning. One can only assume that sensory-motor exploration of objects may be a part of object feature identification but this is not clearly defined in Clark's theory.

Nelson (1973a, 1973b, 1974) suggests a concept-match theory which contends that children come to the language learning stage with a cognitive organization based on sensory-motor experience.

According to Nelson (1973a) the sensory-motor concepts are basic to language development and are followed by differentiation of perceptual properties (variants) and finally word acquisition. Thus the child recognizes "chair" on the basis of function (to sit in, to climb on), then recognizes variations (Queen Anne, lawn chair), then attaches a word to the concept.

Nelson, unlike Clark, does not rely totally on perceptual features such as shape. Nelson (1974) argues that a sensory-motor organization based initially upon function exists in a child at one year of age. Evidence for this hypothesis is derived from research on categorization in young children by Ricciuti (1965) and Nelson (1973b). Both Ricciuti and Nelson found that when children under two years of age are given a

stimulus array of objects, the child will respond by grouping or matching like objects. In addition they found that categorization or grouping based on function occurred more often than categorization based on size, shape or color. This result was even more significant when children were given the opportunity to play with the toys before categorizing. Nelson (1973b) suggests therefore that when a child experiences "hat" the process of word acquisition starts with the function (placed on head). The child then identifies instances of hat (top hat, fireman's hat, etc.) based on perceptual attributes to form a category or concept of hat which is then matched to the word "hat".

Thus Nelson suggests a sensory-motor theory emphasizing function and functional relationships as a primary principle of the child's lexical organization, while Clark focuses on perceptual attributes associated with words during the language acquisition process.

It may not be possible to directly test for the a priori sensory-motor concepts to which Nelson refers. It is possible, however, to explore the effects of sensory-motor experience on language acquisition and to compare function and form as salient cues.

Nelson (1973b) has suggested that when children are asked to categorize objects they will categorize by function more frequently than by form. This is especially true if the child is given the opportunity to play with the toys (sensory-motor activity) prior to the categorization task. Clark (1973) believes on the other hand that perceptual cues are more salient and identification on the basis of configuration is more likely. To test these hypotheses, subjects in the present study will be divided into two treatment groups: sensory-motor and visual-perceptual. Subjects will be

required to learn the identity of three standard stimuli which have a distinct form as well as a distinct function. Once subjects have learned to identify the standard stimuli they will be given a set of transformed stimuli. One set of transformations will vary on function and the other set of transformations will vary on form.

If subjects use function as a learning cue as Nelson suggests, then they should make more correct responses when identifying the transformation where function matches the standard than when identifying the transformation where configuration matches the standard. In addition, subjects in the sensory-motor group should make more correct identifications of the same function transformation than subjects in the visual-perceptual group.

If, however, Clark is correct in her analysis of word acquisition, subjects in both the visual-perceptual group and the sensory-motor group will make more correct responses when identifying the transformation where form matches the standard than when identifying the transformation where function matches the standard.

A final test of the form-function salience will involve a categorizing task. After all tests the subjects will be given all the stimuli to group. If Nelson is correct, more subjects will use function as a basis of categorization and if Clark is correct, more subjects will use form as a basis of categorization.

Finally, all instances of overextension or mislabeling during the experimental procedure will be recorded. An analysis of this information will be made to determine if form or function is the basis of the overextension.

For the purposes of this study, sensory-motor experience is defined as the child's interaction with the objects to be identified in a free play setting where he can explore function (rolling, turning, bouncing) of the objects as well as perceptual qualities. Perceptual experience is defined as the child's looking at the objects under different orientation without exploring the function. Object identification is defined as the ability of the child to choose the object from an array of objects when it is named by the examiner during the test. Perceptual cue is defined as shape or configuration and does not include size or color. Functional cue is defined as the moving parts of the object allowing the object to roll, rock or open.

For the purpose of this study transformation of the objects is defined as a change in the standard stimuli so that in one case function remains the same as the standard but configuration changes and in the second case configuration remains the same as the standard and function changes. Post test categorization is defined as the child's ability to group the test objects into three groups on the basis of either form or function.

Finally, for the purposes of this study, extension of a term of reference includes all of the objects which an individual is willing to denote with that term of reference (Anglin, 1977). Overextension of a term of reference includes objects not appropriate to that term of reference by adult standards.

Test A of the study requires the subjects to identify the three standard stimuli. Test B requires the subjects to identify a set of transformations of the standard. Test C requires the subjects to identify

a second set of transformations. Order of presentation refers to the order in which the transformations are presented.

Null hypothesis for this study are:

1. There will be no performance differences between the sensory-motor and visual-perceptual treatment groups when tested on object identification during Test A.

2. There will be no performance differences between the sensory-motor and visual perceptual treatment groups when tested on object identification during Test B.

3. There will be no performance differences between the sensory-motor and visual-perceptual treatment groups when tested on object identification during Test C.

4. There will be no performance differences between sexes when tested on object identification during Test A.

5. There will be no performance differences between sexes when tested on object identification during Test B.

6. There will be no performance differences between sexes when tested on object identification during Test C.

7. There will be no performance differences on object identification based on order of presentation of the transformations.

8. There will be no preferences shown for form or function between Test B and Test C.

9. There will be no performance differences on post test categorization.

LITERATURE REVIEW

Introduction

Until the late 1970's psycholinguists studied the structure of language and speech production rather than the origin of word meaning. MacNamara (1972) states, "In the late 1960's grammarians came to rely more and more on semantics . . . this turn of fate has engendered a readiness to seek a basis for language learning in infants among non-linguistic cognitive principles" (p. 2). Thus developmental psycholinguists turned to cognitive and perceptual theories to aid in their understanding of early language acquisition.

Most of the data concerning lexical acquisition has been obtained from longitudinal studies of the development of one word utterances (Bloom, 1973, Greenfield and Smith, 1976 and Nelson, 1973a). These studies have mapped the acquisition of words and the context in which they occur in an attempt to analyze functions of the words. From these studies we know that children's early words consist of nouns in categories of food, body parts, clothing, animals, toys, people, vehicles and household items (Nelson, 1973a). Although researchers can agree these are the words children initially produce, they have been unable to agree on the word meaning. For example when a child sees a toy truck on the table and says "truck" he may mean "see the truck", "I want the truck" or "isn't it a beautiful truck". Of interest to the researcher then is the child's concept of the truck and whether the toy truck is seen as a configuration or as part of the category of moving things that are fun to push around. This review will discuss the theories of language acquisition focusing

on word meaning.

Concept Match Theory

Nelson (1973a) undertook a longitudinal study of 18 ten-month-old children to obtain information concerning the origin of early language. Subjects were observed in structured and free play situations by examiners as well as by the subjects' own mothers. Standardized tests also were administered to the infants to obtain a record of intellectual and vocabulary development. The subjects were followed from the age of 10 months to 30 months or until the child had acquired a vocabulary of 50 words.

In documenting the words children first learned, Nelson drew some conclusions about children's early concepts. For example, clothing was an early category of words with shoes learned by 11 of the children in their first 50 words and hat (5 children) and socks (4 children) coming next. Other clothing items just as accessible to the subjects were not learned (bib, dress, shirt) during this period. Nelson contends that the words learned were "those that the child can act on easily". She continues, "Frequency of personal experience, exposure to words, strength of need or desire cannot apparently explain selection of these words. They are personal, selective and for the most part action related" (1973a, p. 31). Thus Nelson concludes that early words representing objects which act (car drives away) or which could be acted upon (shoes) are the most salient. Parental influence was a factor in the Nelson study, but Nelson strongly suggests that there was individual selection and that words represented an "organizational theme" that implicated the child's prior constructs of the world.

The organizational theme Nelson (1974) refers to is borrowed from Piaget's work although Nelson warns that a direct transposition of Piaget's cognitive theory to language acquisition is not possible at this time. She does state however that for the child, "those things are similar that are acted upon in the same way" (p. 274). She suggests that children have certain organizing themes about the world when they start learning language. These themes or concepts are based on the sensory-motor experience. They may be in addition abstract and not immediately available knowledge, but concepts nonetheless which can be named.

Nelson (1974) introduced "functional core concepts" to further clarify the meaning of this preverbal organization. She writes that children construct concepts initially based on the functional relationships the child has observed during sensory-motor experience with objects. She suggests four steps in the development of word meaning.

First, is the identification of the whole object (Step 1). The child sees the object as a whole rather than an image, two dimensional object or a feature.

Secondly, the child identifies important relationships associated with the object (Step 2). The child builds the core concepts by experiencing "ball" under different conditions and with different people so that the core may include information on location of activity, actors, action, movement, and location of the object. For example, ball becomes associated with roll, bounce, rolls under, throw to Mom, etc. These relationships seem to be similar to the action schemes described by Piaget. Nelson suggests that at this point the child catalogues or synthesizes all these relationships so there is a functional core associated with ball. With

further experience parts of the core may be eliminated as irrelevant to the concept while others may be added. This core not only provides word meaning but may eventually provide a mechanism for sentence construction. Concepts and their core may reflect agent, object, and location in a sentence.

Thirdly, the child identifies instances of the concept by noting salient stable characteristics of the members, i.e., large, small, red, blue, etc. (Step 3). Thus perceptual features identify an instance of the concept but not the concept itself.

Finally, the concept will acquire a name or word (Step 4). If the child's concept corresponds to an adult word he hears repeatedly, the match will occur. It may be possible for the child to form core concepts irrelevant to adult categories or words. If this occurs the core will be revised or go without a name. Nelson (1974) suggests that a concept is a dynamic set of functions and relationships while the word is its static representation.

In 1974 Nelson suggested the above steps were the only possible sequence. However, in 1976 she altered this sequence, suggesting that the child can associate the word with the concept at Step 2 rather than waiting for Step 2 and 3 to be completed.

Thus when a child experiences a new object the process of building the concept begins. The core begins to develop on the basis of the experience of a single instance rather than long range comparison of instances and similarities. At this stage Nelson predicts first underextension of the word. The child would use the word to refer to one specific object rather than the class of objects represented by the word. Following

underextension the child would overextend on the basis of function. The child would, for example, refer to all things that roll and bounce as balls. Finally, as the child identifies invariants or instances of a concept (Step 3) Nelson suggests that overextension may occur on the basis of form or other perceptual attributes. Nelson contends that the overextension which occurs during naming (Step 4) is the child's attempt at comparing and categorizing on similarities of objects rather than the child truly believing a ball and a cherry are one and the same.

In summary, Nelson (1974) believes the functional core is established prior to the time or at the same time that the child is learning the object. The core is based on the child's experience with objects. Invariants are identified also through experience. Overextensions associated with the word initially are based on function but may eventually be based on perceptual cues. This second type of overextension is an attempt on the part of the child to sort and categorize or compare objects. Nelson suggests that this is a process we go through even as adults.

Nelson (1973a) found evidence to support the functional core concept in a study of children ages 15 to 20 months. Ten objects, a standard ball and nine transformations, were presented to the subjects. The transformations were either perceptually like the ball but functionally different or perceptually different and functionally alike. The examiner asked the subjects to give her the ball. This was repeated until each subject chose five of the ten objects. The ten objects were then given to the subject to play with for ten minutes and then the test was repeated. Nelson hypothesized that subjects would make choices based on function rather than form. During Trial I form and function choices were equal

but after free play function choices were made significantly more than form choices. Nelson concludes that when given an opportunity to explore or play with an object, function appears to be a more salient cue than form. This study provides evidence that function can serve as a cue when discriminating objects but it does not provide evidence that function is a primary or necessary cue for language development.

Rodgon, Jankowski and Alenskas (1976) provide some evidence in a correlational study that activity is related to word acquisition. They suggest that early language use is closely tied to overt action and hypothesize that the child's first words should be uttered in conjunction with actions; and this co-occurrence should become progressively less frequent. Three subjects ranging in age from one year four months to one year ten months were observed during 18 one hour sessions over a period of six months. Observations were videotaped, transcribed and analyzed. Subject's language production was analyzed for communication, structural-linguistic form and cognitive components. In addition the action occurring during language production was evaluated in terms of the child performing an action, completing an action, others acting or no action. Talking, running, walking were not considered actions. Results of the study supported the hypothesis that early language is closely tied to a child's actions. Two-thirds of each child's single word speech fell into the child performing action-present category. Fifty percent of the time the subjects were engaged in activity relevant to verbalization. Rodgon et al. suggested that this documented a hypothesis previously stated by DeLaguna (1927), Piaget (1952), Sinclair (1971) and Werner & Kaplan (1963) that language arises in conjunction with overt action. Unfortunately

Rogdon's research does not tell us if sensory-motor experience is necessary for language development or what meaning the activity and the words have for the child.

Rescorla (1976) has found "functional extensions" in children 12 to 18 months old which again points to function as a factor in early language learning. She followed six children studying their productive and receptive vocabulary. She gives the example of a functional extension of hat. Initially one of the subjects used the word hat to refer to his hat, then to refer to anything that could be put on his head (including a pan upside down) and finally narrowed it to the adult concept of hat. This example as well as others observed by Rescorla support the notion again that function is a salient factor in exploring and learning word meaning.

Gruendel (1977) has also found evidence to support Nelson's hypothesis of functional relationships occurring prior to perceptual discrimination of cues. Gruendel followed two children from 12.5 months of age to 24 months of age. During that time she videotaped play periods once every three months. Tapes were transcribed and evaluated for the appearance of overextensions as well as language comprehension and effect of setting constancy. In addition each parent kept a language diary. Information in the diary supplemented video tape analysis.

Gruendel (1977) found that children produced overextensions based on both form and function throughout this one year period. However, when examining the developmental characteristics of the data, she found that functional overextensions occurred earlier in language acquisition while overextensions based on form occurred later. Gruendel cites an example of this trend in the use of "aaa". One child used "aaa" to refer to any

object with wheels such as trucks, buses and riding toys. "Aaa" was eventually narrowed down to refer to toy vehicles only, thus taking into account function as well as perceptual properties.

Gruendel (1977) emphasizes that each child maintained a stable organization of referent objects. That is once "aaa" referred to objects with wheels, it never included animals or people. She also suggests that both differentiation and generalization occurred. In other words some children used a word initially to refer to one object, then generalized to the class of objects while on other occasions a word was used to refer to a class of objects then refined. This will be discussed again in this chapter in regard to Clark's theory.

Anglin (1977) addresses the issue of a functional core in his study of conceptual development. Although his research focuses on an older age group (two years to five years) than Nelson's, Anglin agrees that knowledge of functional attributes or "nonperceptible" criteria are as important as perceptual information. Anglin states, "In addition to knowing what the instances of categories look like, sound like, feel like, taste like and so on, one also knows other nonperceptible attributes about those instances such as their internal constituents, their relations to other things in the world and most fundamentally, the uses to which they can be put, their implications for him" (1977, p. 3).

Despite the theoretical agreement that function is the essence of word meaning, Anglin (1977) and Nelson (1974) disagree on the interpretation of the meaning of words to young children. In his detailed study of conceptual development Anglin (1977) suggests that over and under generalization (or extension) of words is based on four factors (1) individual differences

in children, (2) whether the generalization occurs in comprehension or production, (3) the concept itself and (4) the instance of the concept. Most relevant to the current research are his conclusions about the nature of the concept. First he found that when a word (i.e. dog or praying mantis) is an example of a concept (animal) the central example (dog) and most familiar (dog) will be included in the concept more often than the peripheral (praying mantis) and/or least familiar.

In noninstances of a category or concept, the child uses perceptual similarity, contiguity and finally functional similarity to assign the object a name or category. Consequently children would match saddle and horse on the basis of contiguity; ball and moon on the basis of perceptual similarity and train and truck on the basis of function. Nelson does not account for these possibilities in her theory but suggests function as the only initial criteria possible when word meaning is developing.

Anglin's (1977) approach to the study of word meaning and conceptual development with children between two and five years suggests a highly complex organization based upon several factors. He suggests that the development of extension (objects to which a word refers) and intension (the child's knowledge of the word) takes different developmental courses. Thus the child starts with a central concept (iconic prototype) and uses this to match instances and noninstances of the concept. In the case of a concept instance, centrality and familiarity are used as criteria. In the case of a concept noninstance, perceptual similarity, contiguity and function are used as criteria. In reference to Nelson's theory Anglin stresses the difference between them:

"In Nelson's theory the word is simply appended to a concept which is already well formed on the basis of a "functional core" and no semantic changes in the word's meaning are discussed beyond the child's acquisition of a verbal label, presumably since it is well formed from the outset. According to the present argument, the meaning of the word has not crystallized for the child at the outset, which is why he will overextend it and underextend it in production and comprehension" (p. 254).

Again Anglin (1977) and Nelson (1974) agree that knowledge of function is a basic component of word meaning but Anglin believes it is the least used criteria for word meaning while Nelson believes it is the primary criterion. Anglin argues that children often are unable to use the essential function as a criteria. A child calling buttons money is not using function as a criteria in naming but is basing his naming on the perceptual similarity of buttons and money.

In summary, Nelson believes that early word meanings or concepts are developed out of the child's sensory-motor experience and organization, thus making each child's lexical entries unique to that child. In addition she believes that word meaning begins with a functional core concept consisting of actions or relations or experiences the child has had with the object. It is the synthesis of the core plus the perceptual attributes, plus experience with the word through the caretaker that leads to early word meaning. Nelson hypothesizes that after a period of matching concepts to words, the child will begin to develop concepts to match the words he hears although there is apparently always a functional core of relationships.

Although there is some empirical evidence to support Nelson's theory (Gruendel, 1977) as well as theoretical agreement (Anglin, 1977) further research and theoretical development is necessary.

Semantic Features Hypothesis

Clark (1973 and 1974) states that when a child first begins to use language, he does not know the full adult meaning of words but has only partial entries for the words in his lexicon. These partial entries consist of features dominant or salient to the child. These features then represent the word or the word refers to the features until this is modified through experience to eventually match adult referents. Therefore the child's initial use of a word differs conceptually from the adult's because of the features to which the child attends. The child will use the word when an object meets his limited criteria thus resulting in referential errors.

Although eventually it may be possible to identify universal semantic primitives (Bierwisch, 1967), Clark (1973) states that, for the moment, features must be defined as the child's percepts. Clark points out that children's perception is not different from the adults. The child sees the difference between cat, dog, and cow. Rather "there is no a priori reason for the child to respect either adult or biological taxonomies when he first begins to learn the meaning of a word" (p. 17). Consequently, four legged, a feature associated with the word dog, may also apply to cats and cows and thus an overextension occurs. Each word must be learned separately as features are added or subtracted until adult meaning is acquired.

Clark (1973) derives evidence for her hypothesis from an analysis of nineteenth and twentieth century diary studies. This analysis focuses on "overextensions" found in the diaries. Clark suggests that the appearance of overextensions between one year and two years supports the semantic features hypothesis.

Clark (1974) cites examples from a diary by Major (1906) to make her point. Major's son at two years of age referred to most animals as "mum". This reference was used for four-legged animals for which he had no other name (hippopotamus, opossum, tiger). The meaning of "mum" therefore was determined by Major to be "four-legged". When the child was almost three years old he had learned the appropriate name for many of the "mum" animals and refused to name the others. Clark interprets this change as a move on the part of the child from one or two feature-based words to a more adult feature-based meaning. The child has added perceptual features to his repertoire to discriminate word meaning.

Additional evidence for the child's focus on features is provided as terms narrow in reference. Information taken from the diaries of Ament (1899), Leopold (1948), Lewis (1951), Perez (1892) and Schwachkin (1948) supports Clark's hypothesis. Initially bow wow refers to dog. During what Clark calls Stage II, bow wow refers to dog, cat, horse, sheep, and cow. In the third stage, bow wow refers to all animals except cow which is now called moo. The fourth stage includes bow wow, moo and now gee gee for horse. Clark (1974) suggests that the criteria for cow was the sound and for horse the size and possibly the tail and mane. Finally, bow wow refers only to dog while the other animals have their own referents.

Clark (1974) believes the principal features or characteristics that form the basis of overextensions as well as early word meaning are shape, movement, size, sound, taste and texture, with shape being the most common. Clark (1974) cites a great deal of literature on infant perception to support her position. The infant under one year of age does indeed have the ability to perceive and to a point discriminate shapes, configuration,

sound, size, texture and movement. In fact she relies on Gibson's distinctive features hypothesis as a basis for her theoretical position.

Gibson (1969) suggests that prior to one year of age children have gone through a process of perceptual discrimination. This process involves initially focusing on the outline or periphery of the object (shape), then focusing attention to other features until these features are identified as a unique bundle of features. The process results in the child discriminating objects by associating bundles of features with a concept. Clark (1973) further suggests that perceptual discrimination is recapitulated when the child has to begin interpreting his perceptual input in order to use it in attaching a meaning to a word.

Clark (1973) assumes no a priori concepts on the part of the child as does Nelson. She does, however, suggest there may be a hierarchy of development with more general features being learned first such as shape. As the child progresses, more specific features are necessary to represent word meaning and these features fit together into a "bundle" of features. As language development progresses from these early feature criteria, social and cultural information must eventually assume a role so that discrimination between variants of a concept (throne and chair) can be understood. How this is accomplished is not yet known.

It is clear from the literature that overextension is a phenomenon occurring universally during early language development (Anglin, 1977; Gruendel, 1977; Huttenlocher, 1974). However, Clark's reliance on productive overextension to support her theory has been criticized openly. Reich (1975) is a critic of Clark's reasoning. Reich suggests that overextension is not the only possible relationship between referential

coverage of the child's word and that of the adults. Figure 1 illustrates other possible referential errors made by children. In addition, to errors the child's use of a word may match the adult's exactly (identity). There may be underextension where the child's use of a term applies only to a subset of the objects included in the adult concept (Anglin, 1977). Mismatch occurs when the child's use of the term does not correspond to the adult's use of the term. Overlap on the other hand allows for some agreement of the use of the word but also some lack of agreement. Anglin (1977), Gruendel (1977), and Huttenlocher (1974) each concur that the relationships in Figure 1 are possible and do occur. The most frequently occurring relationship is that of identity.

Reich (1976) argues that Clark's theory cannot account for possibilities other than overextension and identity. He provides evidence that underextension occurs as well as overextension. While observing his son in a word game, Reich discovered that "find the shoe" resulted in his son going to his mother's closet. If shoes were in daddy's closet or by the bed the child would ignore them. This was also true of Allison in Bloom's study (1973). Over a period of time Reich's son generalized the concept shoe to any shoe in the room. Thus Reich believes word meanings move from specific (mommy's shoe only) to general (all shoes) while Clark sees development going from general (shoes being anything associated with a specific feature like sole of the shoe) to specific (shoes excluding all other objects).

The reliance on overextension is also criticized by Anglin (1977). Anglin suggests in his study of conceptual development that authors of diaries tend to emphasize overextension and fail to mention underextension.

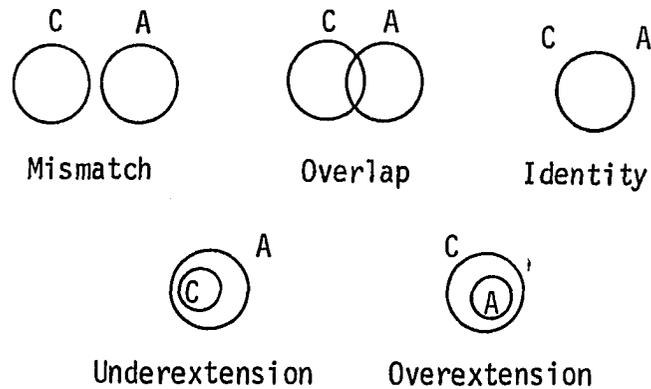


Figure 1. Possible relationships of adult and child meaning
(A = Adult; C = Child)

Anglin found that when children were given an equal opportunity to over or underextend word meaning in a comprehension task, underextension occurred 28 percent of the time and overextension only 8.4 percent. This was true of children two to four years old and continued to hold true for children four to six years of age. Overextension was credited if the child responded yes to the question "is this a _____ (noninstance). Underextension was credited if the child responded negatively to an instance of the concept when asked "is this a _____". Anglin is not suggesting that universally underextension occurs more often than overextensions. He is suggesting, however, that manipulation by the examiner of the concept can effect the incidence of overextension and underextension.

Huttenlocher (1974) has also weakened Clark's position by finding that overextensions occur in production but not in comprehension. Huttenlocher studied three children during the 10 to 18 months age period focusing on language comprehension. During that time, subjects did produce overextensions in regard to animals as Clark suggests. However, when asked to find the _____ the correct picture was chosen. Huttenlocher suggests that overextensions may not be a function of word meaning but of the process of production. It is the case that children produce and comprehend words accurately more often than over or underextension. In addition it seems to be true that both perceptual and functional overextensions occur.

Regardless of the controversy surrounding productive overextensions and the problems associated with interpreting these data, the question remains as to the correctness of Clark's hypothesis. Nelson (1974) remains critical of Clark's theory because of the reliance on perceptual features as the equivalent of word meaning. Nelson criticizes Clark's lack of attention to the child's own organizing abilities as well as her disregard for the child's cognitive processes.

Anglin (1977) on the other hand agrees that perceptual similarity is more likely to elicit overextension than contiguity or functional similarity. When it comes to defining concepts, children refer to the things objects do, what you do to them and where you find them. Thus children know a great deal about objects and can define perceptual as well as functional attributes. But Anglin suggests that word meaning is more than just a match between an object and one or two attributes or perceptual cues. He suggests that initially the use of features as

criteria for naming or categorizing remains fluid. For example, the child knows apple is to eat and may define it as such. But an apple also is red and round like a balloon. The child may on one occasion use "to eat" to define an apple but in another situation may use "round" to define apple. Over and underextensions are a result of this fluid process. It is only over time and with experience that the concept crystallizes in children and that referential error is eliminated.

In summary, Clark believes that early word meaning reflects directly the salient perceptual cues of the object. As the child differentiates objects and their features and gains experience with words, referential items approximate adult meaning. Her reliance on overextension has been criticized but the basic hypothesis needs continued research.

Conclusions

Clark and Nelson differ in two major ways when interpreting early word meaning for children. First they differ in the a priori constructs children bring to language comprehension and production. Nelson believes that sensory-motor activity results in preverbal concepts and classification which the child brings to the language learning situation. Clark on the other hand acknowledges no a priori concepts but rather implicitly states that sensory-motor experience with perceptual features of an object is a factor in language acquisition.

The second disagreement concerns the concepts underlying word meaning. Nelson asserts that function and relationships are synthesized into a functional core which is the primary basis for word meaning. Perceptual properties are a secondary source of information. She sees the

core as a whole with instances and attributes defined as the child develops. Clark feels the child focuses on the perceptual attributes of an object and builds his concepts as he defines the bundles of features associated with the words he hears.

Both seem to agree that information from the care giver plays an important part in the child's language acquisition but Clark sees this contribution as highlighting perceptual features. Nelson on the other hand sees the care giver facilitating acquisition by being aware of the child's concepts and providing opportunities to explore relationships.

Research in word meaning is relatively new in the psycholinguistic literature. Additional investigation of the development of referential terms is necessary. Nelson's and Clark's theories have received a great deal of attention in the current literature. They provide a framework for the research undertaken by the author of this study.

METHODOLOGY

Subjects

Subjects were 36 male and 31 female children between the ages of 24 and 36 months ($\bar{x} = 31.10$; $\bar{s} = 3.259$). All subjects were chosen either from birth records reported in the Ames Daily Tribune, a toddler-preschool day care center in Ames or a Department of Child Development file of families willing to participate in research and teaching related projects. Subjects were living in the Ames community with both natural mother and natural father at home.

Approval for use of human subjects was obtained from the Iowa State University Institution Review Board. Parental consent was obtained prior to conducting the research. A copy of the parental informed consent letter is found in Appendix A.

Subjects were assigned randomly to two treatment groups within sex. One-half of the males and one-half of the females were assigned to the sensory-motor group. The remaining subjects were assigned to the visual-perceptual group. Both groups were subdivided further into two orders, one-half of each group receiving order I (same function as the standard, different configuration); the other half receiving order II (same configuration as the standard, different function). Table 1 displays the treatment groups and the stimuli received by each.

Stimuli

Nine stimuli were constructed for the purpose of the experiment. The three standard stimuli (for object identification Test A) were referred to as Bup, Teter, and Mef (Figure 2). These names were chosen arbitrarily from

Figure 2. The three standard stimuli from left to right: Bup, Mef, Teter

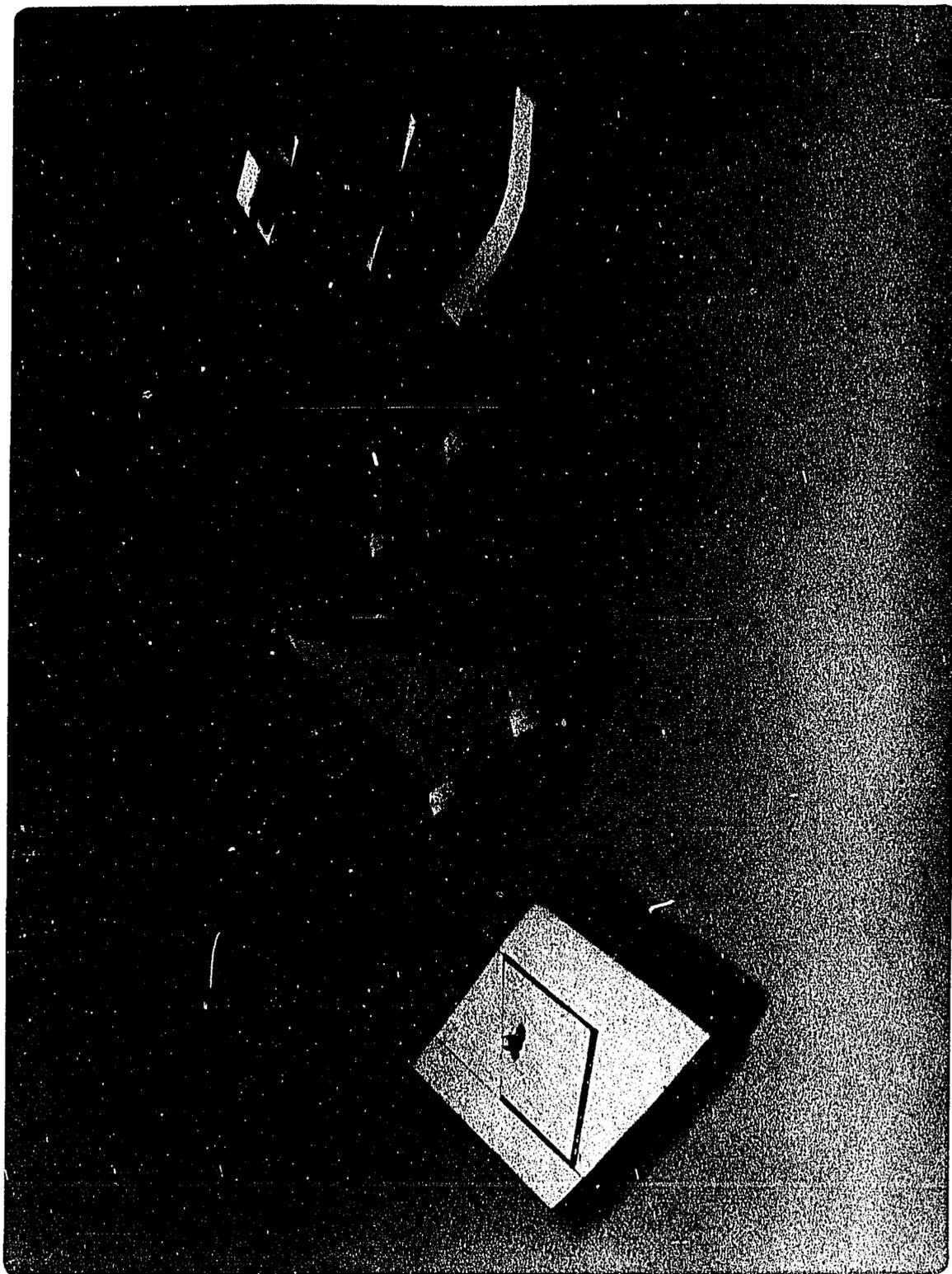


Table 1. Treatment groups

Treatment	Sex	Order	n	Procedure		
				Test A	Test B	Test C
Sensory-Motor	Male	I	9	Standard	Function ^a	Form ^b
		II	8	Standard	Form	Function
	Female	I	7	Standard	Function	Form
		II	9	Standard	Form	Function
Visual-perceptual	Male	I	9	Standard	Function	Form
		II	10	Standard	Form	Function
	Female	I	8	Standard	Function	Form
		II	7	Standard	Form	Function

^aSubjects received the transformation illustrated in Figure 3 where function matches the standard but form varies.

^bSubjects received the transformations illustrated in Figure 2 where form matches the standard but function varies.

a list of nonsense words typically used in psychological research. There were two transformations of each standard. One set of transformations (Figure 3) varied from the standard on function but not on configuration. The second set of transformations (Figure 4) varied from the standard on configuration but not on function.

The outside dimensions of the Bup standard are 13.5 x 5 x 1.5 cm and the door dimensions are 6.5 x 6.5 x 8 cm. The base of the Mef standard pyramid is 13.5 cm square; the height is 12 cm and the wheels are 3.25 cm in diameter. The Teter standard has a center stem 14 x 2 x 2.5 cm; a rocker of 12 x 2 x 2 cm and an assembled base depth of 6 cm.

The Bup transformation I (Figure 3) has outside dimensions of 13.3 x

Figure 3. Transformations which vary on function but not configuration from left to right: Bup, Mef, Teter

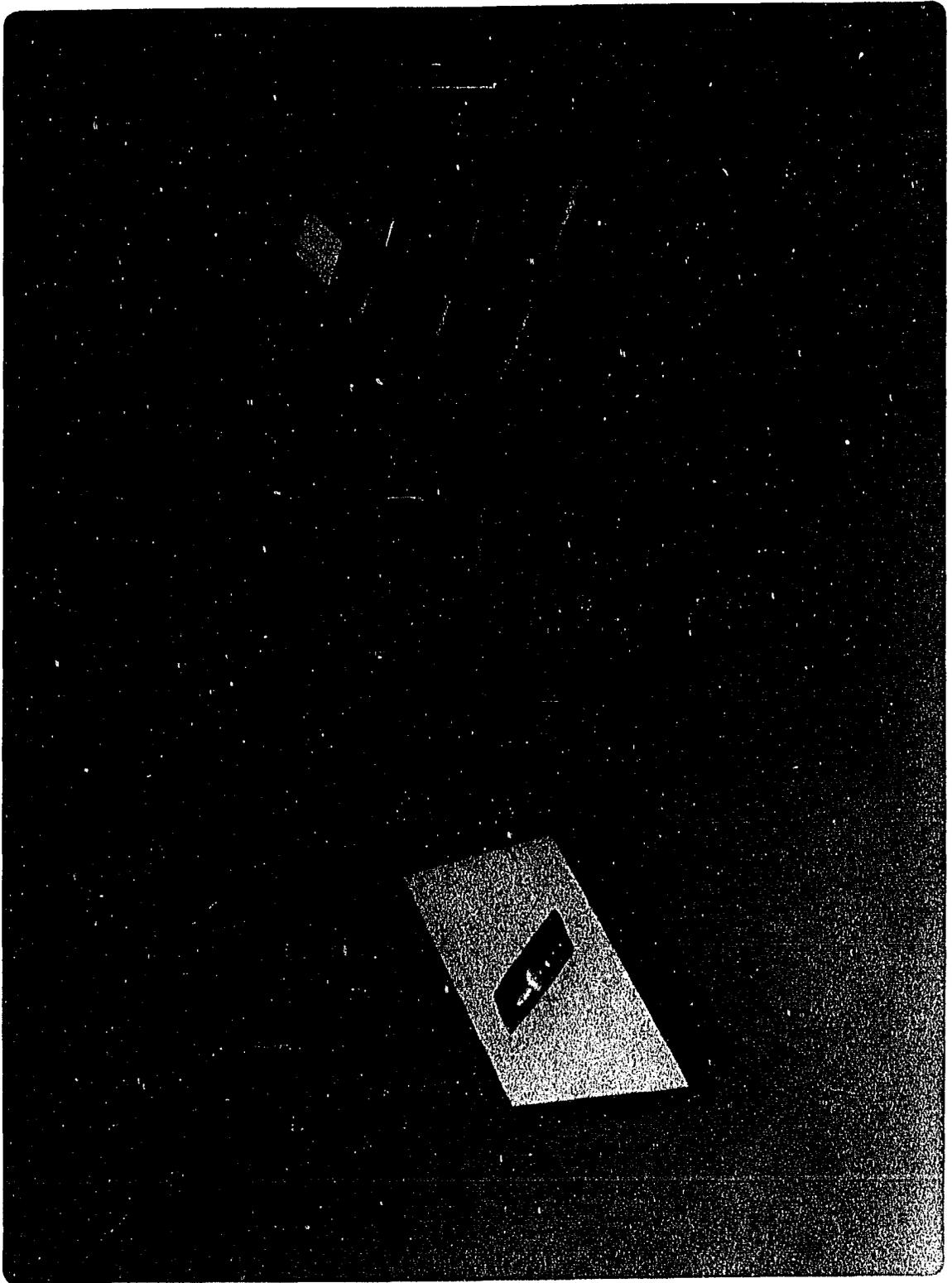
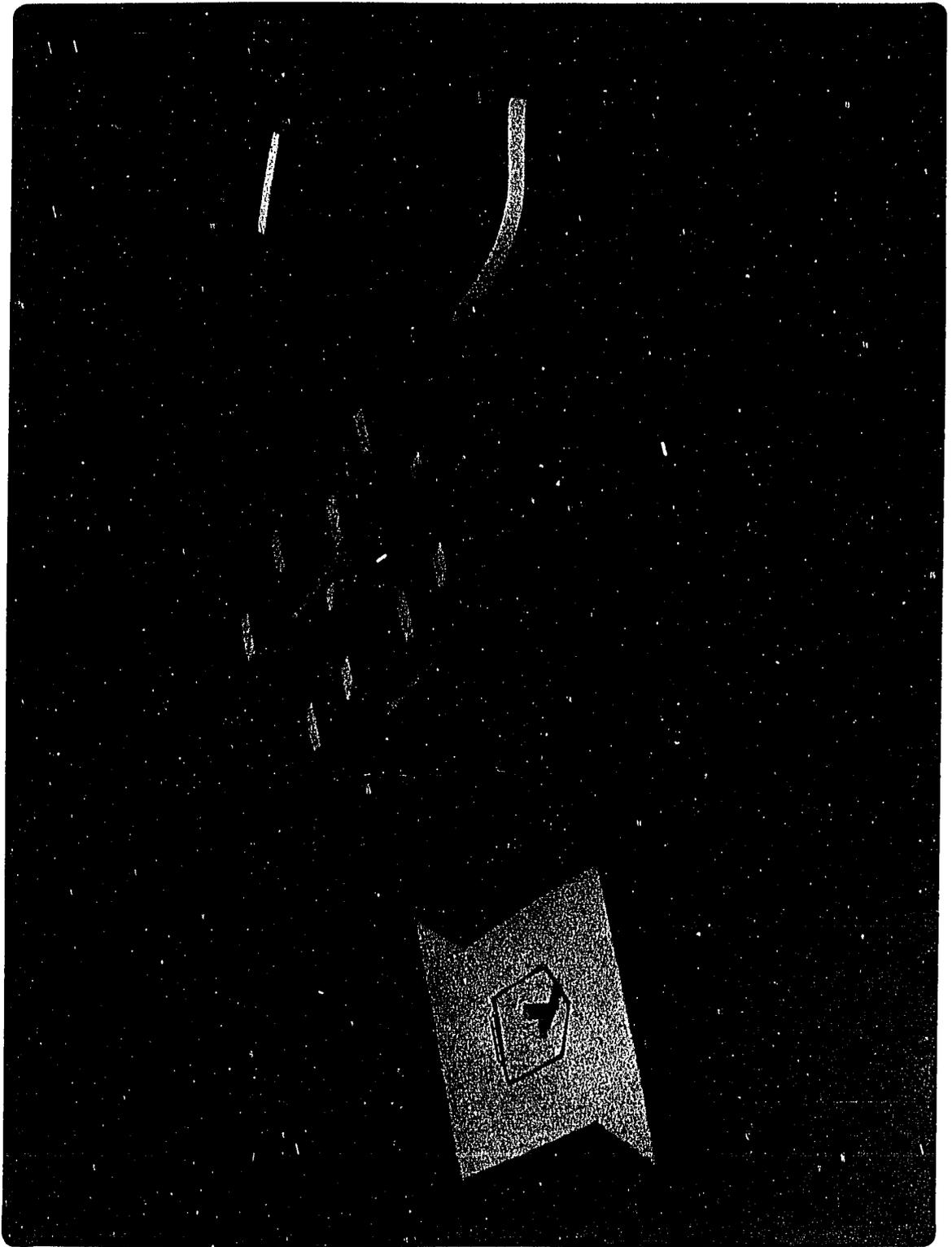


Figure 4. Three transformations which vary on configuration but not function from left to right:
Bup, Mef, Teter



15 x 1.5 cm. Dimensions for the bead opening are 7.5 x 2.5 cm. The Mef transformation I (Figure 3) has a pyramid base of 13 cm square and a height of 12 cm. Dimensions for the triangular openings are 5.5 x 5.5 cm. Inside the pyramid is a baby rattle consisting of seven plastic discs each 5 cm in diameter. The Teter transformation I (Figure 3) has a base of 13 x 3.75 cm and a height of 15 cm. The top cross bar is 5 cm wide and the second cross bar is 7.5 cm wide. Dowels are .5 cm in diameter and 2.25 cm in length.

The Bup transformation II (Figure 4) is 17 cm wide; 10.5 cm high at the center and 2 cm deep. The center door is 4.25 cm high and 6.75 cm wide at the tip. The Mef transformation II (Figure 4) base is 12.5 cm x 13 cm. Each side is connected by dowel rods of .5 cm in diameter. The six wheels are 3.5 cm in diameter. The Teter transformation II (Figure 4) has a center post 10.25 cm high and 5 cm wide at the top and a width of 10.5 cm at the base. Each rocker is 12 x 2 x 2 cm.

The stimuli were constructed of wood and painted with Dutch Boy non-toxic paint color number 172-25.

Procedure

Subjects were tested in their home with their mother or father present. Subjects were seated at the table and chair used during meals. The same female examiner tested all subjects. Parents were instructed not to assist the subject in answering although the child could sit on the parent's lap if the subject appeared to be apprehensive.

The procedure consisted of six parts; a warm-up task, Object Identification Test A, Test B, Test C, Post Test Categorization and Screening Test. The procedure took about one half hour to complete.

Pilot testing was conducted on children ranging in age from 12 months to 36 months. This testing helped to determine the final methodology and subject age group and allowed for practice of the procedure. Data from pilot testing were not included in the data pool for the study.

Warm-up task

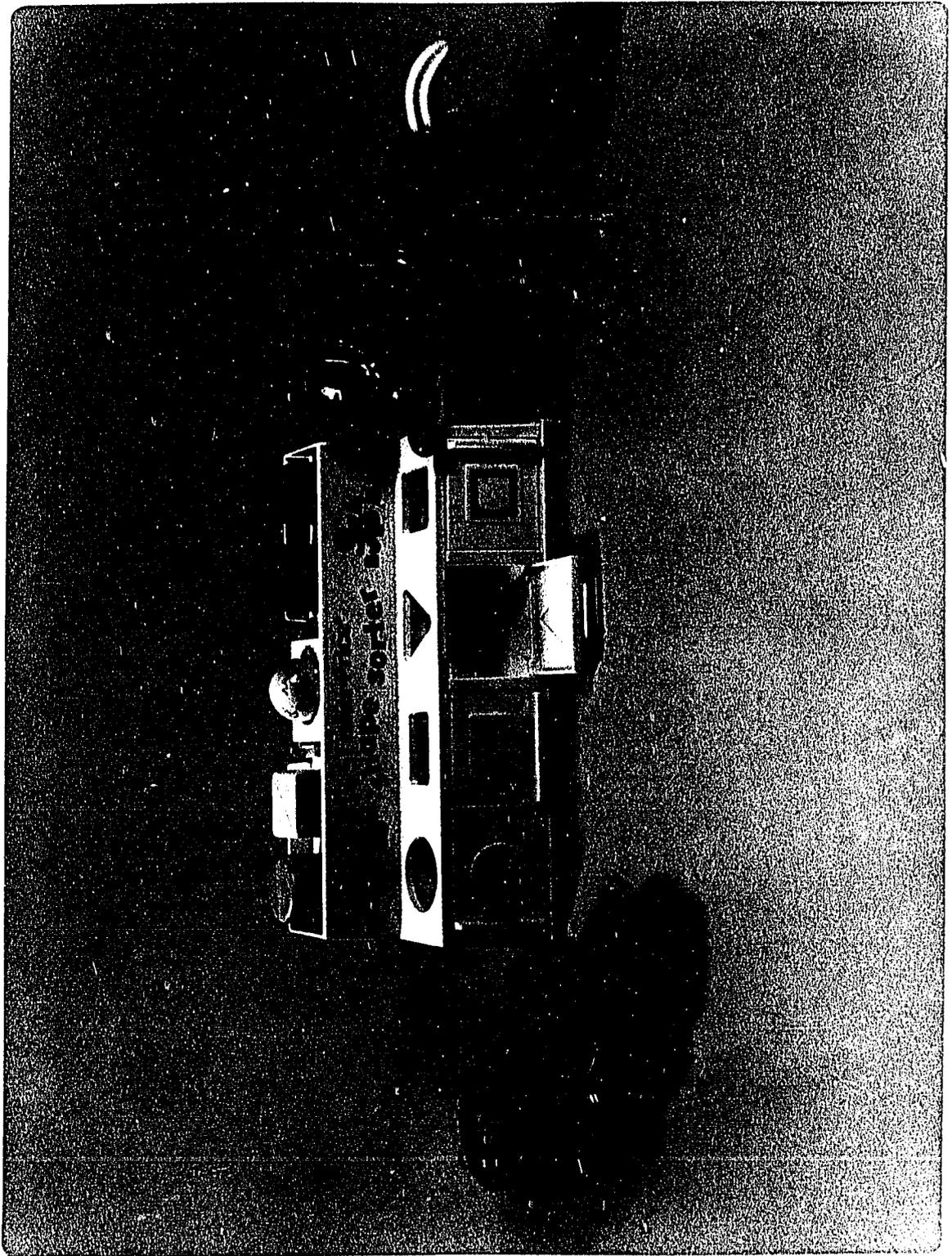
The warm-up task was designed to put the subject and the parent at ease and to build rapport between the examiner and subject. The child was given three commercially made toys (Figure 5) with the instruction, "Show me how you can play with the toys". This instruction gave the child permission to play even though a majority of the subjects started to play spontaneously. If the child hesitated the mother was requested to encourage the child. The five minute period began, however, as soon as the instruction was given.

The examiner recorded which toys were manipulated and the verbalizations of each subject on the record form found in Appendix B. At four minutes after the initial instruction, the child was told that he or she should finish playing to get ready for some new toys. At five minutes after the initial instruction, the toys were slowly put away giving the child an opportunity to complete the activity in which he or she was engaged. This procedure was followed for all subjects.

Object Identification Test A

Object Identification Test A required the child to associate the nonsense names (Bup, Teter, Mef) spoken by the examiner with the correct standard stimuli. Procedures for Object Identification Test A differed depending upon subject assignment to treatment. The procedures for the

Figure 5. Commercial toys used for the warm-up task



sensory-motor and visual-perceptual groups are described below. The record form used during testing is illustrated in Appendix B.

Subjects in the sensory-motor group were shown the three standard stimuli to begin Object Identification Test A. From now on Object Identification Test A will be referred to as Test A. Each child was given 60 seconds to play with the toys during which time the examiner named each of the three stimuli twice. In addition the examiner recorded on the record sheet the child's verbalizations about the stimuli. After the 60 seconds the examiner said, "Now we will play a game". All but one standard stimulus was removed and the examiner said, "Show me the _____". This was repeated with the remaining two stimuli to establish the appropriate pointing response. During the next set of trials two stimuli were presented simultaneously and the examiner asked again, "Show me the _____". These double stimuli trials continued until the child had three consecutive correct responses. Order of stimulus presentation for this portion of Test A is illustrated on the record form in Appendix B. The final set of training trials consisted of presenting the three stimuli simultaneously and repeating, "Show me the _____". This was continued until the child made four consecutive correct responses or until a total of 24 triple stimuli trials had been presented. Thus the minimum number of trials was seven (single stimuli trials were not counted since an incorrect response was not possible). The 24 triple trial maximum was set during an earlier pilot testing. Children did not maintain attention to the training task past 24 trials as evidenced by behaviors such as leaving their chairs, asking for other toys or telling stories.

During Test A position of the stimuli were rotated counter clockwise every third trial to eliminate position as a cue. Positive reinforcement of "Good! You found the _____", was given for each correct response. After an incorrect response the subject was given a second opportunity to find the correct stimuli and was subsequently reinforced. Subjects were allowed to manipulate the stimuli during Test A but all stimuli were replaced on the table before each trial.

Test A ended when the child had reached the criterion of four consecutive correct responses or the child had been presented with 24 triple stimuli trials.

Subjects in the visual-perceptual treatment group were shown the three standard stimuli placed on separate lazy Susans (manufactured by Rubber Maid) to begin Test A. Each subject was instructed to look at the toys but not to touch them. After these instructions the child was given 60 seconds to look at the toys while the examiner rotated the lazy susans and named each standard stimuli twice. After 60 seconds the examiner stated, "Now we will play a game". All but one toy was removed and the examiner requested, "Show me the _____". This was followed by the double stimuli trials and the triple stimuli trials as previously described for the sensory-motor group. At no time however, were the subjects in the visual-perceptual group allowed to touch or play with the stimuli.

Correct responses were reinforced by the examiner with, "Good! You found the _____". Incorrect responses were negatively reinforced with "no" and a second opportunity to respond was allowed. After four consecutive correct responses during the triple stimuli trials, or 24 triple stimuli trials, Test A was complete.

Object Identification Test B and Test C

Object Identification Test B (referred to from now on as Test B) and Object Identification Test C (referred to from now on as Test C) consisted of nine trials each. Test B and Test C required each subject to identify each of the transformations. As previously suggested, Test B and Test C were designed to determine if the child was associating a form or a function cue with the name of the object during the preceding Test A. If the child was assigned to Order I, he or she received the function transformation stimuli during Test B and the Form transformation stimuli during Test C. If the subject was assigned to Order II, he or she received the form transformation during Test B and the function transformation during Test C.

To begin Test B, subjects in the sensory-motor group were presented the appropriate transformations. The standard stimuli remained out of sight so they could not be used as cues. Again each subject was allowed to play with the three transformations for 60 seconds but no naming occurred. The three stimuli were placed on the table and the subject was then asked to "Show me the _____". Responses were recorded on the record form. No reinforcement was given but the examiner did acknowledge each response by saying "ok". Following the nine trials of Test B, Test C was presented. Test C consisted of the second set of transformations. Subjects once again were given 60 seconds to play with the stimuli. Again no naming occurred. When nine trials of Test C followed. With the completion of Test C all subjects in the sensory-motor group had been exposed to the three standard stimuli in Test A, the three form transformations and the three function transformations in Test B and C.

Subjects in the visual-perceptual treatment group saw the transformations on lazy Susans and were not allowed to play with the stimuli. They were, however, given 60 seconds to view the first set of transformations while the examiner rotated them on the lazy susan. After viewing the transformations they were given the nine trials of Test B to see if they could identify the transformations. Following the nine trials of Test B the final set of transformations were presented. Subjects were allowed to look at these for 60 seconds; then the nine trials of Test C were administered. With the completion of Test C all subjects in the visual-perceptual treatment had been exposed to the three standard stimuli in Test A, the three form transformations and the three function transformations in Tests B and C.

Post test categorization

All subjects were presented with all nine stimuli following Test C. The following instructions were given: "Give me two toys that go together, two toys that are alike". If the subject hesitated the standard Mef was presented and the child was asked to find another toy like it. Once the subject responded with the two toys the examiner asked, "Is there one more toy to go with these or is this all?" This procedure was repeated for the standard Bup and Teter if necessary and if they remained unmatched. The groupings chosen by the child were then recorded on the record sheet. This completed the experimental procedure.

During the experimental procedure all instances of overextension or mislabeling were recorded on the record form (Appendix B). This information was utilized to provide additional evidence regarding cue salience.

A screening test (Appendix C) was administered to each child. Three pictures at a time were presented to the child and the child was required to find the picture identified by the examiner. Results were intended to be used to exclude from the final subject pool any child who was unable to respond to the task. No subjects were excluded on the basis of the screening test.

Analyses

Four statistical analyses were performed.

The first was a least squares analysis of variance. This analysis was completed separately for Tests A, B and C. Factors for Test A were sex (male and female) and treatment (sensory-motor and visual-perceptual). The following main effects and interactions were possible: sex, treatment and sex by treatment. A 2 x 2 x 2 analysis of variance was completed on Test B and Test C. The following main effects and interactions were possible: treatment, sex, order, treatment by sex, treatment by order, sex by order and treatment by sex by order. Both sequential and partial sums of squares were computed however data analysis was based on the partial sums of squares. A significance level of .05 was adopted for this study.

A second analysis was a 2 x 2 x 2 x 2 least squares analysis of variance employing a split plot design. Factors were sex, treatment, order and cue (Test B and Test C). The dependent measure was the score received on Test B and on Test C. The factors and interactions were as follows: treatment, order, sex, cue, treatment by order, treatment by sex, treatment by cue, order by sex, order by cue, sex by cue, treat-

ment by order by sex, treatment by order by cue, treatment by sex by cue and treatment by order by sex by cue.

The least squares analysis was chosen due to the unequal number of subjects completing the procedure. Of the 67 subjects completing Test A, 59 of those subjects completed Test B and 58 subjects completed Test C.

An analysis of the post test categorization was conducted to determine which cues (form or function) were more salient to the subjects during categorization. A Pearson Chi Square was used for this analysis.

Finally, an analysis of the overextensions recorded during the experiment was conducted to determine if they were form or function related.

RESULTS

The results of this study are presented in three parts as follows:

- (1) Results of the Analysis of Variance on Test A, Test B and Text C,
- (2) Results of the Post Test Categorization and (3) Summary of Over-extensions Recorded During the Testing Procedure.

Results of the Analysis of Variance
on Test A, Test B and Test C

A 2 x 2 x 2 least squares analysis of variance was calculated to provide information concerning the effects of treatment, sex, and order on the subject's ability to learn the identification of three novel stimuli. The dependent variable for Test A was the number of trials to criterion. For Test B and Test C the dependent variable was the number of correct responses within the nine trials of each test. Independent variables for Test A were treatment (sensory-motor and visual-perceptual) and sex (male and female). Independent variables for tests B and C were treatment, sex and order. Order referred to the set of transformations presented during Test B and Test C. Subjects receiving Order I on Test B saw stimuli with the same function as the standard but a different configuration. Subjects receiving Order II on Test B saw stimuli with the same configuration as the standard but a different function.

Results of the analysis of variance on Test A indicated no significant differences between the means for the main effects of treatment and sex (Table 2). In addition there were no significant interactions. Thus, the first and fourth null hypotheses concerning performance and sex fail to be rejected.

Table 2. Analysis of variance for Object Identification, Test A

Source	df	Sequential SS	F Value	PR > F	Partial SS	F Value	PR > F
Treatment	1	53.64	0.92	0.66	46.60	0.80	0.62
Sex	1	36.23	0.62	0.56	35.94	0.62	0.56
T X Sex	1	7.94	0.14	0.74	7.93	0.14	0.71
Error	63						

Results of the analysis of variance on Test B (Table 3) yielded two significant findings. Males ($\bar{x} = 4.548$) had significantly more correct identifications for Test B than females ($\bar{x} = 3.2857$; $F = 4.73$, $p < .03$). In addition, treatment order and sex interacted to produce a significant interaction ($F = 5.11$, $p < .02$). This interaction is depicted in Figure 6. Main effects due to treatment and order were found not to be significant.

Because of the significant interaction found for Test B, a further analysis was necessary. A test for simple main effects was computed for males and females. Results on two analyses are shown in Table 4 for females and Table 5 for males. For females, no significant effects were found although order approached significance with Order II subjects making more correct responses than Order I subjects. For males, treatment and order interacted for a significant effect ($F = 4.34$, $p < .04$, Table 5). Thus, the fourth null hypothesis was rejected. However, this finding is qualified by the

Table 3. Analysis of variance for Object Identification, Test B

Source	df	Sequential SS	F Value	PR> F	Partial SS	F Value	PR> F
Treatment	1	0.84	0.14	0.71	1.09	0.18	0.68
Order	1	0.82	0.13	0.72	0.53	0.09	0.77
Sex	1	23.85	3.83	0.06	29.50	4.73	0.03
T X Order	1	2.64	0.42	0.52	2.08	0.33	0.56
T X Sex	1	3.17	0.51	0.48	1.17	0.19	0.67
Order X Sex	1	21.65	3.47	0.07	20.80	3.34	0.07
T X O X S	1	31.88	5.11	0.03	31.88	5.11	0.03
Error	51						

Table 4. Analysis of variance for simple main effects for Object Identification Test B, females

Source	df	Sequential SS	F Value	PR> F	Partial SS	F Value	PR> F
Treatment	1	4.68	0.74	0.60	2.13	0.34	0.57
Order	1	14.41	2.27	0.14	13.21	2.08	0.16
T X Order	1	8,35	1.31	0.26	8.35	1.31	0.26
Error	24						

Results of the analysis of variance on Test C indicated no significant differences between the means for the main effects of treatment, order and sex (Table 6). Thus the third and sixth null hypothesis concerning treatment, order and sex fails to be rejected.

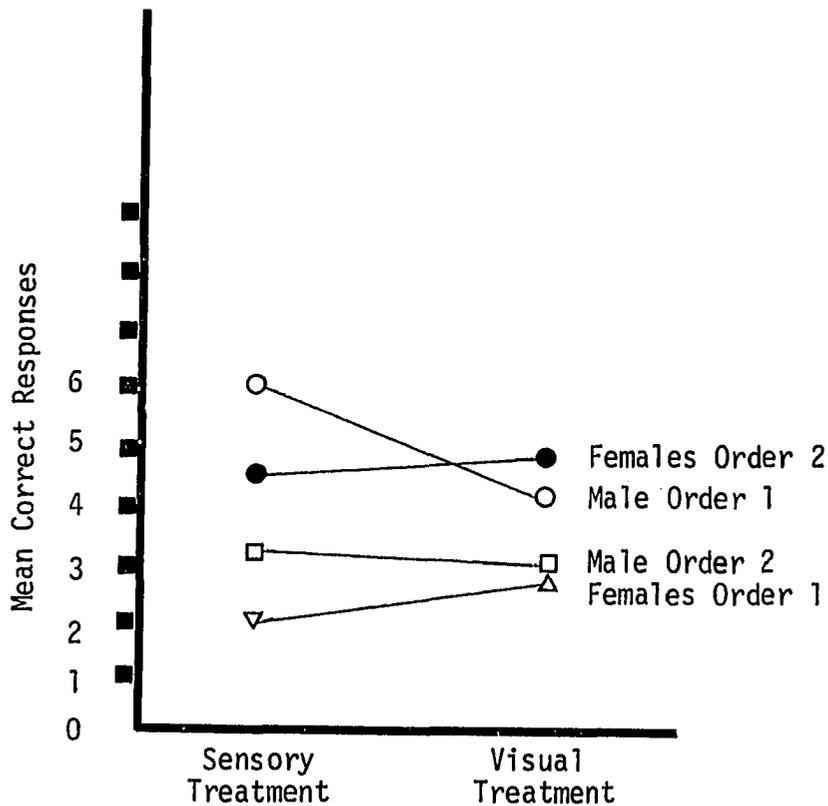


Figure 6. Mean scores plotted to show treatment, order and sex interaction for Test B

A 2 x 2 x 2 x 2 least squares analysis of variance was completed on object identification scores with treatment, order and sex as the between subjects factors and cue (form or function) as the within subjects factor. This analysis provided an opportunity to study the relationship between treatment, order and sex as well as to compare subject's response to form and function cues as they moved from Test B to Test C. The dependent variable was again the number of correct responses within the nine trials of Test B and the nine trials of Test C.

Table 5. Analysis of variance for simple main effects for Object Identification Test B males

Source	df	Sequential SS	F Value	PR> F	Partial SS	F Value	PR> F
Treatment	1	0.19	0.03	0.85	0.00	0.00	0.98
Order	1	7.06	1.15	0.29	7.80	1.27	0.27
T X O	1	16.69	4.35	0.04	26.60	4.35	0.04
Error	27						

Table 6. Analysis of variance for Object Identification, Test C

Source	df	Sequential SS	F Value	PR> F	Partial SS	F Value	PR> F
Treatment	1	0.62	0.12	0.73	0.42	0.08	0.78
Order	1	0.92	0.17	0.68	0.93	0.17	0.68
Sex	1	3.07	0.58	0.45	3.12	0.59	0.45
T X Order	1	0.25	0.05	0.83	0.36	0.07	0.79
T X Sex	1	2.16	0.41	0.53	2.11	0.40	0.53
Order X Sex	1	3.15	0.59	0.44	3.12	0.59	0.45
T X O X S	1	2.11	0.41	0.53	2.11	0.40	0.53
Error	50						

The main effects and interactions possible were as follows: treatment, order, sex, cue, repeated measure treatment by order, treatment by sex, treatment by cue, order by sex, order by cue, sex by cue, treatment by order by sex, treatment by order by cue, treatment by sex by cue and treatment by order by sex by cue.

Cue or the within subjects factor referred to the stimulus cue (form or function) collapsing across order. Therefore the function scores (Order I on Test B and Order II on Test C) were compared with the form scores (Order II on Test B and Order I on Test C) to determine if a cue preference did exist.

It had been hypothesized that subjects could have used one of several strategies for learning the object identification task. First they could have used function as a primary learning cue as Nelson suggests. If so subjects receiving Order I on Test B and Order II on Test C (Cue I, function) would have received higher scores on the object identification task than the subjects receiving Order I on Test C and Order II on Test B (Cue II, form). If however subjects chose form as a primary cue, then subjects receiving Order I on Test C and Order II on Test B would receive the higher scores.

A second learning strategy suggested that subjects in the sensory-motor treatment would use function as a learning cue (Cue I) and would therefore have more correct responses during the presentation of the function than the form transformation. Likewise it was suggested that subjects in the perceptual-motor treatment would use form (Cue II) as a learning cue and would therefore have more correct responses when presented with the form transformation than the function transformation.

Results of the 2 x 2 x 2 x 2 analysis of variance are illustrated in Table 7. There were no significant main effects although sex approached significance. There was a significant triple interaction of treatment by sex by cue (Figure 7). In the sensory-motor group males receiving function cue scored the highest while females receiving function cues scored the

Table 7. Results of the 2 x 2 x 2 x 2 analysis of variance on Tests B and C

Source	df	Sequential SS	F Value	Partial SS	F Value
Treatment	1	.016	.002	.003	.000
Order	1	.006	.000	.003	.000
Sex	1	22.392	2.991	23.312	3.092
Cue	1	3.117	0.784	0.939	0.236
T X O	1	2.108	0.281	1.474	0.195
T X S	1	5.471	0.730	4.019	0.533
T X C	1	0.612	0.514	0.644	0.162
O X S	1	20.291	2.710	17.802	2.361
O X C	1	12.760	3.210	10.133	2.549
S X C	1	4.237	1.066	4.679	1.177
T X O X S	1	8.296	1.108	7.294	
T X O X C	1	1.179	0.296	1.993	0.501
T X S X C	1	24.740	6.222**	27.039	6.80**
O X S X C	1	7.670	1.929	7.684	1.933
T X S X O X C	1	0.244	0.061	0.244	0.061
Error	50				
Error	51				

** p = .01.

lowest. Subjects in the sensory-motor group receiving form scored in between. Had the subjects followed the predicted trend, subjects in the

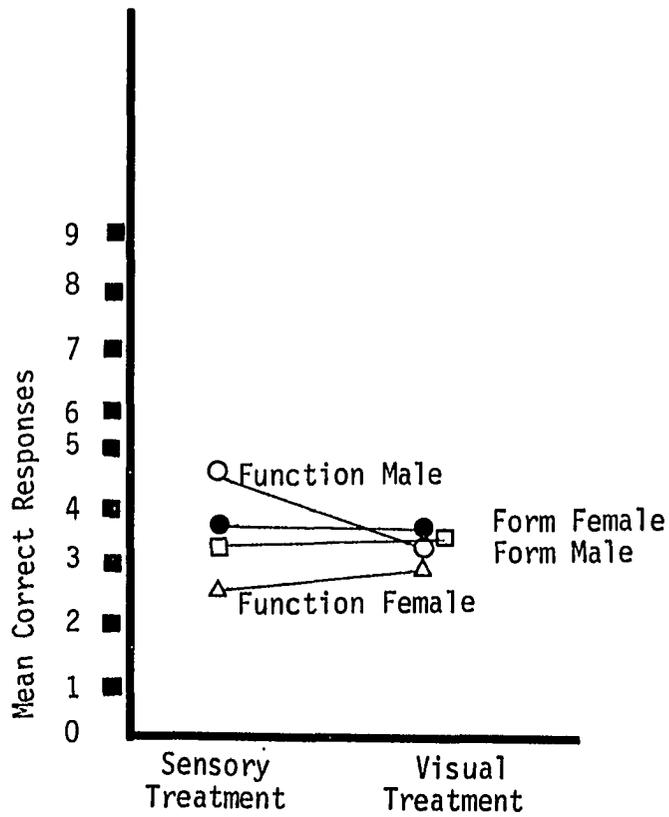


Figure 7. Means of the triple interaction of treatment, cue and sex for the $2 \times 2 \times 2 \times 2$ analysis of variance

sensory-motor group receiving function should have received the highest scores. Subjects in the visual-perceptual group also failed to follow the predicted outcome. Female form and male function scores were almost identical. Thus the eighth null hypothesis concerning performance differences between Tests B and C fails to be rejected.

Results of Post Test Categorization

After Test A, B and C were administered, all nine stimuli were placed on the table in front of the child. Each child was asked to put those toys together which they thought were alike. It was hypothesized that subjects in the sensory-motor treatment would group the stimuli by function more often than by form and subjects in the visual perceptual treatment would group by form more often than by function. Although the $2 \times 2 \times 2 \times 2$ ANOVA suggested a lack of relationship between treatment and the cue used by subjects during object identification, several analyses were done to see if this held true for the post test categorization.

Subjects' responses were placed into one of the following categories for the purpose of analysis: 1) groups containing three related stimuli (ex. all three bups), 2) groups containing the standard matched with the same function, 3) groups containing the standard matched with the same form, 4) random or unrelated groups.

Twelve subjects, six in the sensory-motor and six in the visual-perceptual, failed to make any grouping. Two subjects in the sensory-motor treatment made totally unrelated or random groupings. The remaining 49 subjects made from one to four matched or related groupings as well as nonrelated groupings. Table 8 shows the distribution of groupings according to treatment groups, while Table 9 shows the post test categorization when distributed by age.

It would appear that like the ANOVA results the post test categorization had little relationship to treatment, order or sex as shown in Table 8. The prediction that subjects in the sensory-motor treatment, for example, would match function more often than form did not hold true when comparing the percentages.

Table 8. Frequency of post test categorization by treatment

Grouping	Treatment			
	Order 1 Female	Order 1 Male	Order 2 Female	Order 2 Male
	<u>Sensory</u>			
Random	7 (33.3%) ^a	1 (9%)	2 (8.69%)	4 (21.05%)
3 matched	9 (42.85%)	0 (0%)	5 (21.73%)	8 (42.10%)
Matched on basis of function	4 (19.02%)	7 (63.63%)	6 (26.08%)	2 (10.52%)
Matched on basis of form	1 (4.76%)	3 (27.27%)	10 (43.47%)	5 (26.31%)
Total	21	11	23	19
	<u>Visual</u>			
Random	4 (20%)	3 (14%)	2 (10%)	5 (25%)
3 matched	9 (45%)	4 (19.04%)	3 (15%)	8 (40%)
Matched on basis of function	5 (25%)	6 (28.57%)	8 (35%)	5 (10%)
Matched on basis of form	2 (10%)	8 (38.09%)	7 (35%)	2 (10%)
Total	20	21	20	20

^aPercentages calculated for columns.

Since no trend appeared when percentages in Table 8 were examined, a post hoc examination by percentages on the same groupings was done using age as a factor. When the subjects were divided by age some interesting trends did appear. First the older the subject the more likely they were

Table 9. Frequency of post test categorization by age

Post test groupings	Age		
	24-28 mos.	29-32 mos.	33-36 mos.
Random	9 (24.32%) ^a	9 (19.14%)	9 (16.36%)
Three matched stimuli	10 (27.02%)	10 (21.27%)	23 (41.18%)
Two matched stimuli by function	10 (27.02%)	17 (36.17%)	15 (27.27%)
Two matched stimuli by form	8 (21.62%)	11 (23.20%)	18 (32.72%)
Total	37 N = 14 6 No response	47 N = 20 5 No response	55 N = 21 1 No response

^aPercentages calculated for the columns.

to respond to the task. Of the 20 subjects in the first age group, six did not respond, as opposed to the third age group where only one subject failed to respond. A second trend of interest is the apparent steady increase with age in the form responses. Within the first age group, form responses accounted for 21.62% of the total (Table 10) while in the third age group the form responses accounted for 32.72% of the total. Function responses on the other hand went from 27% to 36% and back to 27%. Finally the ability to match the three stimuli also increased for the third age group.

To analyze the results of the post test categorization more objectively a Pearson Chi Square Test was employed. Contingency tables were arranged for each of the four categories: Two matched stimuli by function,

Table 10. Results of post test categorization matched to cue preference during Test B and C

Post test groupings	Form preference (N = 24)	Function preference (N = 23)
Random	12 or 20%	1 or 2%
Three matched stimuli	12 or 20%	15 or 36.58%
Two matched stimuli by function	18 or 30%	16 or 39.02%
Two matched stimuli by form	18 or 30%	9 or 21.95%

two matched stimuli by form, three matched stimuli and random. Each table consisted of the three age levels (rows) and whether the subjects had a post test group in that category of zero or more than zero times. The chi square was computed. Using a directional test the chi square for three matched stimuli reached significance ($\chi^2 = 3.2387$; $p = .05$). Therefore, subjects in the older age group did group the three matched stimuli choice more frequently than the younger group. Chi square for the 2 matched stimuli by form approached significance ($\chi^2 = 2.58396$; $p = .08$) while the other two groups failed to reach significance. Chi square analyses are located in Appendix E.

One last post hoc analysis was considered to see if the preference shown during Test B and C, regardless of treatment or order, was maintained for the post test groupings. Subjects were placed into one of two groups. The first group consisted of those subjects who identified the form transformation most often. The second group consisted of those subjects who identified the function transformation most often. Forty-seven subjects

fell into these two groups while the remaining subjects showed no preference between form and function. Of the 47 subjects, 24 were placed in the form preference category and 23 were placed in the function preference category. The post test groupings organized in this manner are illustrated in Table 10. Subjects' preference on Tests B and C did not seem to hold for the post test groupings. For those individuals in the form preference category, form and function post test groupings were equal (30% each). Subjects in the function preference group did show a slight preference for function over form. These results are confounded, however, by the fact that the form preference group had a higher percentage (45%) of 33-36 month old subjects while the function preference group had a slightly lower percentage (31%) of older subjects.

Overextensions

The child's use of overextensions has been used in prior research as a cue to the child's concept of the word. Clark (1973) has analyzed overextensions to build support for her theory of lexical development. During the course of this experiment, overextensions were recorded and that information is presented here.

In every case overextensions were spontaneously produced during the course of the warm up period or during the experiment itself. All overextensions are listed along with the context in which they were produced in Appendix D.

Thirty-six overextensions were recorded for the 67 subjects. Of these, 10 were produced in response to the test stimuli and the remainder were produced in response to the screening pictures. An attempt was made

to classify the overextensions, according to the categories used by Clark, of either form or function. Seventeen of the overextensions were classified as overextensions based on function and 16 were classified as overextensions based on form. Three were not classified due to ambiguity. Given that this classification reflects the child's cue preference and classification scheme, function and form seem to have equal salience.

An alternative classification system is that suggested by Anglin (1977) where overextensions are classified on the basis of perceptual similarity, contiguity or functional similarity. Fourteen responses were judged to be based upon perceptual similarity, 12 were judged to be based on functional similarity, none on contiguity alone and eight on a combination of contiguity, perceptual similarity and functional similarity (Appendix D). Results fail to support Clark's hypothesis concerning shape as a basis of overextensions. Rather the results were similar to those of Anglin's (1977) where perceptual similarity, contiguity and functional similarity all play a part.

Summary

There were no significant differences between the means for the main effects of treatment, order and sex on Test A and C. Thus the hypothesis concerning Test A and C failed to be rejected. On Test B the main effect of sex reached significance but there was a triple interaction of treatment, order and sex. An analysis of simple main effects yielded no significant differences for females. Analysis for males again yielded a significant order by treatment interaction.

A repeated measures design comparing form and function on Tests B and C did not yield significant results; therefore, the eighth null hypothesis failed to be rejected.

Post test categorization had no apparent relationship to treatment, order or sex but there was a moderate trend toward older subjects using form as a cue more often than younger subjects.

Finally, overextension seemed to be equally divided on form and function as a cue thus failing to support either Clark or Nelson. However, the division of overextension does correspond to Anglin's hypothesis on concept development.

DISCUSSION

The discussion of the results is divided into five sections as follows: (1) Effects of Treatment, Order and Sex on Performance in Test A, Test B and Test C; (2) Post Test Categorization; (3) Overextensions; (4) Limitations of the Study; and (5) Implications for Further Research.

Effects of Treatment, Order and Sex on Performance
in Test A, Test B and Test C

Test A was designed as a training test in which all subjects learned to identify the same three stimuli. No performance differences were found for the main effects of treatment and sex. Therefore, the sensory-motor experience in the present study did not appear to facilitate the learning process as Nelson has suggested. It was observed, in fact, that some subjects became so involved in play that their attention was not focused on the examiner and the task.

Test B offered the first opportunity to determine whether form or function was the more salient cue. The presence of a significant interaction for treatment, order and sex requires qualification of the significant sex effect. When the simple main effects analyses are evaluated it appears that males and females behaved differently.

There were no significant treatment effects for females but they did appear to perform better on the form transformations (Order II) than the function transformations (Order I). The order effect however did not reach significance. Males, on the other hand, performed slightly better on Order I (function) than Order II (form). Treatment for Order II subjects had no effect on performance. Treatment appeared however to have an effect

on Order I subjects with the sensory-motor treatment resulting in better performance than the visual-perceptual treatment.

The discrepancy between male and female performance is not accounted for in Nelson's or Clark's theory. Sex of the subject typically has not been a factor in early language research due to the small number of subjects in most diary studies. There is some evidence reviewed by Maccoby and Jacklin (1974) that females generally excel over males in verbal abilities prior to the age of three years. This is not the case in the present study. There were no significant sex differences in Test A or C and results of Test B are qualified by the presence of the interaction.

The choice of function for males and form for females may reflect differences in age of subjects. It is possible that because females in the study have a slightly higher mean age ($\bar{x} = 30.166$ months) than do males ($\bar{x} = 29.02$ months), form is more salient for the females. This would agree with the findings of Gruendel (1977) who suggests a developmental trend toward form salience as children approach two years of age.

There were no significant differences due to treatment, order or sex for Test C. The results of Test B and Test C therefore fail to support either Clark's or Nelson's theory. The results of the present study do correspond, however, to the results of Gruendel's (1977) work. She concluded that either form or function may act as salient cues and may be used by children as criteria in early word application. That, in fact, is what appears to be happening in the present study. There is no dominant choice of form or function by the subjects in this study.

The results of the present study also fail to support Nelson's finding that sensory-motor experience will increase the likelihood of children using function as a cue. The procedure for the present study does however, vary somewhat from that used by Nelson. Also it may be that exposure to the stimuli was too short to obtain results similar to Nelson who used one five minute period. This, however, is not the only possibility. A more convincing argument and one closer to the theoretical issue is that made by Gruendel (1977) and supported by Anglin (1977). It well may be that the age group in the current study represents a transition period where children are in the process of shifting from functional cue salience to form cue salient. A second possibility concerns the stimuli themselves. Despite the fact that the stimuli as well as their names were novel, they did consist of familiar components. It may be that children fit those cues into their own categorization scheme, a scheme not obvious to the examiner in this experimental procedure. Finally, it is possible that in the limited time of the experiment, children were unable to organize a strategy for identifying the salient features.

This study also failed to support Clark's contention that when the child associates a cue with a word, that word has that meaning for the child. Huttenlocher (1974) found this not to be true in her research on overextensions. Huttenlocher found that subjects who overextended on production did not overextend in comprehension. She suggests, therefore, that mistakes in production do not necessarily reflect mistakes in comprehension. In the majority of cases in the present study, identification in Test B was equivalent to object identification in Test C. This could mean that subjects were flexible in the cues used to solve the

identification task. It could also mean that during the testing period subjects were unable to organize a classification system to solve the problem. It apparently does not mean that a cue is equivalent to a word meaning as Clark suggests. Had that been true, there would have been more consistency within an individual's response and a greater difference between subject's performance on Test B and Test C.

Gruendel (1977) found in her study of overextension that children could use either action or form as a cue for an object. She also found that once children chose an action or form cue, no shifting across categories occurred (i.e., form to function) but some shifting within categories did occur. In the present study a similar strategy was hypothesized. If subjects chose function as their cue in Test A, they would perform better when receiving the function transformation than the form transformation. This hypothesis was not supported in the $2 \times 2 \times 2 \times 2$ analysis of variance as reflected in the within subjects factor. Subjects did not show a preference for either form or function, suggesting that they did equally well with either cue. Once again the evidence from the present study fails to support the hypothesis that one criteria or feature represents a word. Neither did it support the hypothesis that once a criteria is chosen there is no shifting between form and function. Six of the eight treatment groups seem to be equally successful when presented with form and function.

Post Test Categorization

Nelson suggests that subjects exposed to objects through sensory-motor activity would categorize on the basis of function more than on the basis

of form. This did not hold true for subjects in the current study. When presented with all nine stimuli to categorize, subjects in the sensory-motor treatment categorized on the basis of function at the rate of 25.67%, while subjects in the visual-perceptual treatment categorized on the basis of function at the rate of 29.6%. Subjects in the visual-perceptual group categorized on the basis of form at the rate of 22.6% and subjects in the sensory-motor group categorized at the rate of 25.67%. Therefore, in the present study, sensory-motor activity did not lead to more function categorizations. This may be due to the limited amount of time with the stimuli or it may be that children of this age group do not require direct contact with an object to pick up cue salience. There remains, however, an apparent desire to touch, turn and interact with toys. Subjects in the visual-perceptual group did attempt to handle the toys on occasion. It may also be that function as defined in this study is not an important factor in object identification for this age group.

Categorization by age (Table 9) offers some support for Gruendel's (1977) finding of a developmental trend from function to form. It may well be that the age group used in the current study is at the end of the developmental sequence described by Gruendel. Evidence for this comes not only from the function and form matches but also from the matching of all three. Children may start early language learning by naming objects or people most important or functional as Anglin (1977) suggests. Children at this level may also focus on the function of the object as Nelson (1974) suggests. However, as the child increases his vocabulary and begins to develop categories of objects, form becomes the primary cue. It is not until the preschool years (Anglin, 1977) that function in the liberal

sense becomes an integral part of the concept. Thus the function of the object (bounce ability) may not be used consistently as a criterion until the child is three years old.

Overextensions

Clark (1974) has used the concept of overextensions in children's utterances in support of her theory of lexical development. This approach has come under attack as previously cited. During the present study overextensions were recorded and judged on the basis of Clark's as well as Anglin's (1977) categorization. There is no clear evidence for either form or function preference in either Clark's or Anglin's categorization. Again the results of the present study fail to support Clark's hypothesis concerning shape as a basis of overextensions. Rather the results are similar to Anglin's (1977) where perceptual similarity, contiguity and functional similarity all played a part.

In summary, results of the present study as reflected in the ANOVA fail to support either Nelson's or Clark's theory. Subjects in this study did not show preference for form or function as defined. In fact the presence of the triple interaction in the $2 \times 2 \times 2 \times 2$ ANOVA suggests that subjects may have used form and function cues interchangeably. It may be that exposure to the stimuli was too short to obtain results similar to Clark's or Nelson's. Another possibility may be that the age group in the current study represents a transition period where children are relying on a combination of configuration and function as suggested by Gruendel (1977). It also may be possible that subjects were not given enough time to fit the identification task into a currently available classification scheme.

Limitations of the Study

The first limitation of the study involves the short testing time. Perhaps several testing sessions within a week for Test A would have allowed the subjects to establish a framework for the remaining two tests. Several testing sessions over a three to six month period is another possibility. The longer introductory session might have provided insight into how word meanings develop rather than determining at one point in time what a word means. The results of several testing sessions would have confirmed or failed to confirm Gruendel's results concerning the developmental change of function to form. In addition, more testing would have provided an opportunity to study the resolution of overextensions, data Clark has not provided.

A second limitation involves the abstractness of the stimuli and their names. To avoid such abstractness, stimuli might have included a combination of real names and the objects they represent as well as the nonsense objects and names and the transformations. An example of a real stimulus would be a standard train with a function transformation in which wheels would be replaced with shoes. Such stimuli might have provided a comparison of the development of word meaning in a more concrete context as well as in the more abstract context of stimuli used. The screening test failed to exclude subjects. Words used in the test were not difficult enough to provide a range of word comprehension skills. Although the screening test limitations did not pose a significant problem in this research, in the future a measure of mean length of utterance would be a better indicator of the child's linguistic development.

Finally, it may be more workable to use photographs rather than the actual stimuli themselves for subjects in the visual-perceptual treatment group. This would allow more time for exploration without having to remind subjects not to touch.

Implications for Further Research

Several theoretical and research questions remain. First, it seems appropriate to question further the definition of function and its relationship to word meaning and concept formation.

Anglin (1977), Nelson (1974) and Nelson et al. (1977) both refer to function as a criteria for naming. Nelson (1974) refers to the functional core or actions the child imposes on the objects. She suggests that evidence for the functional core may not be obvious once the child produces the word. It may be that the function Nelson refers to is a sensory-motor process not unlike secondary circular reactions where the child learns to grossly categorize objects based on his limited actions on objects. Action on objects leading to gross categories may be the link between actions, perceptual cues and words at the time when the child first begins to produce words. A systematic study of the type of action in which a child engages and whether it is repeated in association with naming may illuminate this question.

The problem raised by this study as well as by Anglin's work is a consideration of function in the literal sense as a criteria for naming. Anglin suggests objects most important to the child (functional) will be learned before objects which are not important to the child. Thus function is defined as the degree of importance the object holds for the child.

Words not carrying functional significance will be learned later and given more general names. Anglin takes exception with Nelson's use of function and suggests that function of the object (bounce, roll, bark, run) is not used as a criterion for naming. Anglin has shown that children do use specific attributes of an object to define it. For example, when children were asked, "What is a dog?", Anglin got answers such as; "It barks; it eats; its black". These attributes are used inconsistently, however, suggesting that the child is not aware that attributes or properties are part of the concept or meaning.

To clarify the definition of function, further research on word meaning needs to be done. However, rather than studying the meaning of single words, the development of words within categories or concepts should be studied. Furthermore this should be done starting before the first word is spoken so that the child's early experience and actions can be documented.

Age should continue to be considered as a factor in future research. It may be as Gruendel (1977), and to a limited extent, this study suggest that criteria associated with word meaning differ with age. Perhaps function of movement or experience is more important or focuses attention more readily for the younger child and form is not so important until a child is two years old.

Continued research contrasting comprehension and production should be considered. The question of what a child knows about words and categories before he talks requires attention in the future.

Anglin (1977) is critical of research, using nonsense words and categories, and attempts in his research to study language and concept

development within the child's daily experience. A combination of daily experience words as well as nonsense words couched in a longitudinal study seems appropriate. Research which would involve a documentation of word meanings over a period of time as well as introducing nonsense stimuli into the child's daily environment might provide insight into the development of word meaning.

Finally, studies of parental influence (Snow, in press, Bruner, 1978) on early comprehension and production are just now being published and receiving attention. Bruner (1978) suggests that the parental role of focusing the child's attention on specific objects and properties is an important part of pre-linguist learning. Neither Nelson or Clar emphasizes this influence in their theories although Nelson suggests parental behavior may be a part of the functional core. Future research should include investigation of the influences of vairous kinds of parent-child interactions on the development of word meaning.

SUMMARY

The present study was designed to explore two contrasting theories of lexical development. The semantic features hypothesis as stated by Clark (1973) suggests that children first discriminate individual features of an object and attach the word to that feature. As the child develops and gains experience with words and objects more features are incorporated into the meaning. Eventually the child's meaning and the adult meaning coincide.

Nelson's (1973 a) concept match theory suggest that the child's sensory motor experience and resulting organization is the basis for language acquisition. She contends that function cues are more relevant to the child than form cues but that form cues play a secondary role in the development of word meaning.

In the current study 66 children (males and females) between the ages of 24 and 36 months were tested to determine if form (Clark's theory) or function (Nelson's theory) were more salient when learning to identify nonsense objects. Nine stimuli were constructed for the experiment. Three standard stimuli were designed to have a shape and a function. Three additional stimuli maintained the standard's shape but changed function. The remaining three stimuli maintained the standard's function but changed shape.

Subjects were divided into sensory-motor and visual-perceptual treatment groups. Prior to training, subjects in the sensory-motor treatment group were allowed to play with the standard stimuli while subjects in the visual-perceptual group were only allowed to look at the stimuli.

Each subject received three tests. Test A required the subjects to learn the identity of the standard stimuli. Test B and Test C required the subjects to identify the transformations. In order to control for order effect half of the subjects received the form transformations first and half the function transformations first. A second effort in determining cue salience was the post test categorization in which all subjects were given the nine stimuli and asked to group the like stimuli. Finally overextensions or misnaming was recorded throughout the experiment.

A $2 \times 2 \times 2$ least squares analysis of variance was completed on each test followed by a $2 \times 2 \times 2 \times 2$ least squares analysis of variance employing a split plot design. In addition post test categorization and overextensions data were analyzed.

Results of this study failed to support either Nelson's or Clark's theory. There were no significant main effects for treatment (sensory-motor vs. visual-perceptual) or for the stimulus cue (form or function). The presence of a triple interaction for treatment, cue and sex suggests that the same subjects behaved differently under different conditions. There was no trend toward function being the more salient cue for the sensory-motor group or form being the more salient cue for the visual-perceptual group.

Likewise, results of post test categorization and overextensions failed to support Clark's or Nelson's theory. It appeared that subjects were able to use form and function cues interchangeably or were using some other organizational plan not readily apparent.

It was concluded that children of this age may be in a transition where their ability to identify important aspects of an object is moving from function to form.

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F. S. M.

APPENDIX A: PARENTAL INFORMED CONSENT LETTER

Iowa State University *of Science and Technology* Ames, Iowa 50011



Child Development Department
101 Child Development Building
Telephone 515-294-3040

February, 1978

Dear

I am a graduate student in the Department of Child Development at Iowa State University. I am completing research on language development in children between two and three years old. As I indicated in our telephone conversation I would like your child to participate in the research.

Your participation would involve my coming to your home for approximately one half hour. During that time your child will be given a series of toys to play with while I name them. After a period of play, I will ask your child to point to each object to determine if he/she has associated the object with the name.

I will also ask your child to identify several pictures to determine what words he/she already knows. Finally I will observe your child playing with several toys to document toy manipulation and naming.

I would like you to remain with your child during the entire procedure but will ask you not to assist your child during the procedure. Every attempt will be made to help your child feel comfortable during the study. You may however withdraw at any time from the research. Your participation in this research will remain confidential.

If you agree to participate in this research please sign two copies of this letter indicating your informed consent. Return one copy in the enclosed envelope. If you have any questions call me at 292-4026, evenings.

Sincerely,

Ferol J. Menzel

I have read the above information and agree to participate in the research, knowing that I may withdraw my child at any time.

Parent Signature

APPENDIX B: RECORD FORM

Subjects Name _____ No. _____ Tx and Order _____

(Note: Verbalization and toy play recorded on the back)

TEST A

Single Trial: Dup ___ Teter ___ Mef ___

Double Trial: Bup-Mef _____

Teter- Mef _____

~~Bup~~-Teter _____

Triple Trial: (Teter - mef - bup / L to R examiners)

Bup 1. 13.

Teter 2. 14.

Mef 3. 15.

Teter 4. 16.

Mef 5. 17.

Bup 6. 18.

Mef 7. 19.

Bup 8. 20.

Teter 9. 21.

Bup 10. 22.

Teter 11. 23.

Mef 12. 24.

TEST B

1. Mef
2. Dup
3. Teter
4. Mef
5. Bup
6. Teter
7. Mef
8. Bup
9. Teter

TEST C

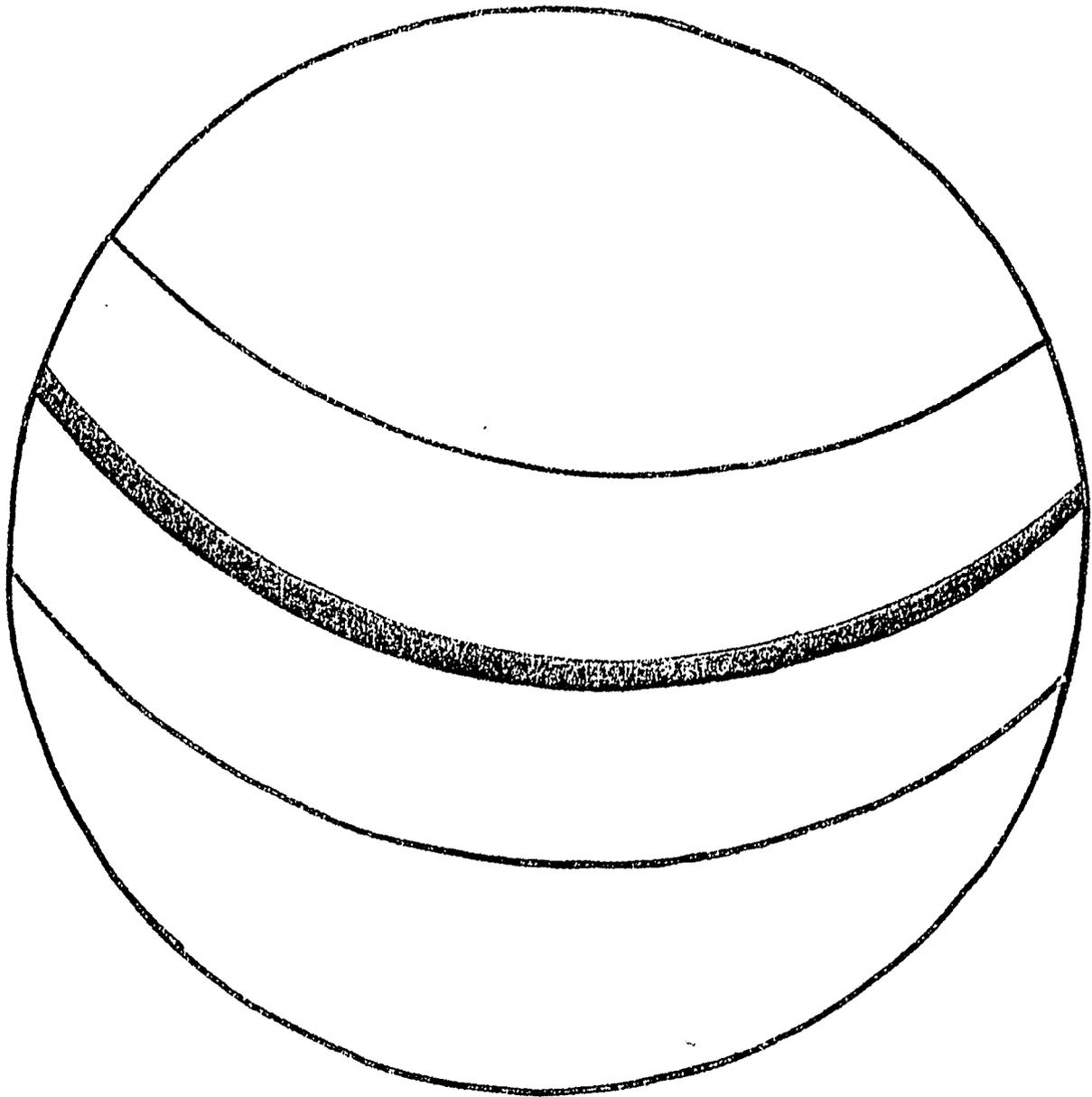
- 1.
- 2.
- 3.
- 4.
- 5.
- 6.
- 7.
- 8.
- 9.

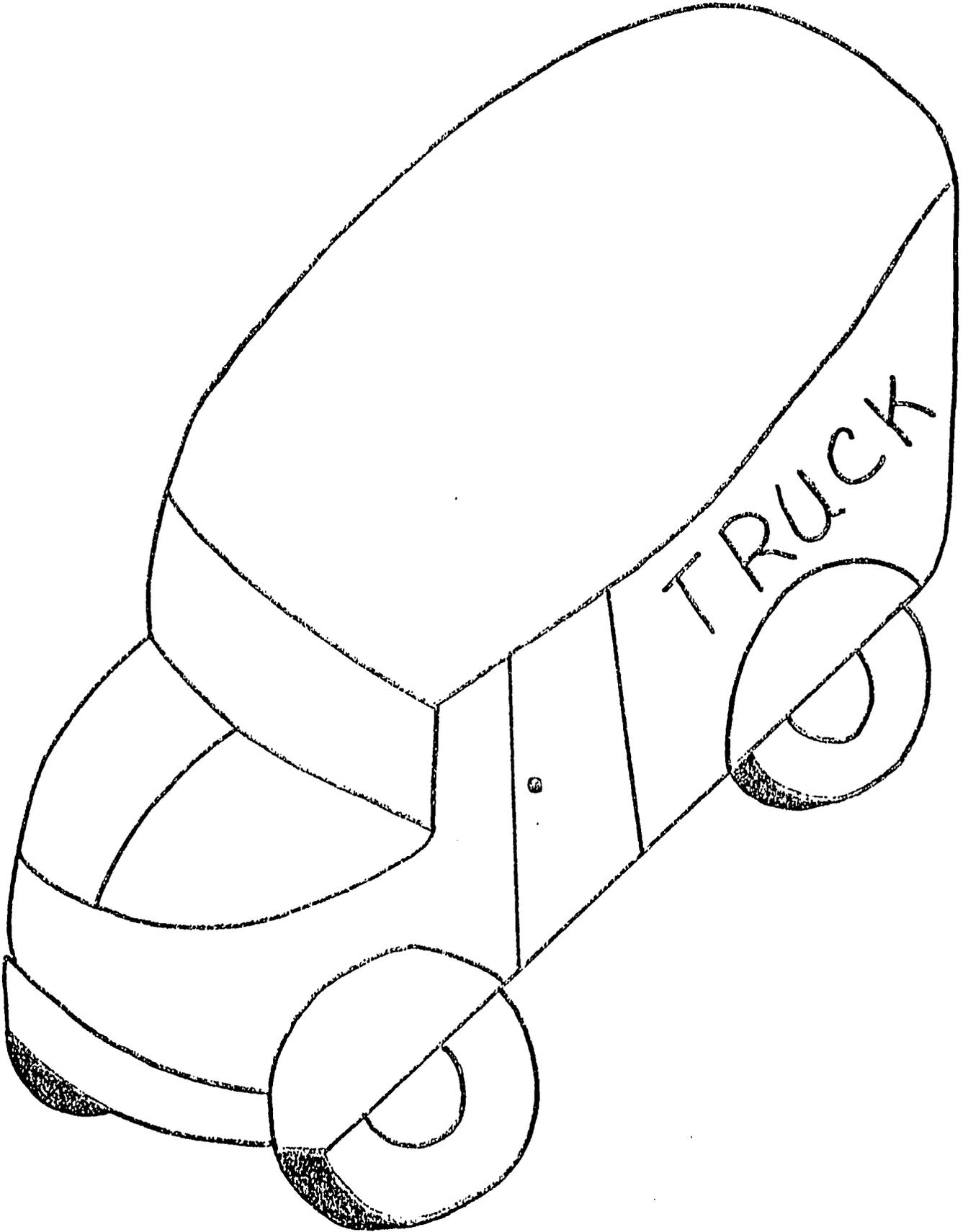
POST TEST CATEGORIZATION

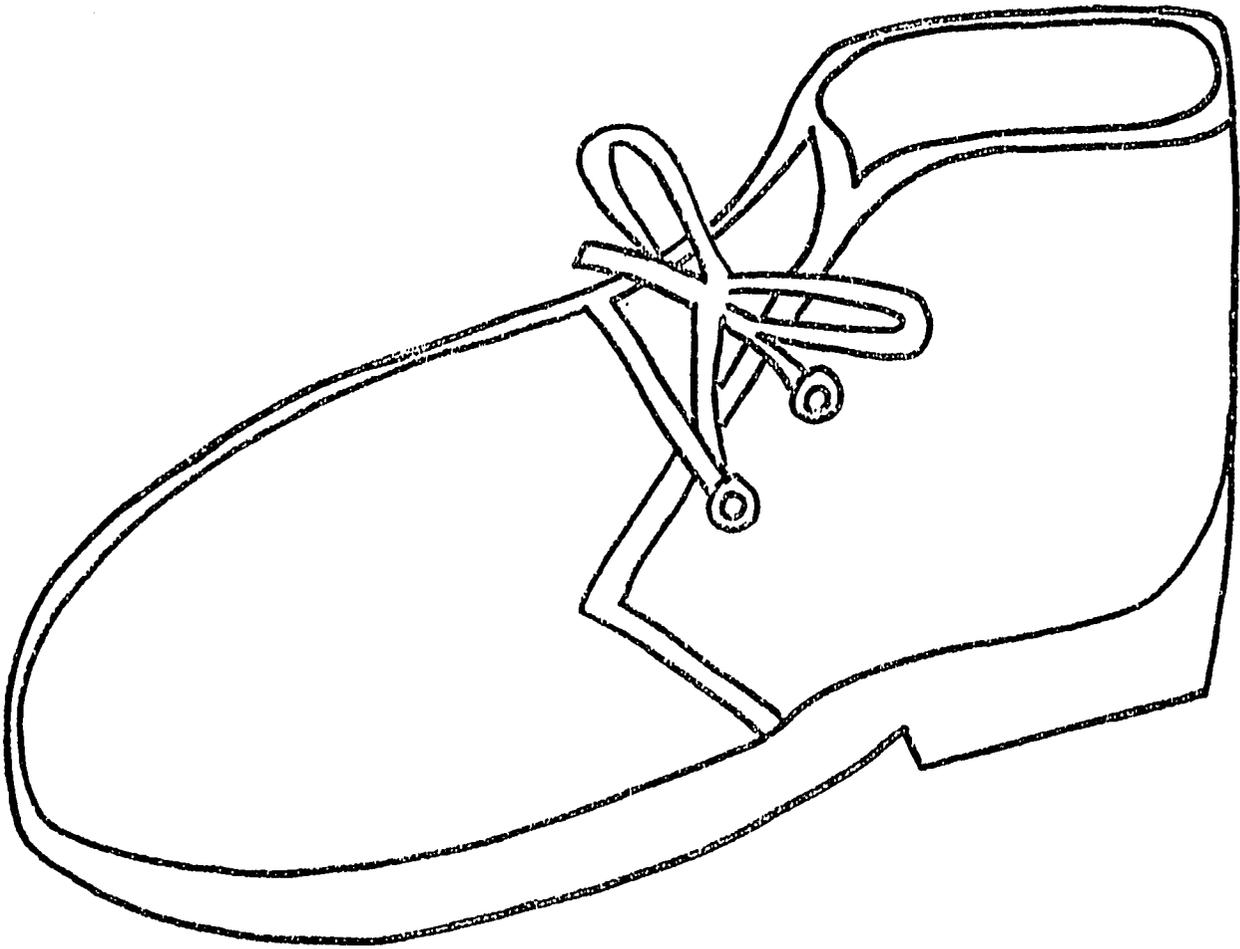
- 1.
- 2.
- 3.
- 4.

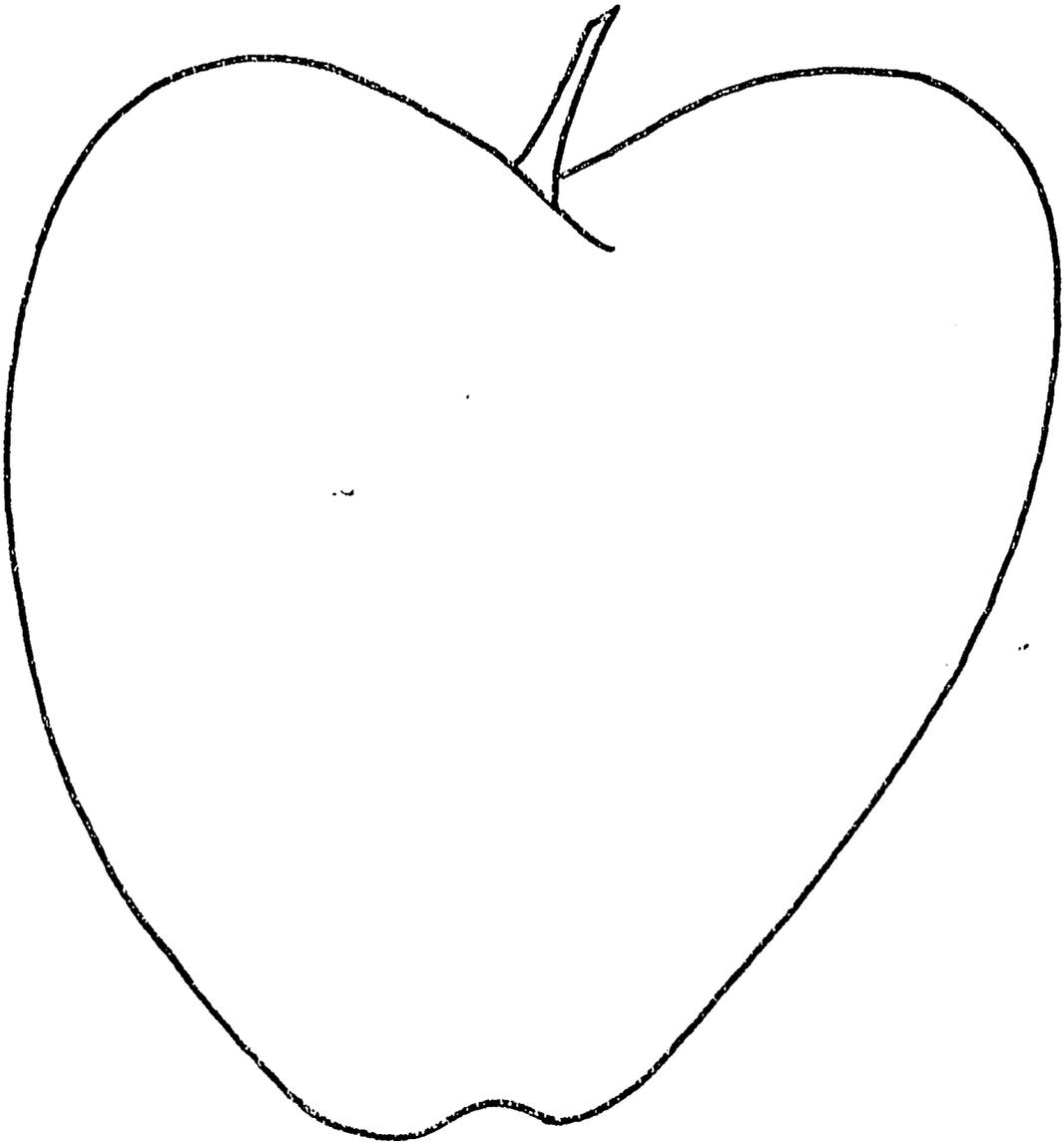
APPENDIX C: SCREENING TEST¹

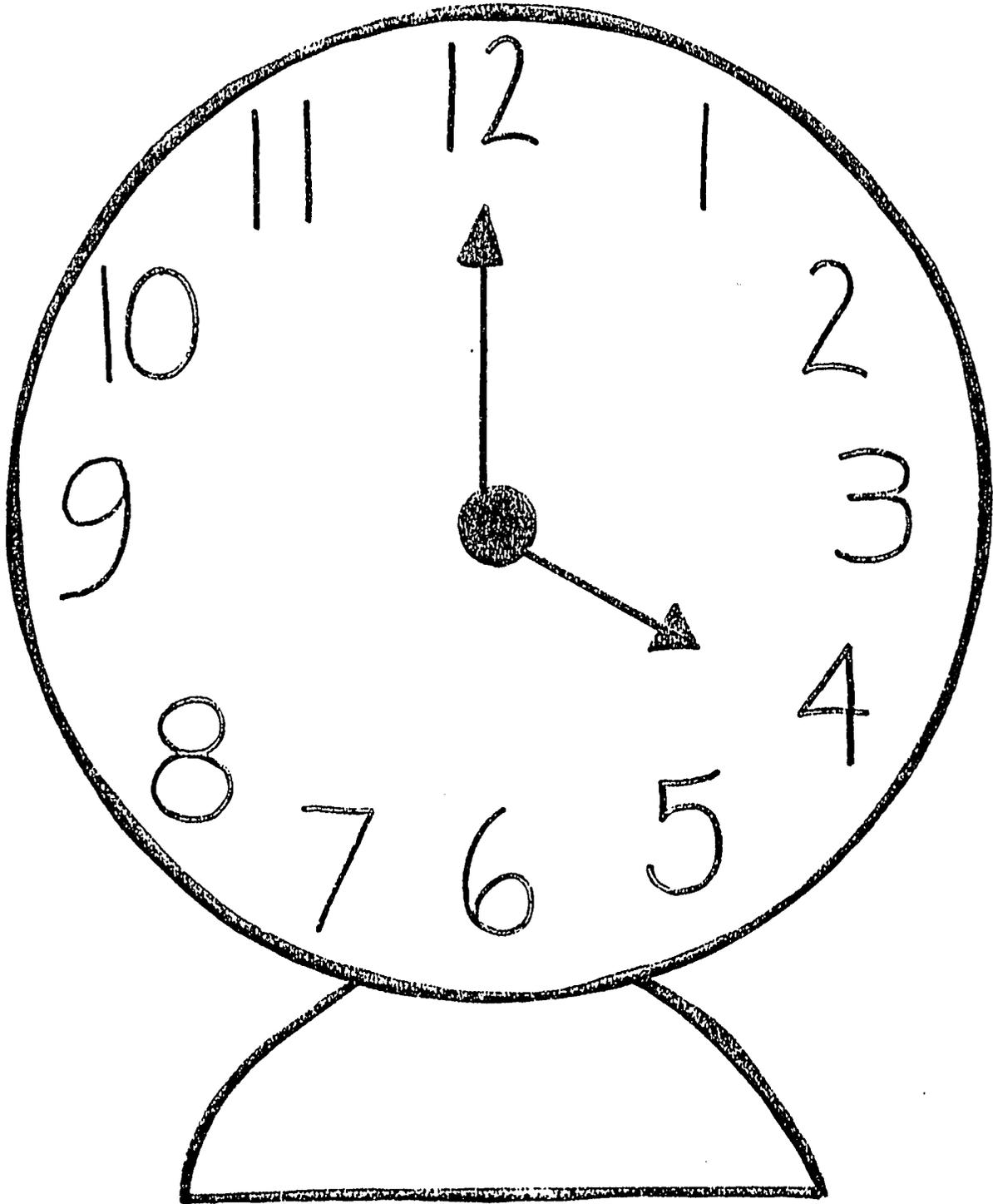
¹In addition to the line drawings included here, Items 15-23 were from Baby's First ABC Words to Say Book by Child Guidance.

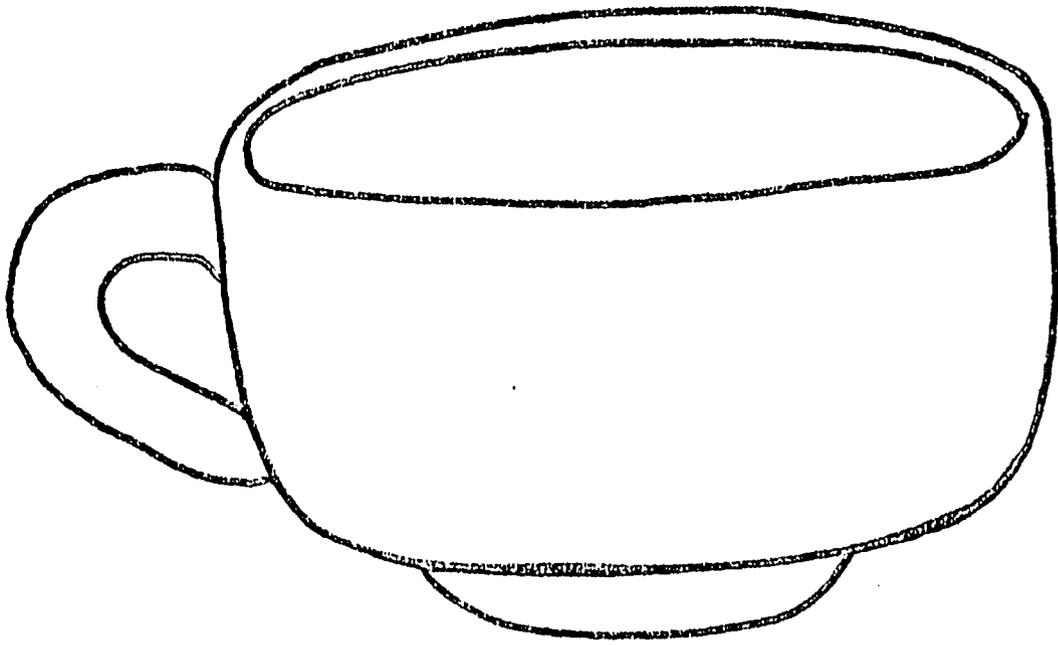






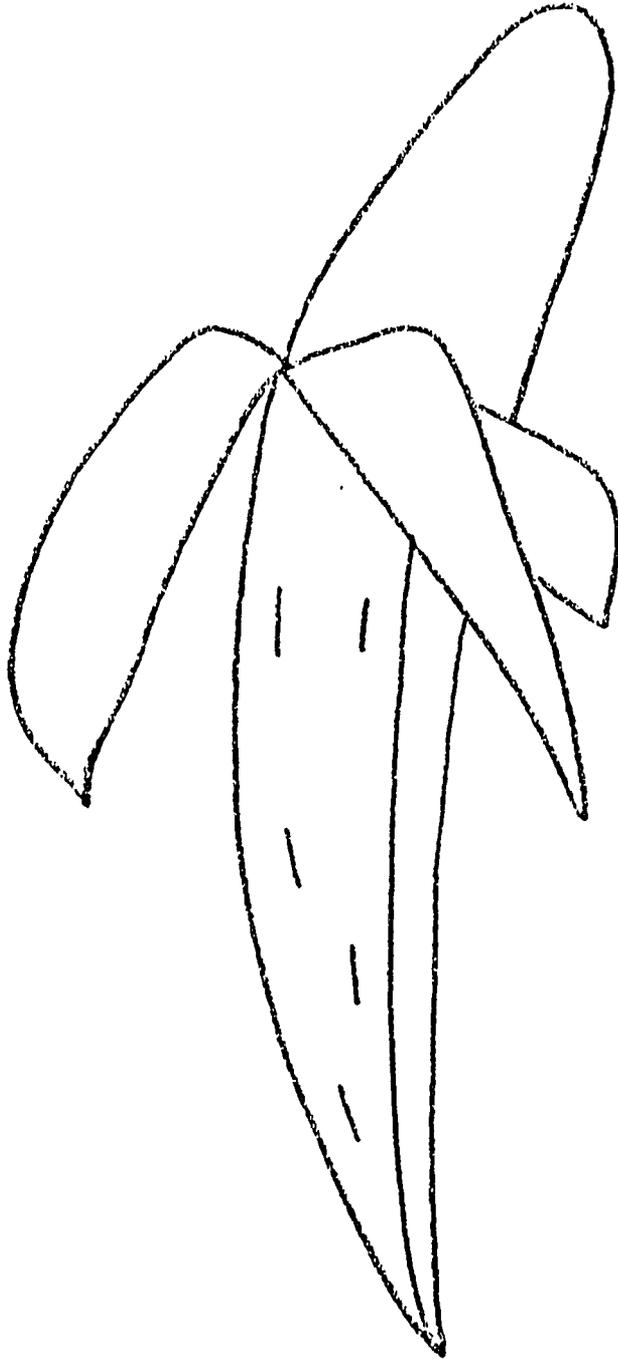


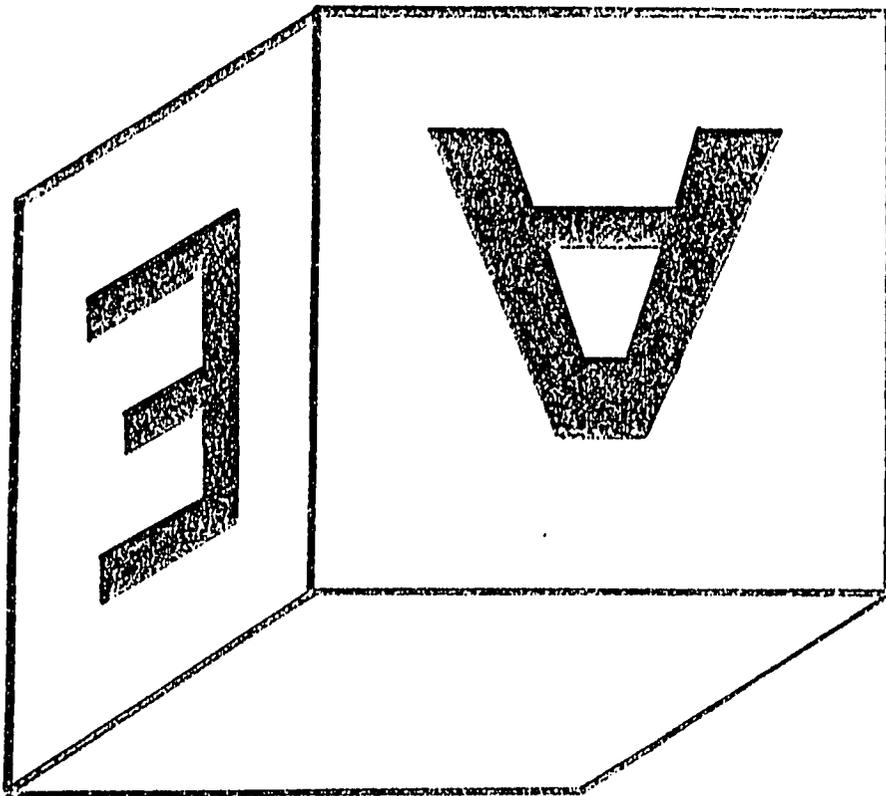


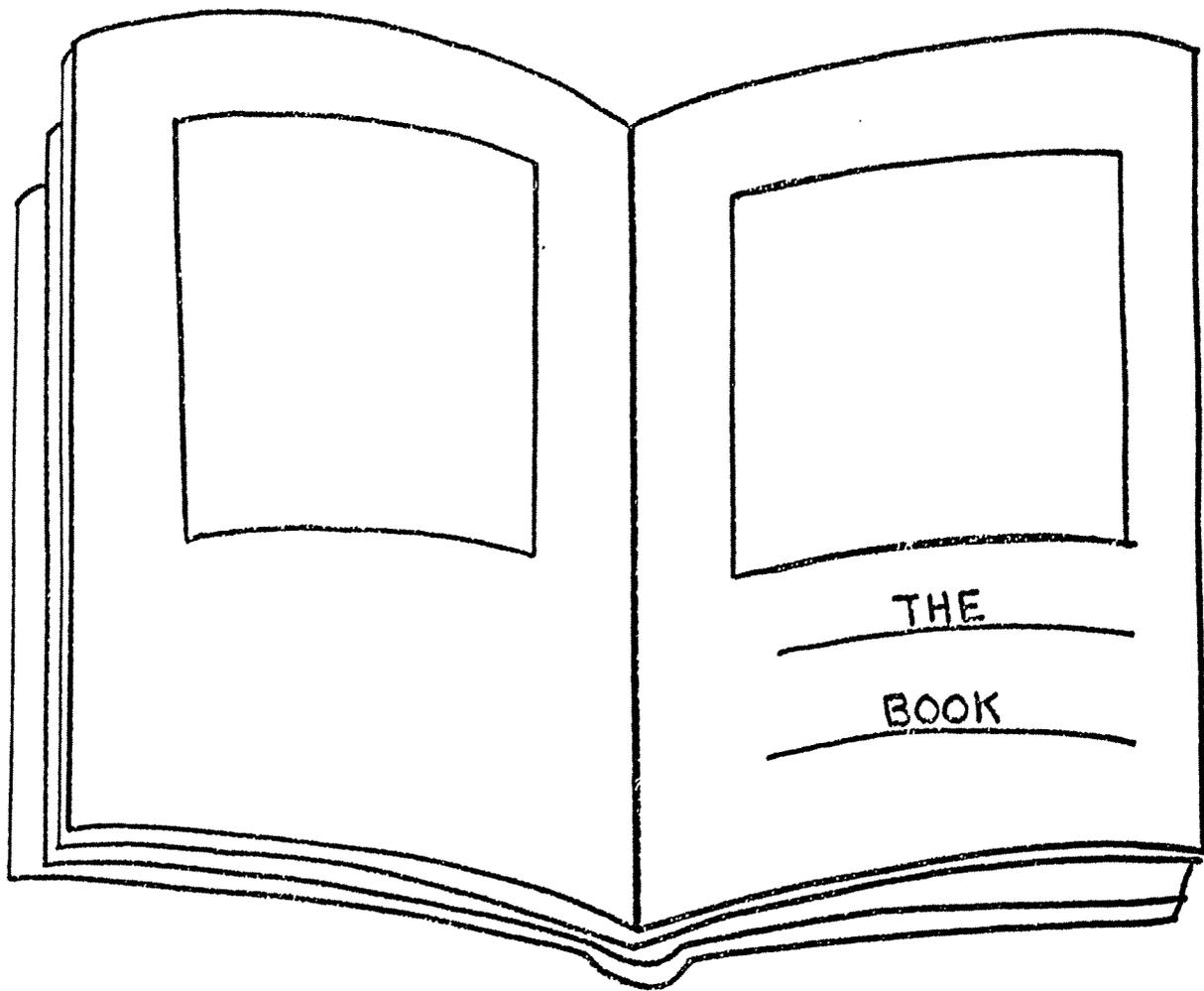


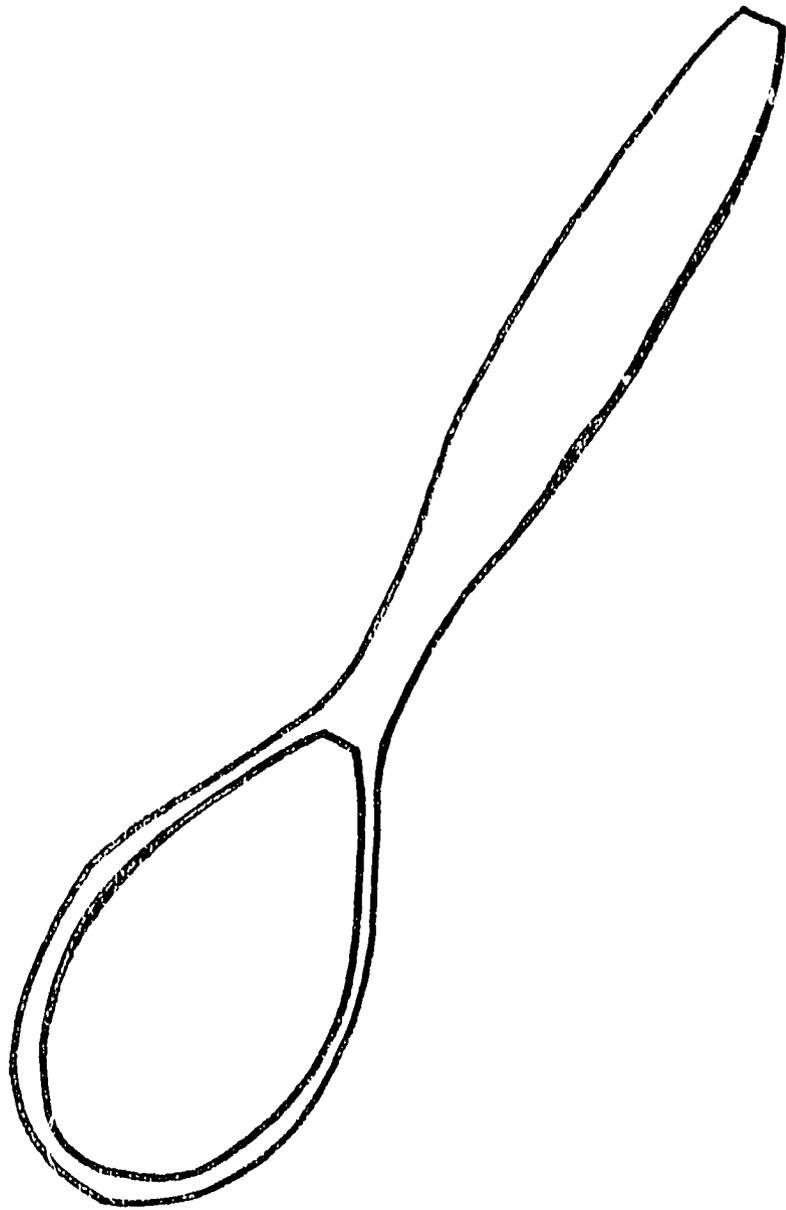


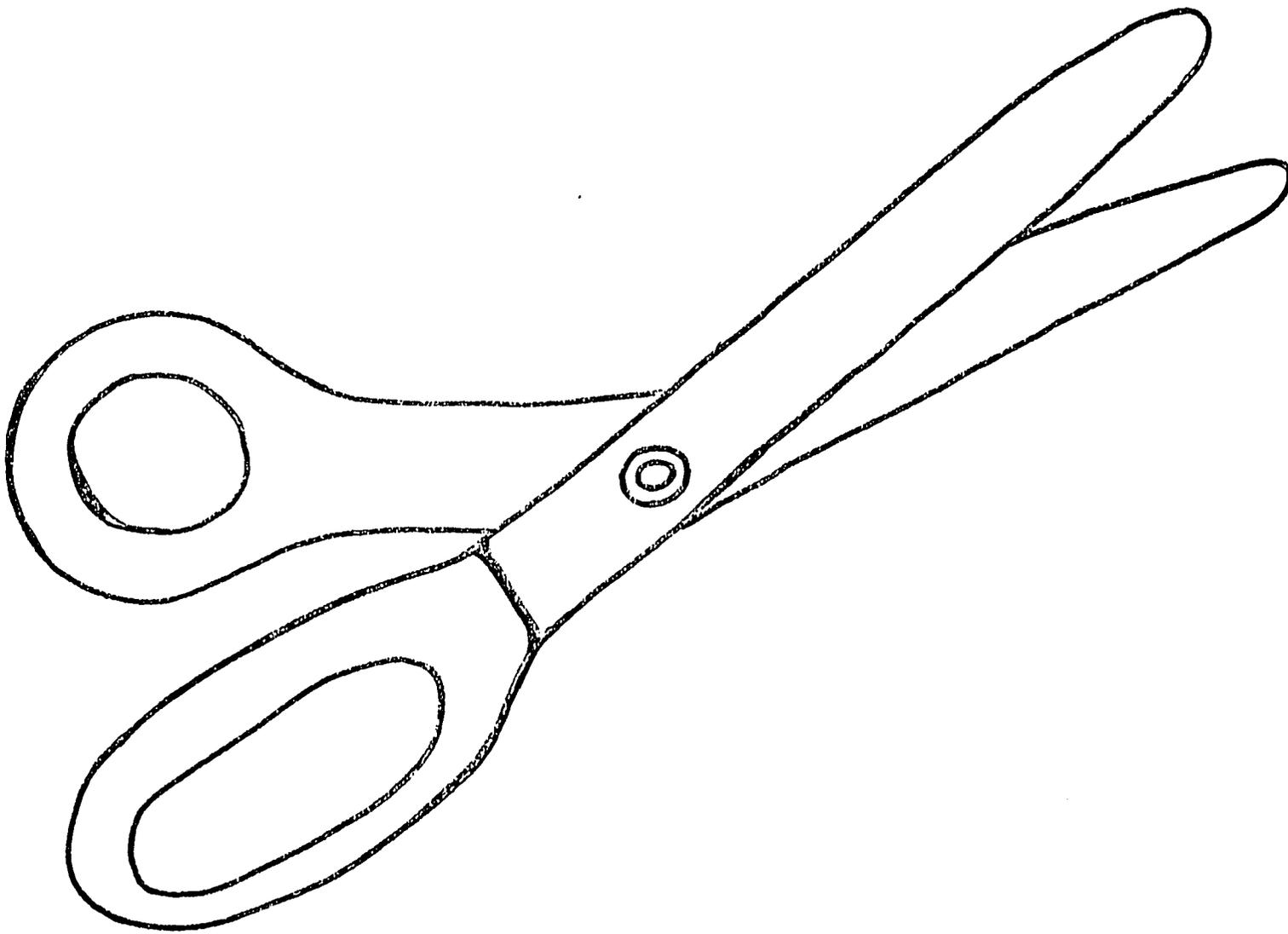


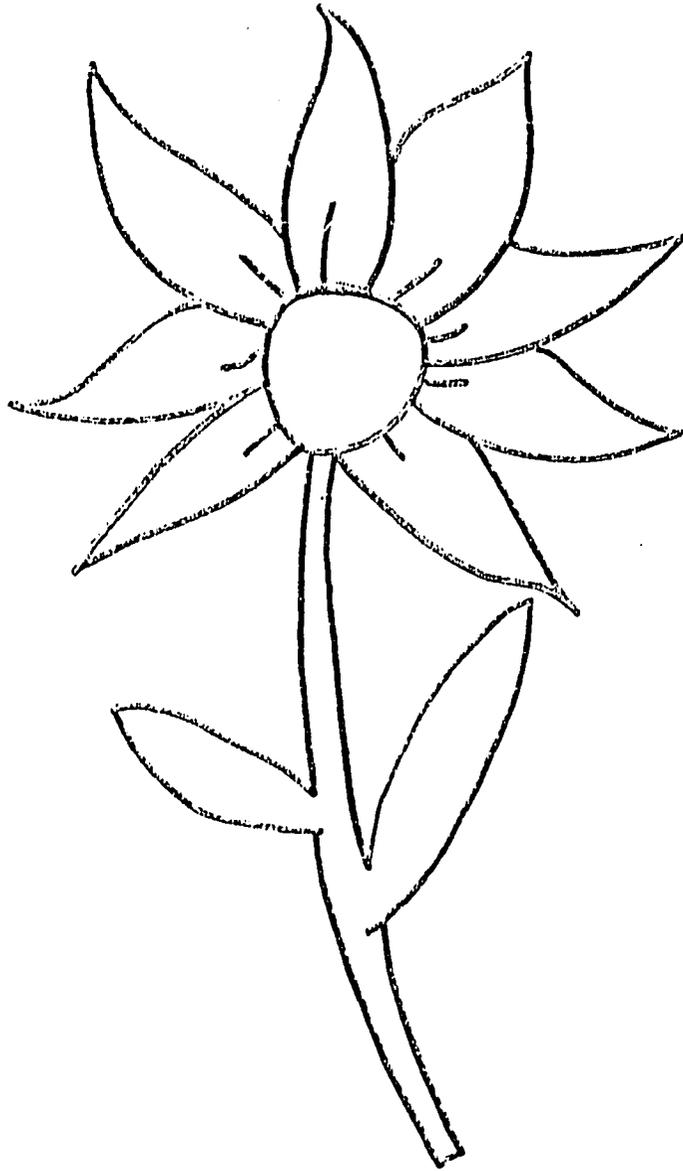












APPENDIX D: OVEREXTENSIONS

Stimuli	Overextension Produced	N	Suggested Classification	
			Clark	Anglin
Mef Standard	Car	3	Function	P. & F. ¹
	Train	2	Function	P. & F.
	Cho Cho	1	Function	P. & F.
Mef I	Triangle	1	Form	P.
	Bell	1	Form	P.
Mef II	Fire Trucks	1	Function	P. & F.
	Steps	1	Form	P.
Bup Standard	Church (point to door)	1	Function	F.
	Dump Truck/ Caboose	1	?	?
Bup II	Coo Coo House (point to door)	1	Function	F.
Teter Standard	Steps	1	Form	P.
Teter II	Rocking Horse	3	Function	F.
	Boat	2	Form	P.
Picture of Goat	Cow	2	Form	P. & F.
Baby Rattle	Keys	1	Function	F.
Picture of Egg	Balloon	1	Form	P.
Picture of cup	Teapot	1	Function	C.
Picture of yarn in a ball	Ball	1	Form	P.
Fischer Price Toy	Train	1	Function	P. & F.
Yellow Rectangle	Sun	1	Color	color
Dolls Foot in Picture	Egg	1	Form	P.

¹ P = Perceptual similarity; F = Functional Similarity
C = Contiguity

Stimuli	Overextension Produced	N	Suggested Clark	Classification Anglin
Picture of Banana	Fish	1	?	?
Picture of Truck	Car	1	Function	P. & F.
Picture of Goat	Horse	1	Form	P., F., & C.
Picture of a Block	Box	1	Form	P.
Picture of Doll	Girl	1	Substitution	
Picture of yarn ball	Red Ball	1	Form	P.

APPENDIX E: CHI SQUARE CONTINGENCY TABLES FOR POST TEST CATEGORIZATION
BY AGE.

Random

	0	0 1
Age 1	O = 9 E = 11	O = 7 E = 4.94
Age 2	O = 13 E = 11.745	O = 4 E = 5.254
Age 3	O = 16 E = 15.20	O = 6 E = 6.8

Three Matched Stimuli

	0	0
Age 1	O = 12 E = 10.32	O = 5 E = 6.6785
Age 2	O = 13 E = 11.53	O = 6 E = 7.46
Age 3	O = 9 E = 12.1428	O = 11 E = 7.857

Two matched stimuli by Function

	0	0
Age 1	O = 8 E = 6.81	O = 7 E = 8.18
Age 2	O = 6 E = 8.18	O = 12 E = 9.81
Age 3	O = 11 E = 10	O = 11 E = 12

Two matched stimuli by Form

	0	0
Age 1	O = 11 E = 9.37	O = 5 E = 6.62
Age 2	O = 13 E = 11.72	O = 7 E = 8.2758
Age 3	O = 10 E = 12.89	O = 12 E = 9.103

¹ O = Observed Frequency; E = Expected Frequency