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ABSTRACT

This report describes an investigation of the acquisition by children of a symbolic system, specifically English nomenclature--that set of nouns that serves the function of naming, denoting, or referring to objects. The five studies involve nine experiments dealing with one or another of the aspects of this problem. Two questions guided these studies from the outset: (1) What is the order of acquisition of category labels? and (2) How does the meaning of these labels change as the child grows older? Two different definitions of conceptual complexity were considered to see whether either is predictive of the order of acquisition of category labels in development. In a number of studies it was found that neither of these definitions of conceptual complexity is a good predictor of the order of acquisition of category labels. A good predictor was given by various frequency of occurrence measures in general and in particular frequency of occurrence of the words in child speech, according to Rinsland (1945). The vocabulary of young children is consistent with the way in which mothers name objects for them. (Author/LL)

Final Report

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STUDIES IN SEMANTIC DEVELOPMENT

February 10, 1974

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE

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Abstract

This is a report of a scientific investigation of the acquisition by children of a symbolic system, specifically English nomenclature -- that set of nouns that serves the function of naming, denoting or referring to objects. This work can be viewed as a study of conceptual development where the concepts being investigated are the various categories of objects that happen to be labeled by English names, e.g., 'dog', 'cat', 'animal', 'man', 'flower', 'money', 'car', etc. The five studies involve nine experiments dealing with one or another of the aspects of this problem. Two questions have guided these studies from the outset: (1) What are the child's first terms of reference or, to put it another way, what is the order of acquisition of category labels? (2) How does the meaning of these labels change as the child grows older, for even though a child may have a word in his vocabulary it cannot be assumed that that word has the same meaning for him or that it refers to the same set of referents as the corresponding adult term?

With respect to the first question two different definitions of conceptual complexity are considered to see whether or not either is predictive of the order of acquisition of category labels in development. The first definition is in terms of extension such that one category label is considered to be conceptually more complex than another if it denotes all of the objects denoted by the second term <u>and</u> additional objects as well. Thus, according to this definition, 'collie' is less complex than 'dog' which is less complex than 'animal'. If this definition of conceptual complexity were the sole predictor of the order of acquisition of category labels, the order would be 'collie' first, 'dog' second, and 'animal' third. The other definition is in terms of intension such that one term is considered to be conceptually more complex than another if it is "defined by" all of the properties defining the second term <u>and</u> additional properties as well. Since it is the case for nested category labels that the subordinate term is defined by all of the properties defining the superordinate term <u>and</u> additional properties as well, according to this definition of conceptual complexity 'animal' is less complex than 'dog' which is less complex than 'collie'. If this definition of conceptual complexity were the sole predictor of the order of acquisition of category labels the order would be 'animal' first, 'dog' second, and 'collie' third.

In a number of studies it turns out that neither of these definitions of conceptual complexity is a good predictor of the order of acquisition of category labels. We developed a test which we thought was a fair one of the order of acquisition of such terms of reference, in which there was (1) a context which made the use of a given category label obligatory for adults, and (2) the use of instances which were equally "central" (cf. Heider, 1973) to the concepts being tested for for all concepts. The resulting order of acquisition is seen to be 'dog' first, 'animal' second, and 'collie' third for this particular hierarchy or, to take some other hierarchies of concepts, it is 'flower' first, 'plant' second, 'rose' third, or 'car' first, 'Volkswagon' second, and 'vehicle' third, or 'apple' first, 'food' second, and 'fruit' third, and so on. Obviously these orderings are compatible with neither of the definitions of conceptual complexity outlined above (although they may be compatible with some other definition of conceptual complexity, possibly one which acknowledges "natural kinds"). This raises the question of what <u>is</u> a good predictor of the order of acquisition of category labels. It turns out that a good predictor is given by various frequency of occurrence measures in general and in particular frequency of occurrence of the words in child speech according to Rinsland (1945). In several studies the rank order correlation coefficients between frequency of occurrence of the words and the child's ability to produce those words in a context that requires them is of the order of .70 to .95, most of them being highly significant. (Frequency

of occurrence [according to Rinsland, Thorndike and Lorge, and Kucera and Francis] is also found to be a good predictor of the difficulty of vocabulary items on the Stanford Binet I.Q. test, with rank order correlation coefficients being in the neighborhood of .30.)

To identify frequency of occurrence as a predictor of the order of acquisition of category labels is not to explain this order, although it does provide some clues. Having discovered that frequency of occurrence of the words in child speech is a good predictor we compared the 275 most commonly occurring names of objects in Rinsland with the 275 most commonly occurring names of objects in adult frequency tables. A large scale Millerian sorting task on each of these sets of words reveals many similarities as well as differences among the semantic categories that result. Both the nature of these most commonly occurring words in child speech and the differences between these and the corresponding adult words seem to be consistent (in many but not all cases) with the idea that children use mos and learn first words that are likely to be important to them in their day-to-day activities (e.g., social interaction, eating, dressing, play, etc.).

The vocabulary of young children is also consistent with the way in which mothers name objects for them. When adults name objects for other adults they often give very specific names (e.g., 'collie', 'Volkswagon', 'pigeon', etc.) However, when mothers name objects for their children they sometimes tailor their naming practices, providing the child with less specific but more frequently occurring terms of reference (e.g., 'dog', 'car', 'bird', etc.) Whenever there is a difference between the way in which mothers name objects for adults and for their children it always appears to be in the direction of the less specific but more frequent term for the child. (Brevity appears to be less important as a factor.) Thus the child's first terms of reference are in fact consistent with the way in which mothers name objects for them in the original naming process.

With respect to the second question of how the meanings of these terms of reference change as the child grows older we concentrated on the extension of the child's names of objects rather than on their intension. This is not only because of the philosophical problems associated with attempts to define meaning in terms of intension (see Nelson Goodman's Problems and Projects) but also because of the difficulty that children seem to have in verbalizing what they know about words, whereas they seem to both enjoy and are better at simply naming objects or pictures of objects or indicating which objects are instances of a given concept. There are several possible relationships between the extension of a child's word and the extension of the corresponding adult term. For example, the child might underextend the term, overextend it, both underextend and overextend it, and so on. A review of the psychological literature on the subject reveals that many authors believe the child overgeneralizes his first terms of reference and gradually narrows down or differentiates and sharpens his concepts as he grows older. However, the evidence upon which their conclusions are often based (e.g., diaries of the child's first words) is biased in a way which will show only overextension (and differentiation as the developmental process) and because of the way in which it is collected and interpreted cannot reveal underextension (and generalization as the developmental process) if it occurs in development. In one experiment in which we attempted to create an opportunity for both overextension and under-extension errors we found that the child's tendency to make underextension errors is at least as pronounced if not more so as his tendency to make overextension errors. Thus, children in fact make both kinds of errors and whether they make more of one kind or the other depends upon (1) the child in question, (2) the concepts being investigated, and (3) the nature of the instances and non-instances

of the concept being tested. With respect to the children, some seem more prone to make one kind of error than the other. With respect to the concepts being investigated, certain terms are likely to be overgeneralized by children whereas others are likely to be undergeneralized. For example, most young children overgeneralize the concept 'flower' to various other kinds of plants (e.g., cactus, philodendron, elephant's ear, etc.). On the other hand most children undergeneralize the word 'plant', not including some trees and some flowers as instances.

We conducted a number of studies in an attempt to discern the nature of the instances of a concept which are likely to produce underextension errors and the nature of the non-instances which are likely to produce overextension errors. With respect to underextension errors, adult ratings of centrality-peripherality and familiarity-unfamiliarity of the instances of a given concept yield reasonably good predictors of which instances the child is likely not to include in that concept. The best single predictor is adult judgements of centrality (How good an instance is it? How close to a prototypic instance is it?). Specifically, children almost always include instances which are judged by adults as being central, whether they are familiar (dog to 'animal') or unfamiliar (aardvark to 'animal'), whereas they will often not include instances which are judged by adults as being peripheral, whether familiar (butterfly to 'animal') or unfamiliar (crustacean to 'animal'). Actually, somewhat surprisingly, familiar instances are somewhat less likely to be included in a general concept by children than unfamiliar instances, which may often be a result of the fact that they have a dominant name for a familiar instance ("That's a dog, not an animal") which they do not have for unfamiliar instances (e.g., aardvark).

With respect to overextension errors we attempted to tease apart the contributions played by (1) perceptual similarity of the non-instance to the instances of the concept, (2) association through contiguity: Is the non-instance likely to be contiguous to an instance of the concept? and (3) functional similarity: Does the non-instance serve the same function as an instance of the concept? We had adults rate various pictures with respect to these three dimensions for various concepts and then tested children to see which of these pictures were most likely to produce overextension errors. Stimuli rated as perceptually similar to instances of the concept (e.g., balloon to 'apple') produce by far the most overextension errors; stimuli rated as "likely to be contiguous" to an instance of the concept (e.g., saddle to 'horse') produce some overextension errors; stimuli rated as "serving the same function" as an instance of the concept (e.g., banana to 'apple') produce virtually no errors unless they are also rated as being "perceptually similar" or "contiguous".

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NOTE

All tables, figures and illustrations have been incorporated into the text for easy reference.

Any abbreviations, symbols and special terms have been explained in the text in the section in which they occur.

1. <u>On the Order of Acquisition of Category Labels</u>
(J. Anglin, Maryellen Ruvolo, and Elizabeth Smith)

In thinking about the possible determinants of the order of acquisition of category labels I have found it useful, if somewhat simplistic, to distinguish between horizontal development and vertical development. By horizontal development I mean the acquisition of category labels which categorize the world at roughly the same level of generality. Preliminary investigations had revealed that the child is better able to name correctly a picture of an apple than a picture of a persimmon, or a picture of a dog than a picture of an aardvark. These results are hardly surprising and they suggest simply that the child will learn category labels first for objects which are familiar to him and important to him in his day-to-day commerce with the world and only later will he learn names for less familiar and less important objects. An implication of this result is that frequency of occurrence of the word in parental or, better still, child speech will be a good predictor of the order of acquisition of category labels at the same level of generality on the assumption that frequency of occurrence is correlated with familiarity and importance.

But what about vertical development, by which I mean the acquisition of category labels at different levels of generality? The child may want a term to refer to his pet collie but the English language, in fact, contains several valid possible names at different levels of generality -- for example, 'Lassie', 'collie', 'dog', 'mammal', 'animal', 'being', 'thing', 'entity'. Is it possible that a purely formal consideration of such words could result in a prediction of their order of acquisition? What are the semantic relationships among the words in English which can be ordered along a "specific" to "general" dimension such that the category denoted by one word is a proper subset of the category denoted by another word? Consider, for example, the terms 'collie', 'dog', and 'animal'. Is there some sense in which one of these terms could be considered to be more conceptually complex than the others, and might this metric of conceptual complexity be a predictor of the order of acquisition of such category labels?

Philosophers and psychologists have often made a distinction between the extension of a word and the intension of that word (see, for example, Inhelder and Piaget [1964], Brown [1958a], Goodman [1972]). Roughly, a word's extension refers to the group of objects denoted by the word whereas its intension refers to the properties which define the word. For example, the extension of the word 'animal' is the set of dogs, cats, birds, fishes, insects, etc. which are the instances of the concept 'animal'. The intension of the word 'animal' is the set of properties 'lives', 'breathes', 'is capable of spontaneous movement', 'digests', etc. which constitute the defining properties of the class of 'animals'.

It is possible to speculate about a metric of conceptual complexity for nested category labels defined either in terms of extension or in terms of intension. Consider first a definition in terms of extension. Conceptual complexity might be defined in terms of extension such that a term that refers to a set of objects is conceptually more complex than a term which refers to only a subset of those objects. That is to say, according to this definition the more diversity in the referent class for a given category label the more conceptually complex it is. If conceptual complexity were defined in this fashion and if this metric were the sole predictor of the order of acquisition of category labels, then the order would be 'collie' first, 'dog' second, and 'animal' third, as the arrows in Fig. 1 indicate.

Insert Fig. 1 here

Fig. 1

Schematic representation of the relations among the extensions of the words "collie", "dog" and "animal". If conceptual complexity were defined solely in terms of a concept's extension such that a term with the smaller extension were conceptually simpler than a term which extends to all of the objects denoted by the first term <u>and</u> to other objects as well, then accoriing to this definition of conceptual complexity "collie" would be simpler than "dog" which would be simpler than "animal". If this definition of conceptual complexity were the sole predictor of order of acquisition of category labels then the order would be "collie" first, "dog" second and "animal" third as the arrows indicate.

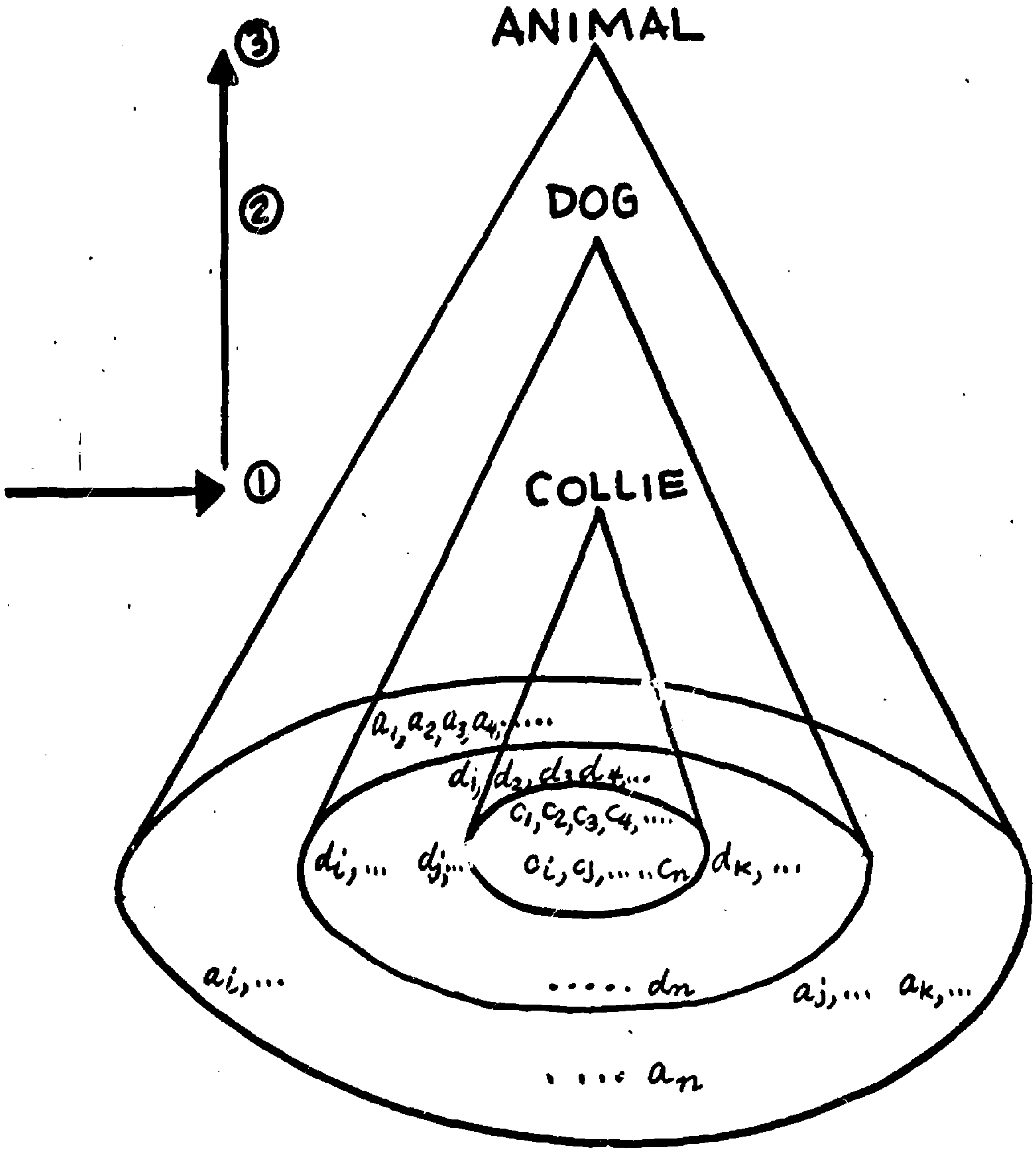


Fig. 1
Arrows indicate the order of acquisition of nested category labels that might be predicted by a definition of conceptual complexity in terms of extension.

Consider now a definition of conceptual complexity in terms of intension, i.e., the set of properties that define the word. It is the case that for nested category labels every property which is true for all instances of the superordinate term is also true for all instances of the subordinate term. For example, the properties 'live', 'breathe', 'digest', etc. which are the defining properties of the class of 'animals' are also all true of the class of 'dogs'. However there are certain properties which are true for all instances denoted by the subordinate term which are not true for all instances of the superordinate term. For example, 'is a mammal' is a predicate which applies to all dogs but not to all animals and 'has four legs', 'has fur', 'barks', etc. are predicates which apply to virtually all dogs but by no means to all animals. If conceptual complexity were defined solely in terms of a concept's intension such that the term defined by a set of properties were conceptually simpler than a term defined by those properties <u>and</u> other properties as well, then according to this definition of conceptual complexity animal' would be simpler than 'dog' which would be simpler than 'collie'. If this definition of conceptual complexity were the sole predictor of the order of acquisition of category labels such that simpler terms are acquired before more complex ones, then the order would be 'animal' first, 'dog' second, and 'collie' third (for this particular hierarchy of terms) as the arrows to the left in Fig. 2 indicate.

Insert Fig. 2 here

As a matter of fact neither of our definitions of conceptual complexity seems that likely to be a good predictor of the order of acquisition of category labels. For one thing each definition makes exactly the opposite prediction of the other. For another thing Brown (1958 b) has argued that

Fig. 2

Schematic representation of the relations among the intensions of the words "collie", "dog" and "animal". If conceptual complexity were defined solely in terms of a concept's intension such that the term "defined" by a set of properties were conceptually simpl~r than a term defined by those properties and other properties as well, then according to this definition of conceptual complexity "animal" would be simpler than "dog" which would be simpler than "collie". If this definition of conceptual complexity were the sole predictor of order of acquisition of category labels, then the order would be "animal" first, "dog" second and "collie" third as the arrows to the left indicate.

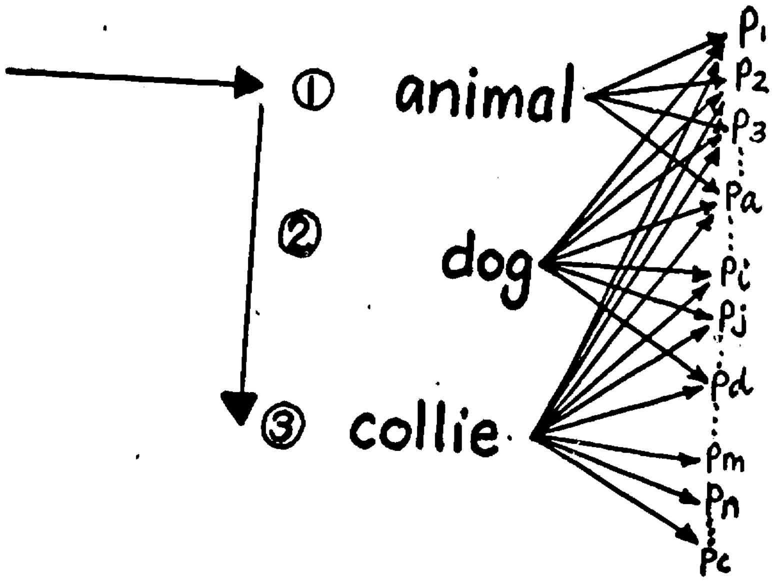


Fig. 2

Arrows indicate the order of acquisition of nested category labels that might be predicted by a definition of conceptual complexity in terms of intension.

with respect to category labels children often start by learning to categorize a given object at some intermediate level of generality and beyond that learn both more specific and more general terms to categorize that object. Such a trend was suggested by our preliminary investigations. The child when shown a picture of a sandal and asked "What is this?" would call it a 'shoe' rather than a 'sandal' or 'clothing'. He would call a rose a 'flower' rather than a 'rose' or a 'plant'; a collie a 'dog' rather than a 'collie' or an 'animal'; a Volkswagon a 'car' rather than a 'Volkswagon' or a 'vehicle' and so on. The problem with this sort of study is that since each of the terms 'collie', 'dog', and 'animal' is actually correct for a picture of a collie we cannot say for sure that children are not capable of producing the specific or the general terms -- perhaps they simply prefer to give the intermediate term for some reason. This is especially problematic for more general terms such as 'animal', 'plant', 'food', etc., since when asked to give a name for a single object adult subjects certainly and probably children as well tend to give the most specific name they can, since these convey more information. Thus the task of naming single pictures will rarely evoke these more general terms even though they may be part of the child's linguistic competence. What is needed therefore is a task which will make the production of specific terms, and general terms, obligatory.

In puzzling about this problem Maryellen Ruvolo, an undergraduate at Radcliffe, and I came up with the following solution. We decided to present to the child not a single picture of an object but rather a set of pictures of objects and ask him to name each picture in the set with a <u>different</u> name and also to give a name that applies to all of the objects in that set by asking "What are they all?". The idea was to provide a context which for an adult makes the use of both differentiated terms and of general terms obligatory.

Experiment 1

Method

We decided we would like to examine the child's ability to produce names for several different domains and at different levels of generality within any given domain. To this end we constructed a set of 26 posters with four pictures on each poster. Since one of our interests was in the child's ability to produce class names at different levels of generality we constructed a set of eight hierarchies such that for a given hierarchy there were three posters (in all cases but one) such that the class name for the four objects depicted on one of them would, we suspected, be named at a different level of generality by adult subjects from the others. So, for example, our first hierarchy was:

I. people
children
boys

On the first poster there were four pictures of boys. On the second there were four pictures of children, two girls and two boys. On the third poster there were pictures of four different people, a boy, a girl, a man and an old woman. Our design was such that posters for a more general class name always included an instance of the most specific class name. For example, in this case there was a picture of a boy on the posters for 'children' and for 'people'.

The other three-term hierarchies of concepts which we had in mind were as follows:

II. food	III. plants	IV. vehicles	V. money	VI. animals	VII. animals
fruit	flowers	cars	coins	dogs	fish
apples	roses	Volkswagons	dimes	collies	sharks

Finally we decided to study an eighth hierarchy with five levels in it:

VIII. living things
animals
mammals
primates
chimpanzees

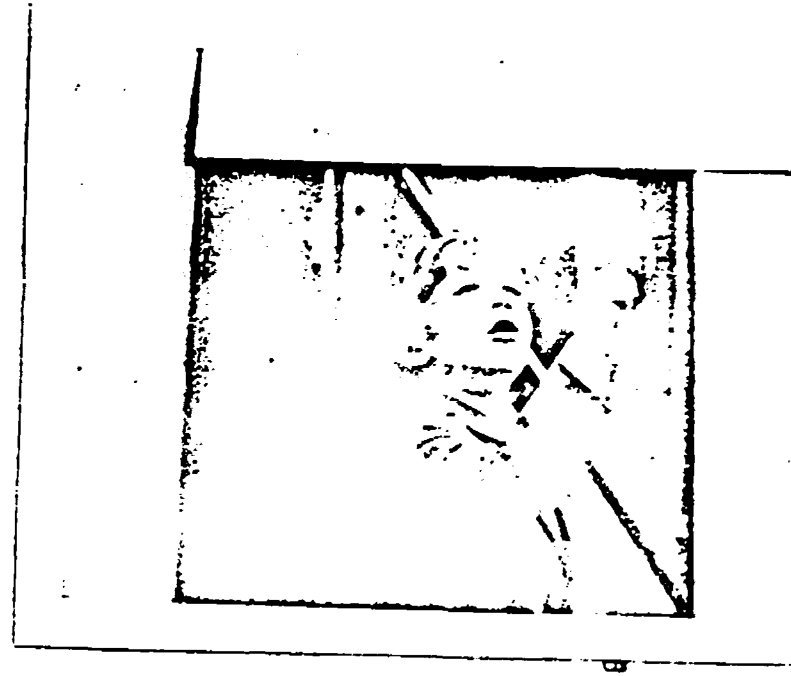
It should be pointed out that these words were our reference words only and were not actually an integral part of the experiment.

The actual pictures used are shown in the next 26 pages. Each page is actually a Xerox of a poster and unfortunately the Xeroxes are not very clear. The pictures used in the experiment were clear black and white photographs, however.

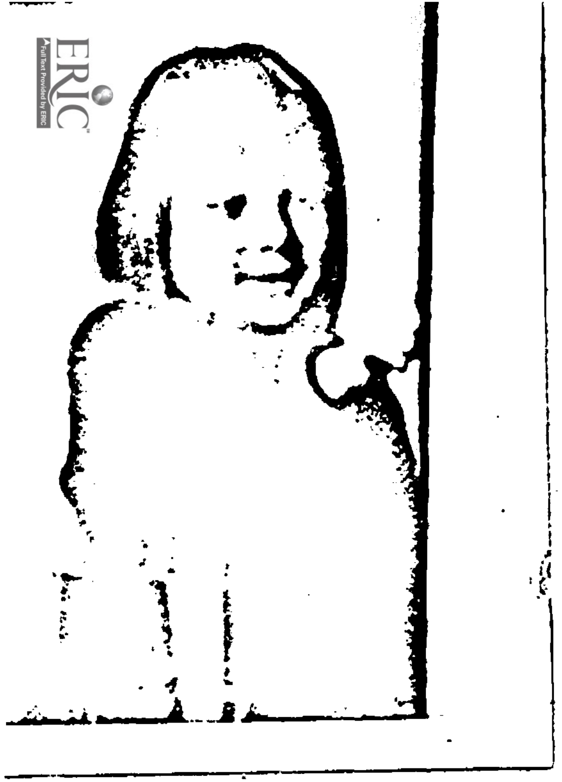
Insert Pictures here

There were three groups of subjects in the experiment. There was one group of 10 children between 2 and 3½ years of age, one group of 20 children between 4 and 5½ years of age, and one group of 20 adults half of whom were mothers of 10 of the children and half of whom were graduate students at Harvard.

The three posters for the first hierarchy (boys, children, people) were used as a demonstration and subjects were helped if they had trouble. They were not given hints or feedback on the rest of the posters, however. The posters for hierarchies II-VII were presented in a different random order for each subject. For each poster the subject was asked to name each object depicted in the four pictures and then to give a class name for all the pictures on a given poster. In order to elicit individual names for each picture E would point to each in turn and say "What is this?". In order to elicit class names, after the subject had attempted to name each picture E would ask him "What are they all?".



(boys)

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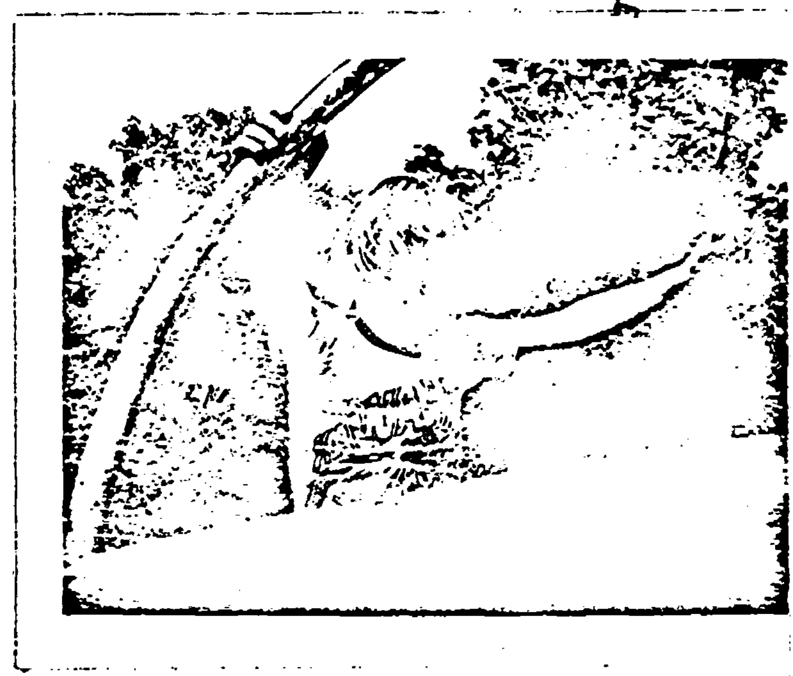

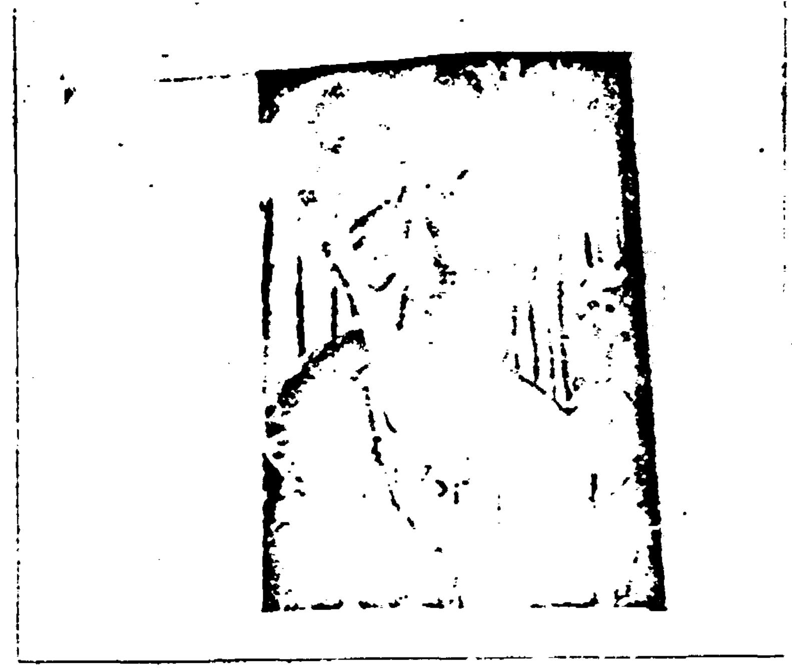

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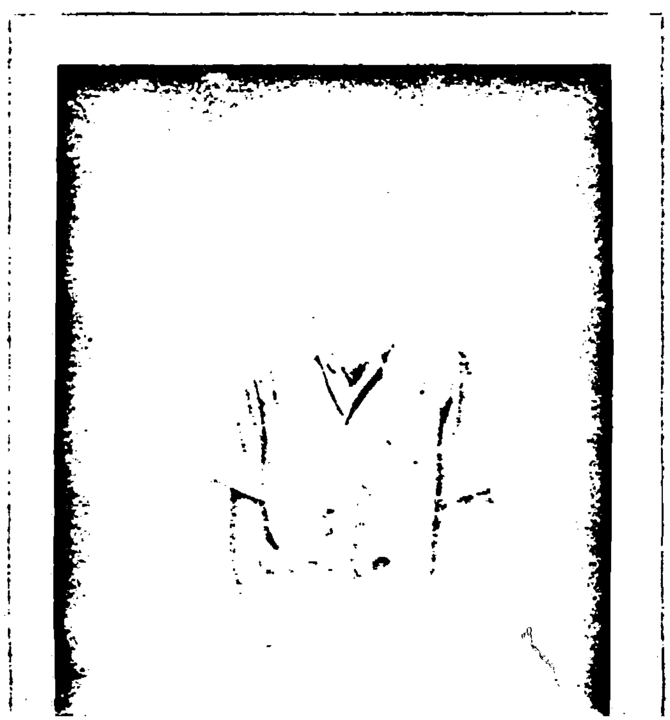

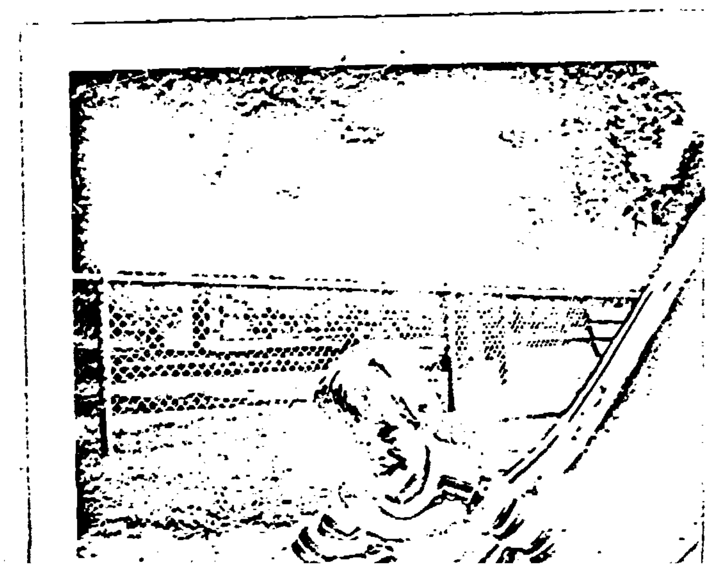

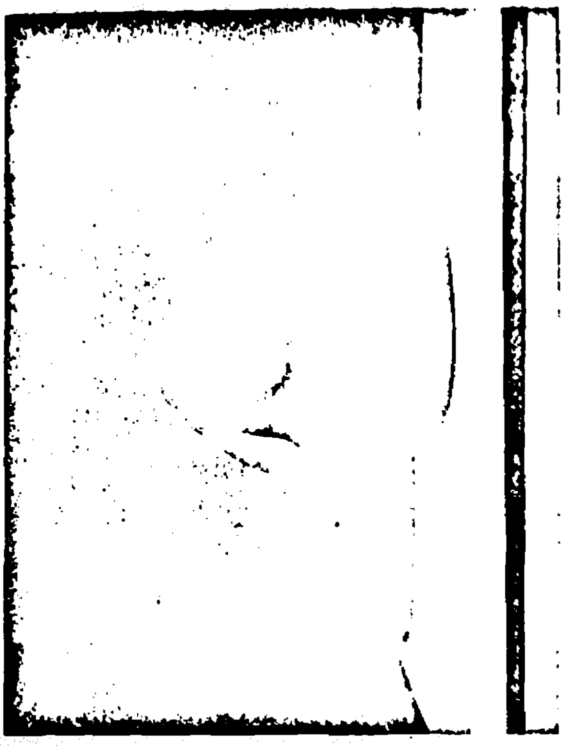

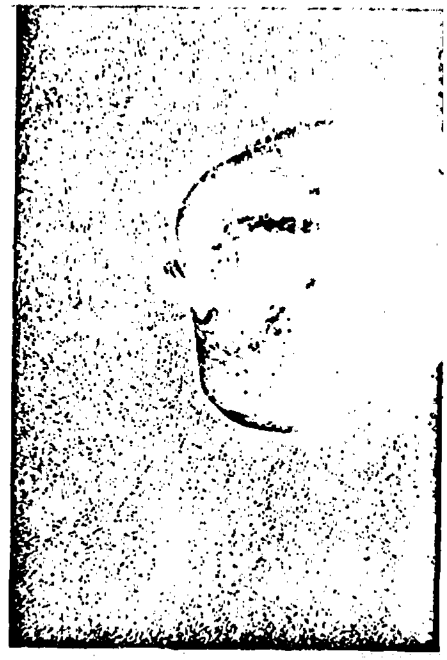

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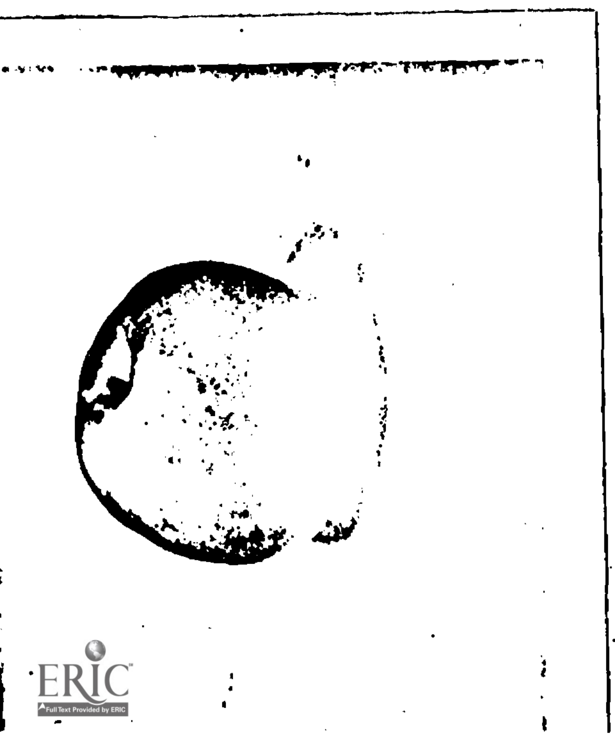

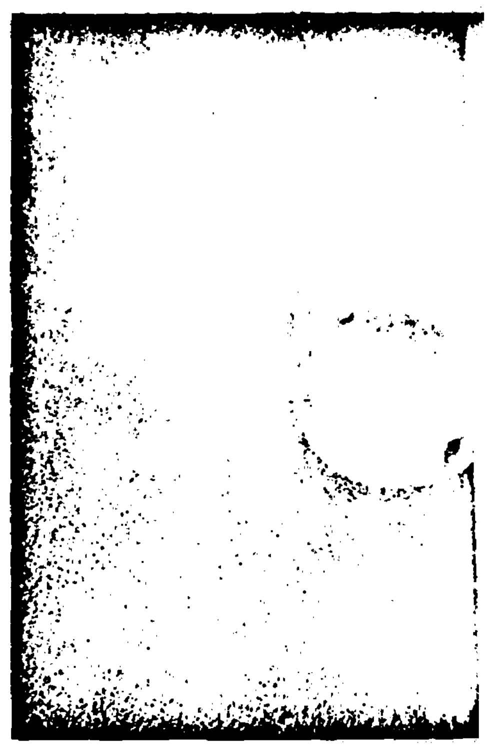

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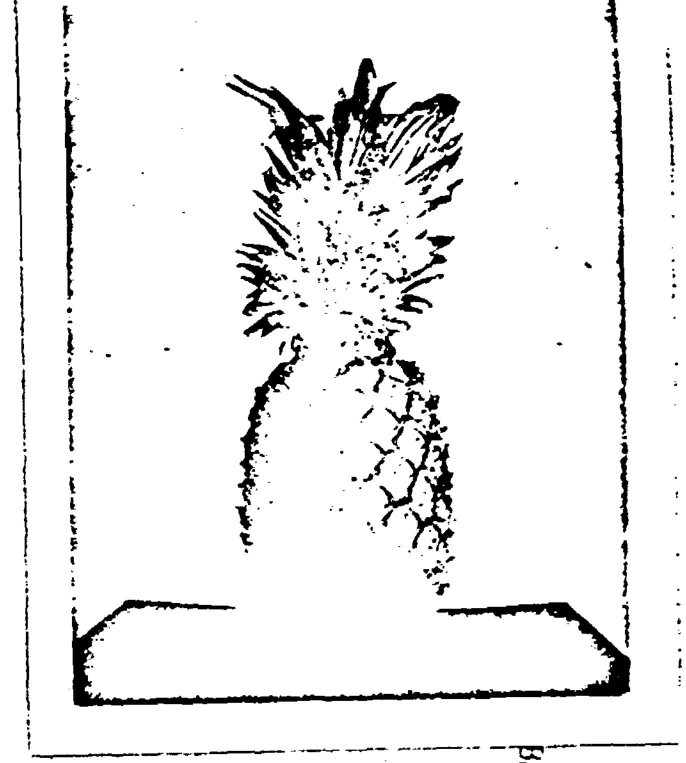

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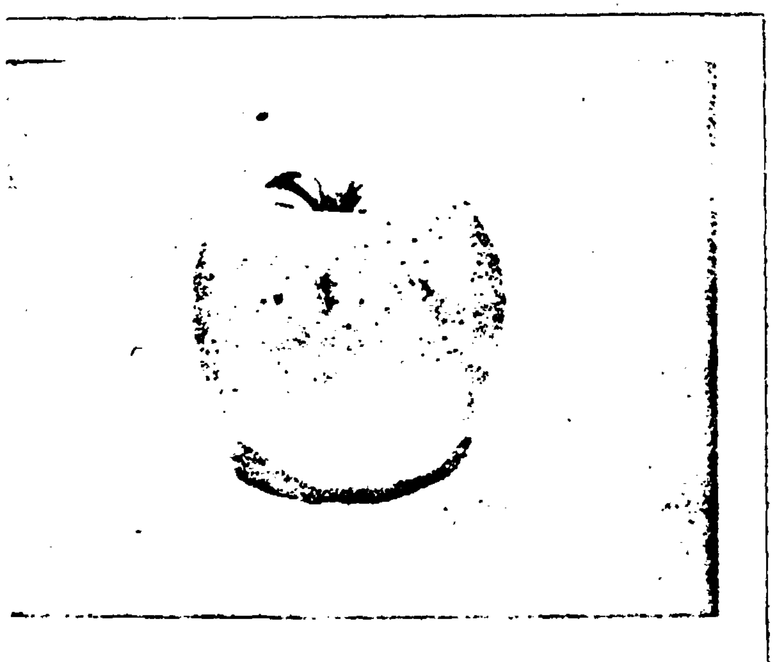

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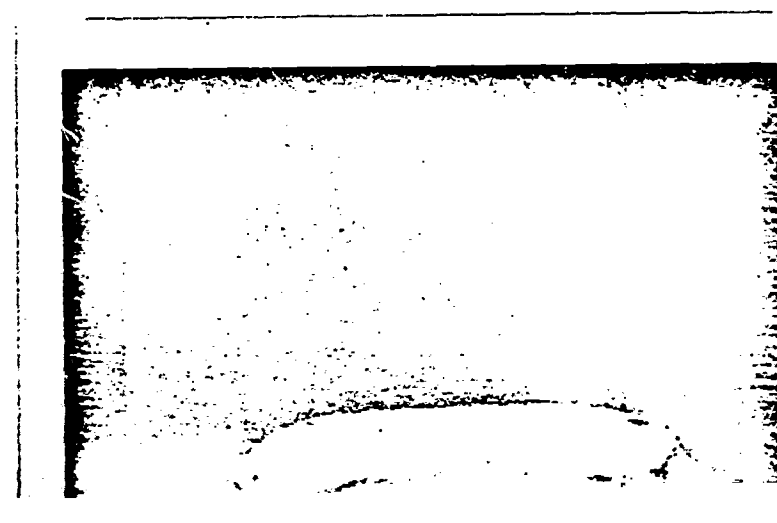

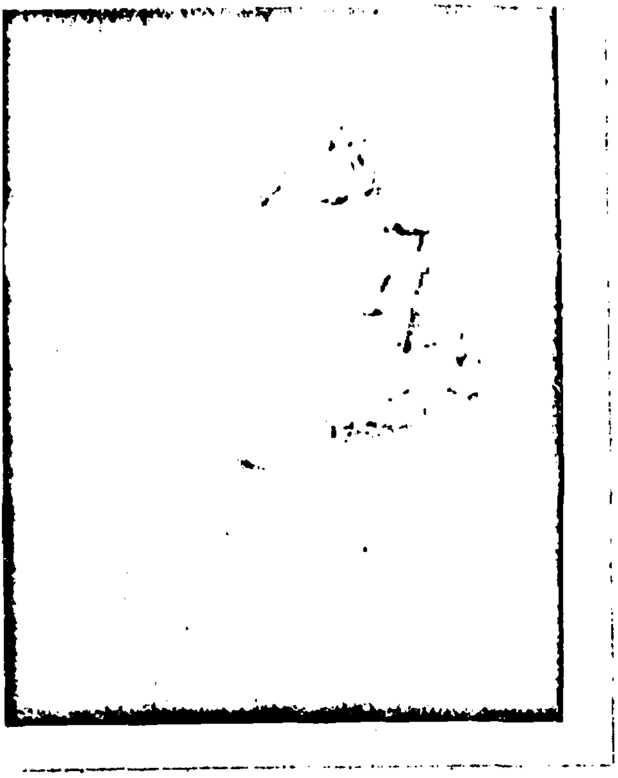

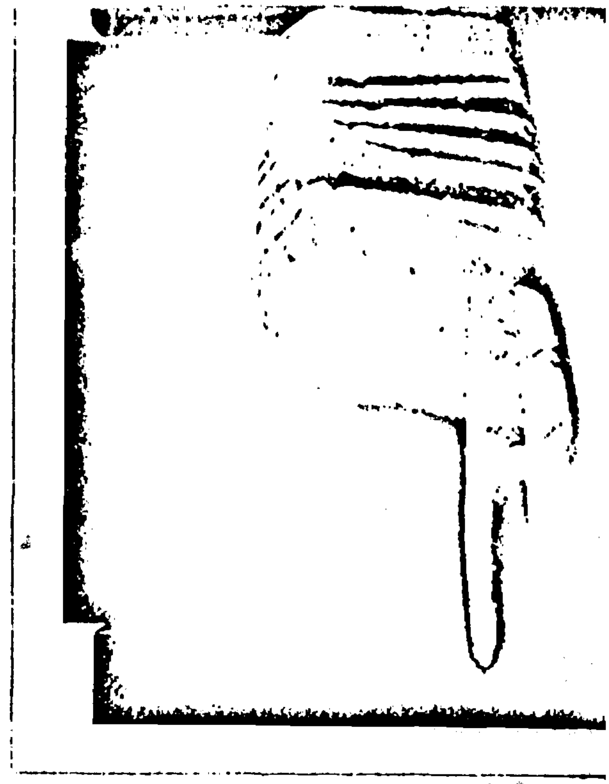

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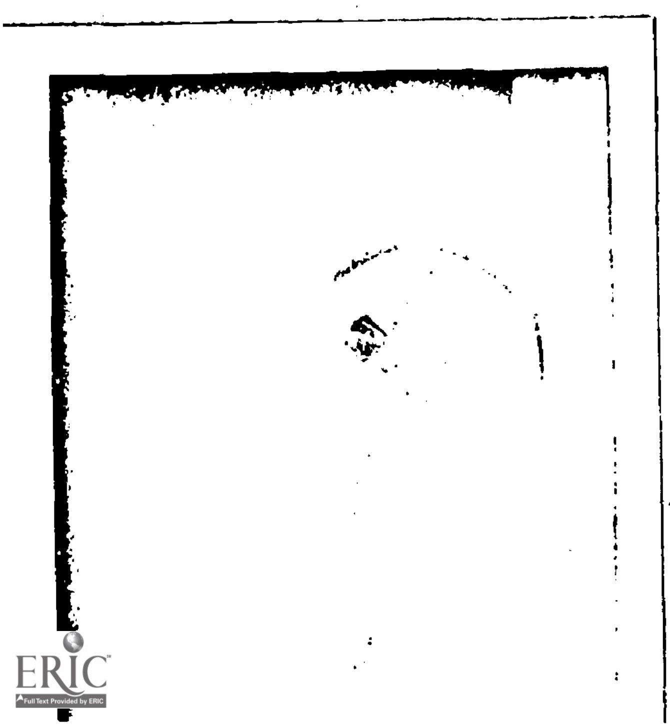

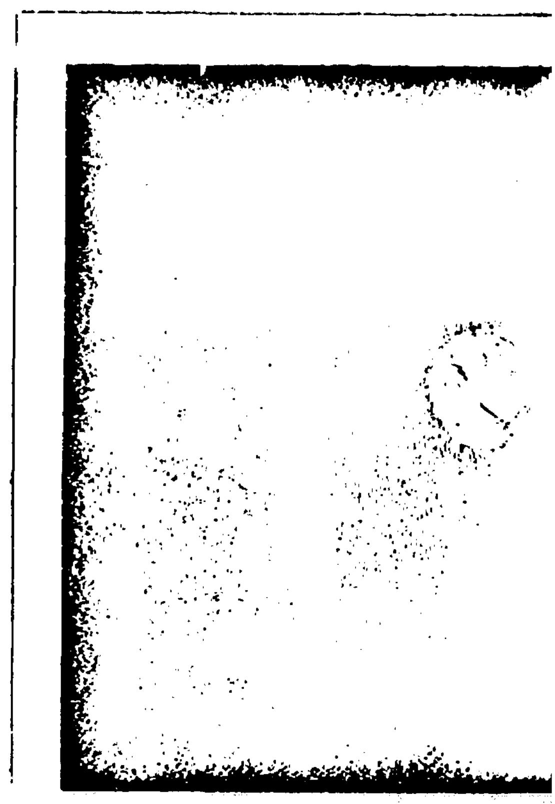

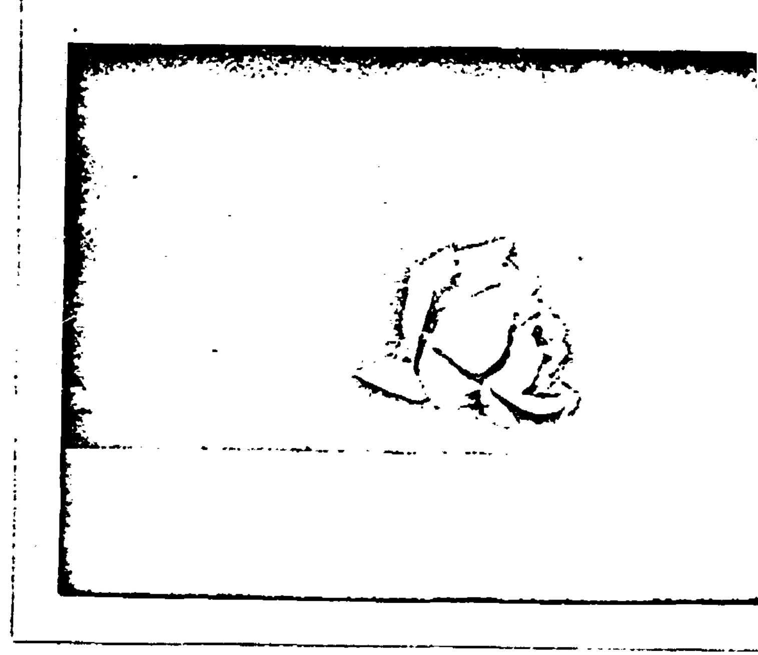

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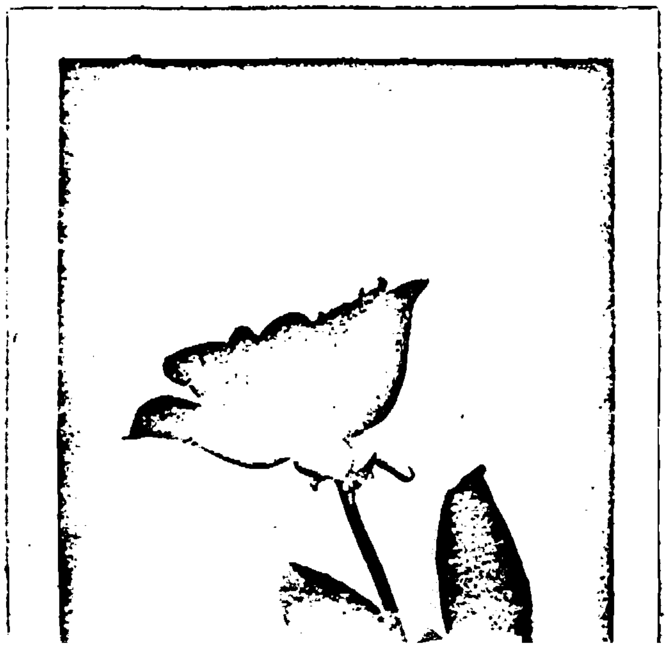

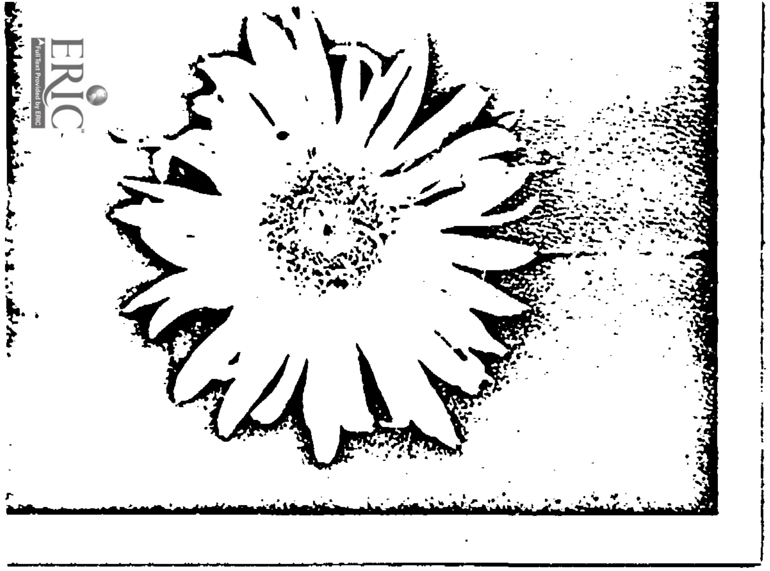
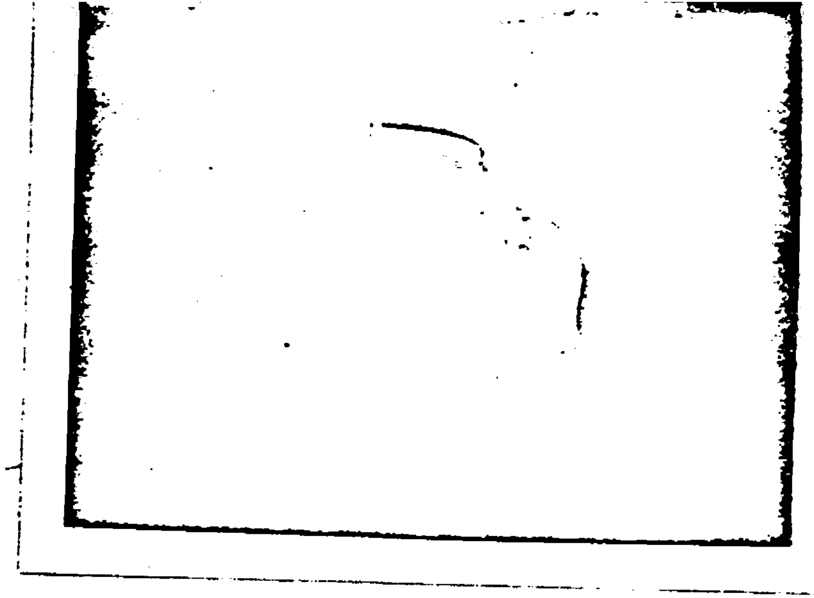

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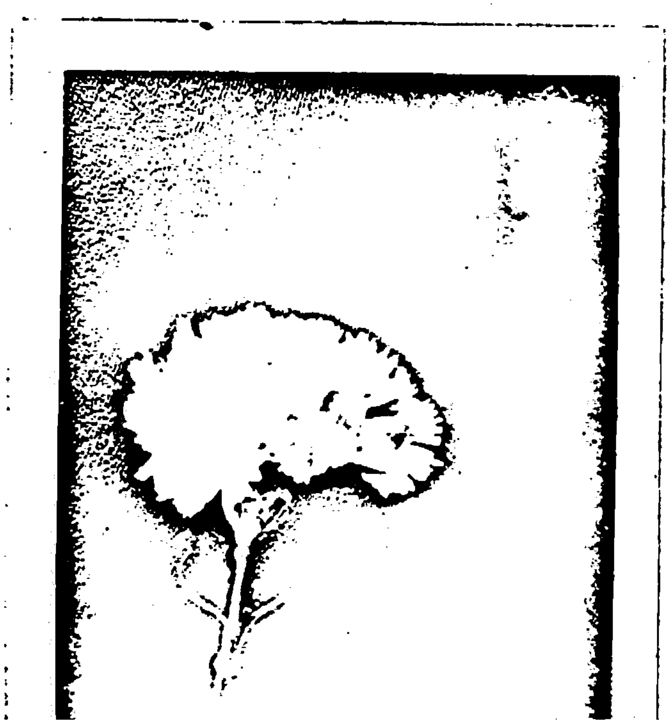
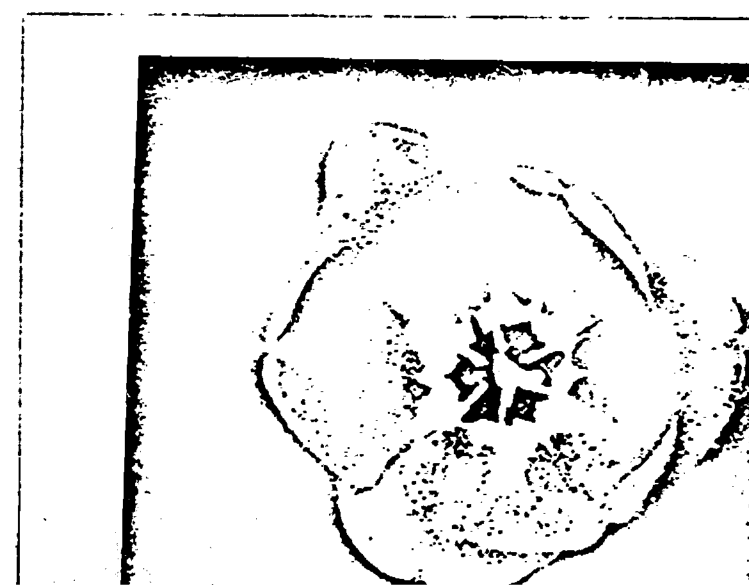

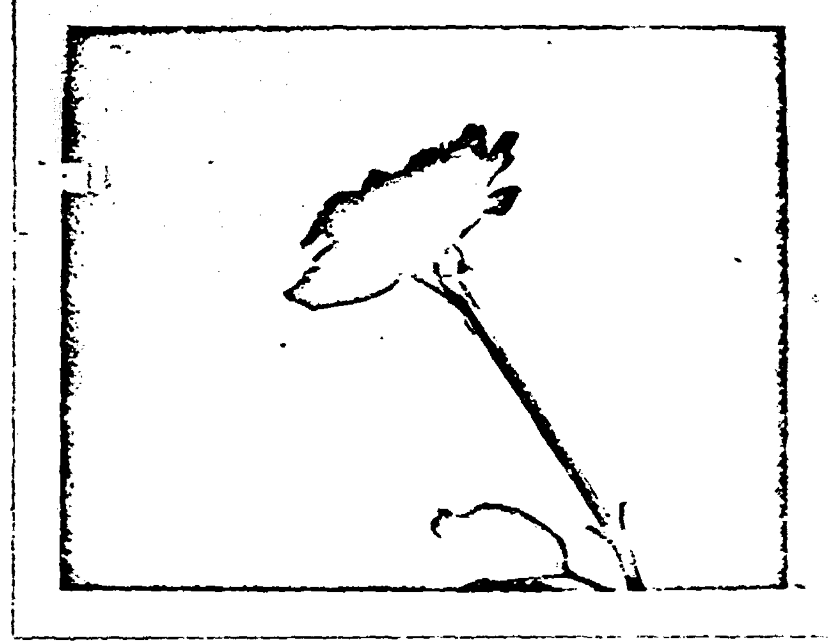

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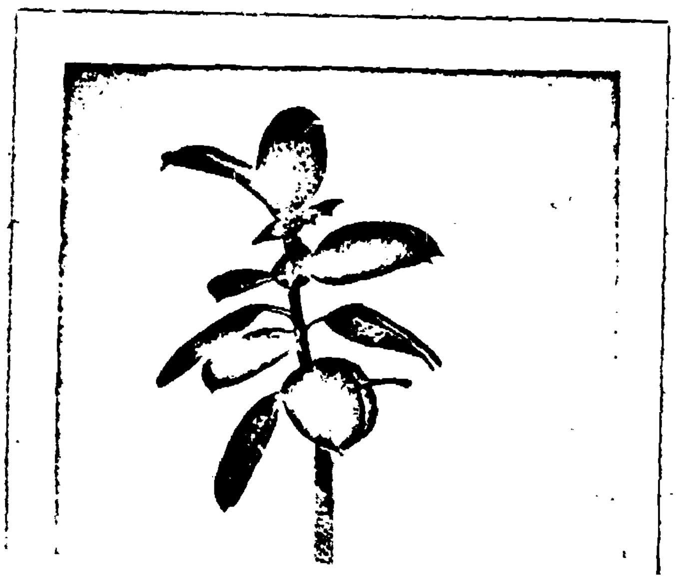

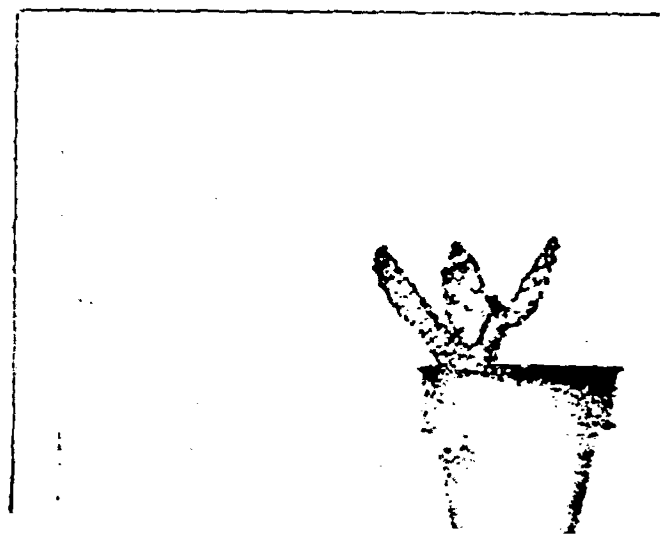

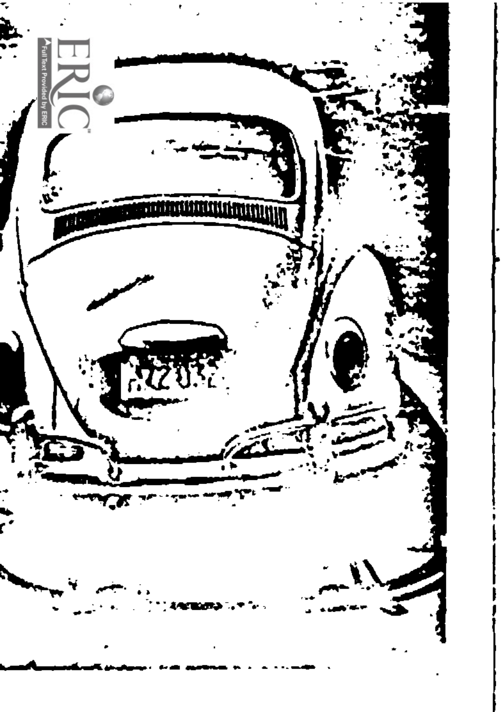

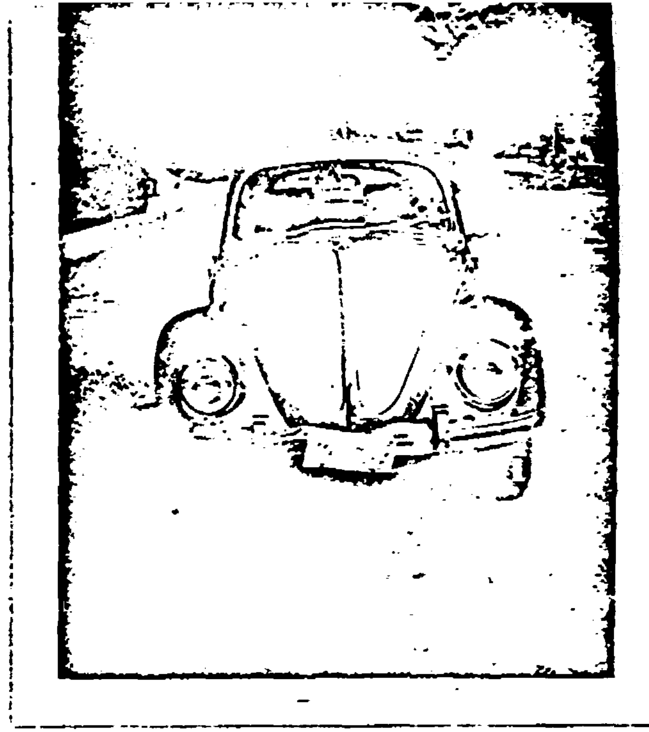

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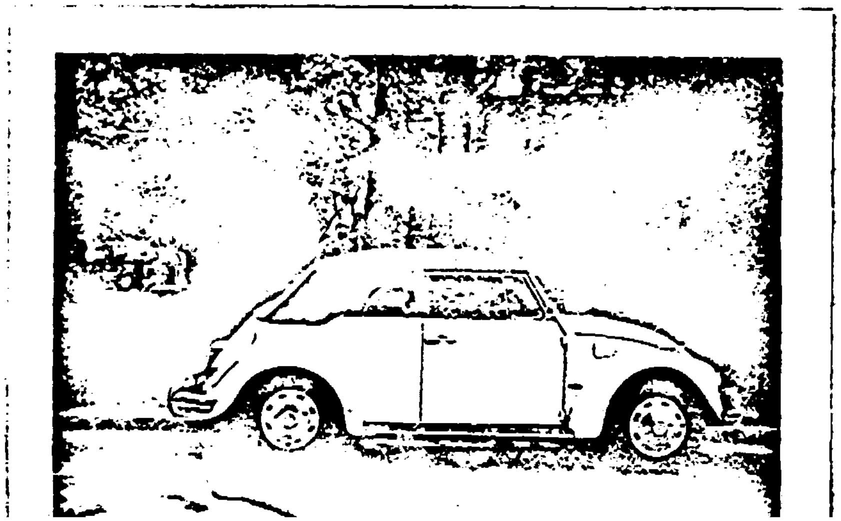

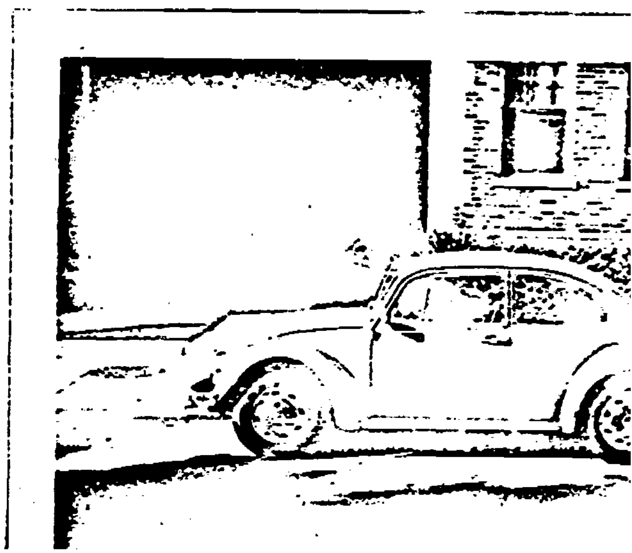

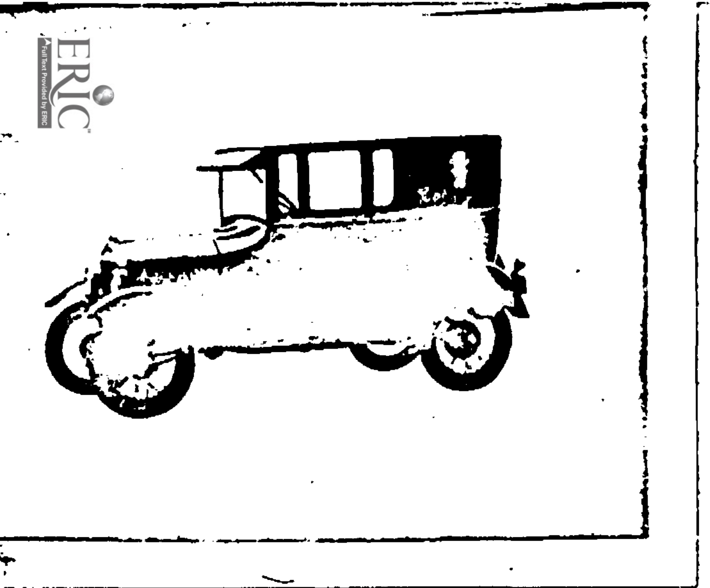

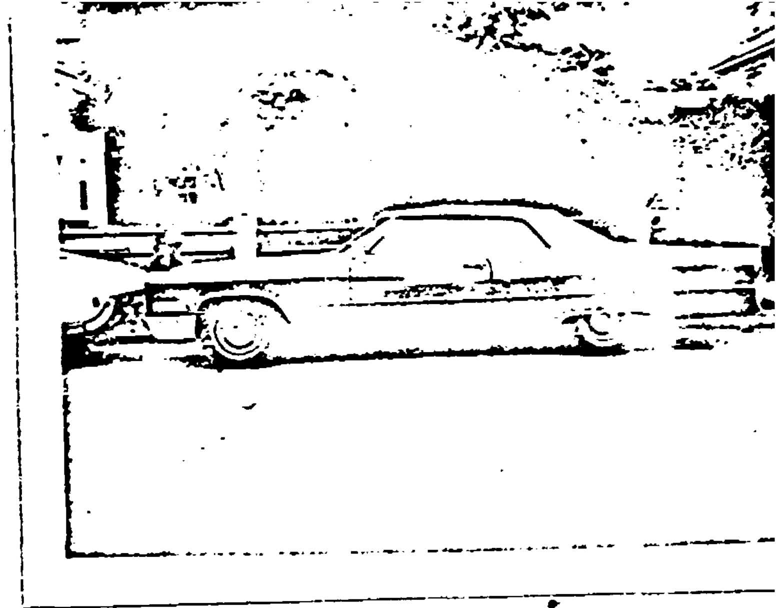

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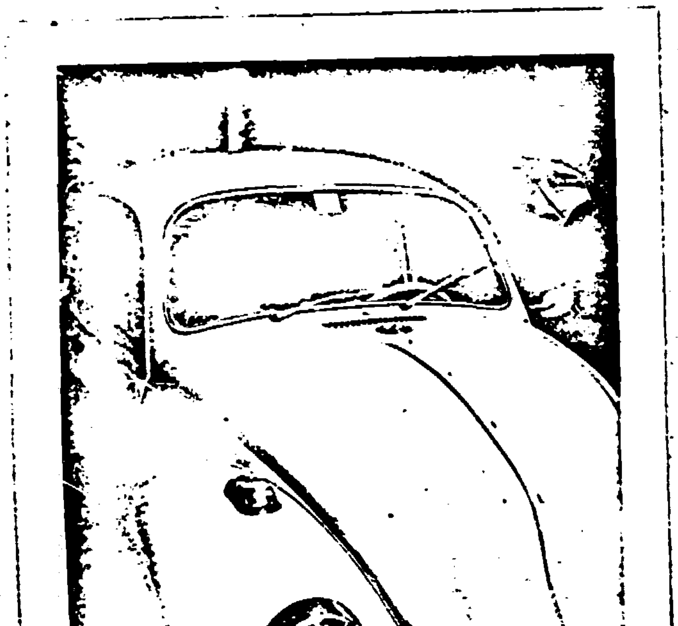

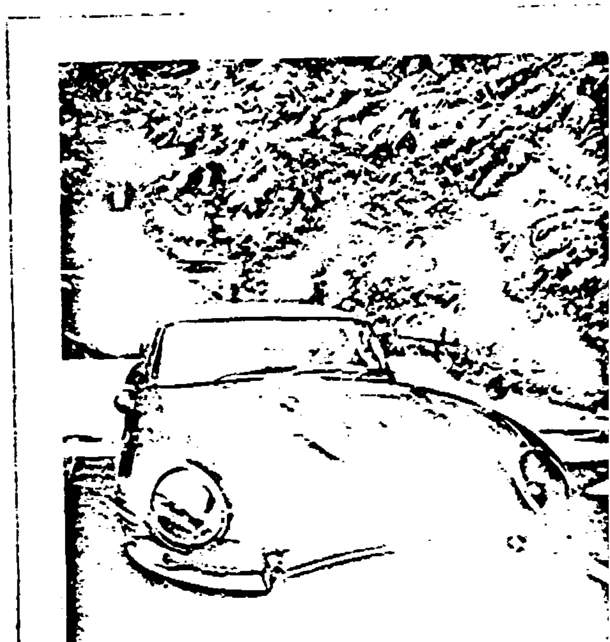

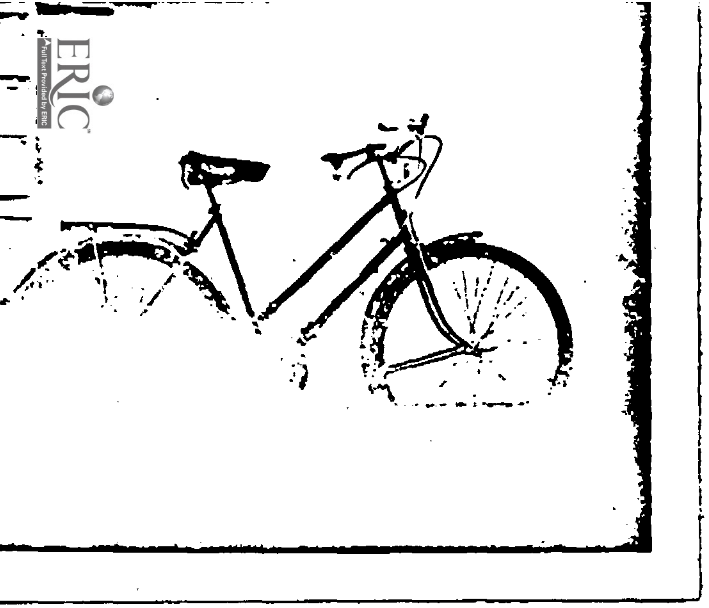

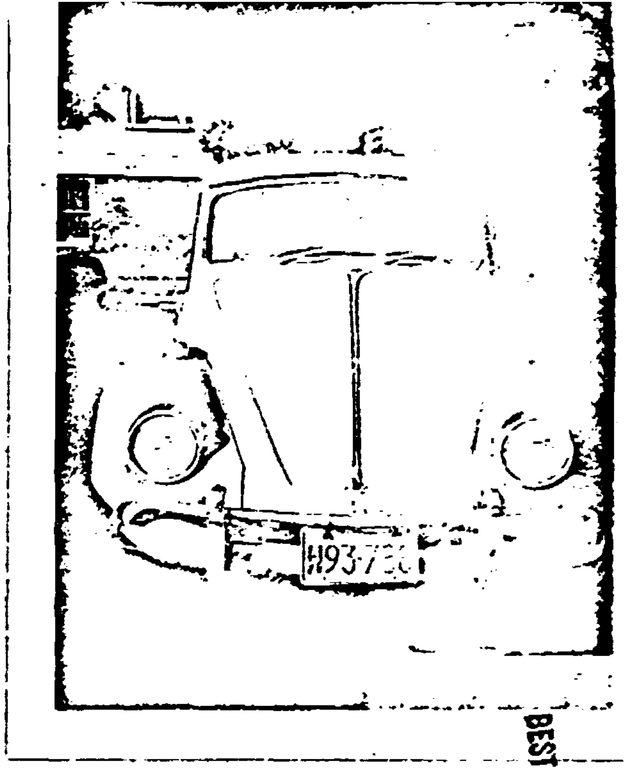

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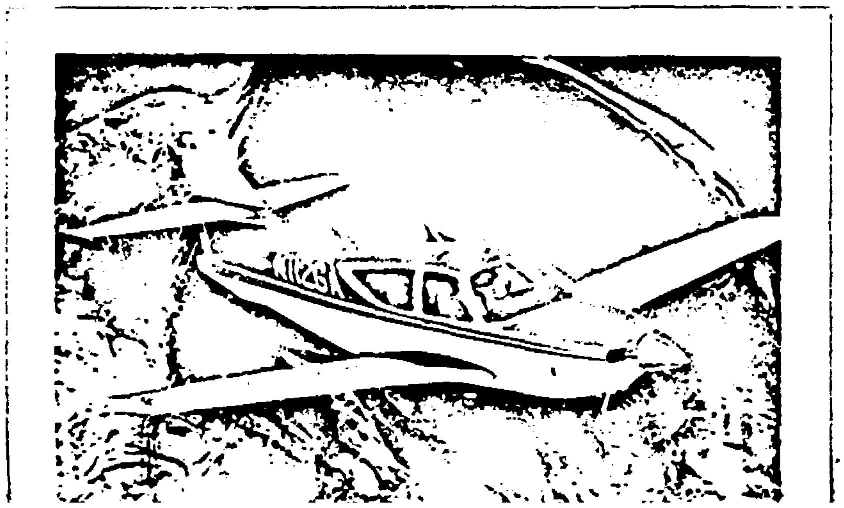

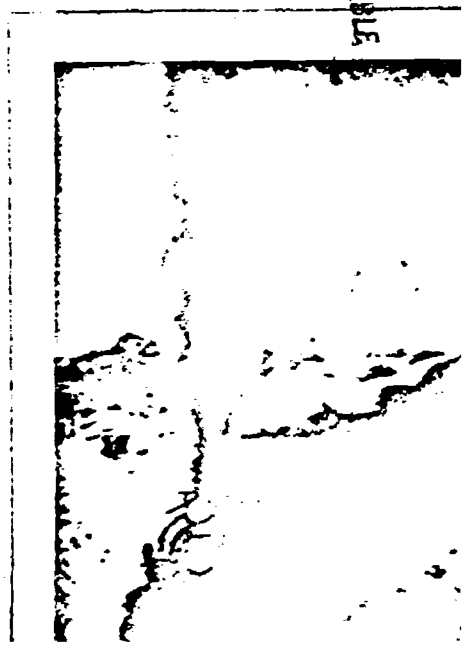

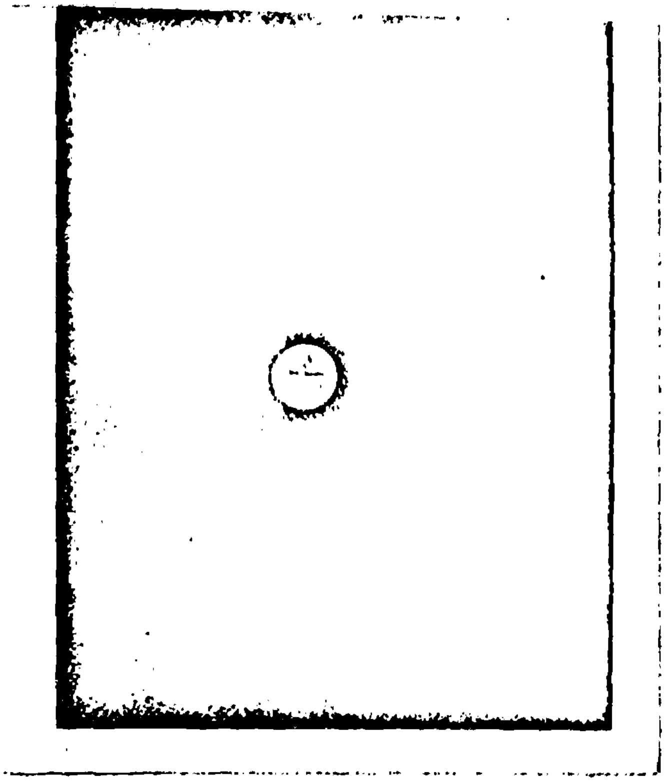

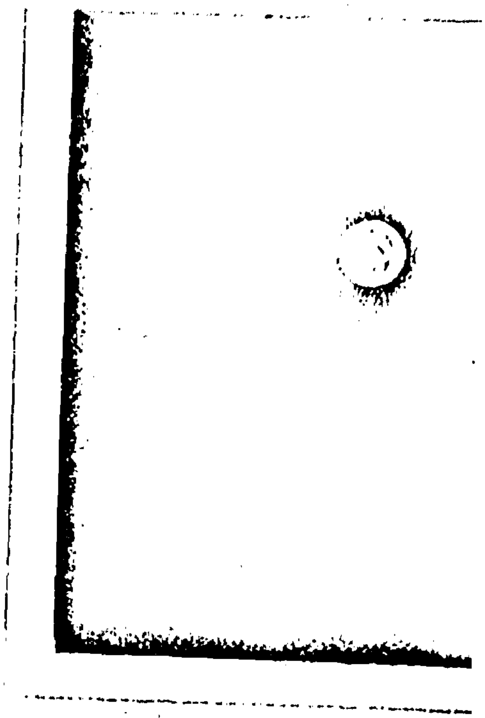

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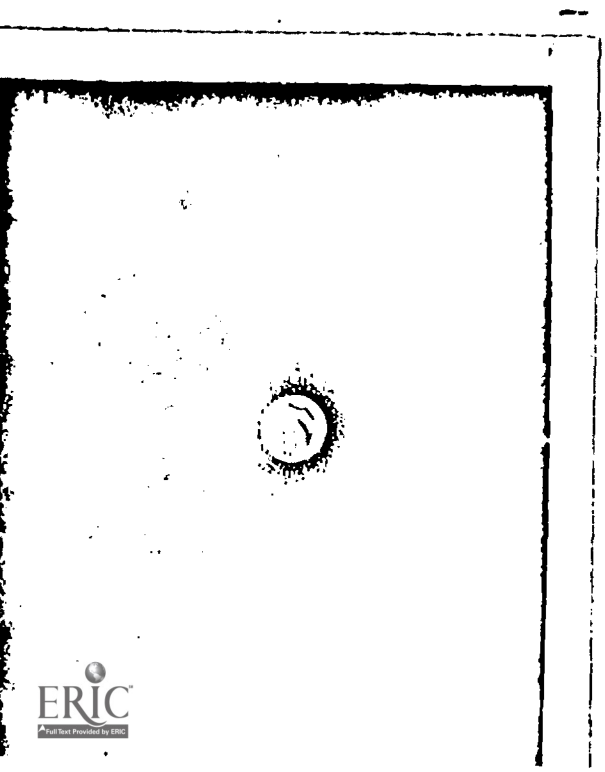

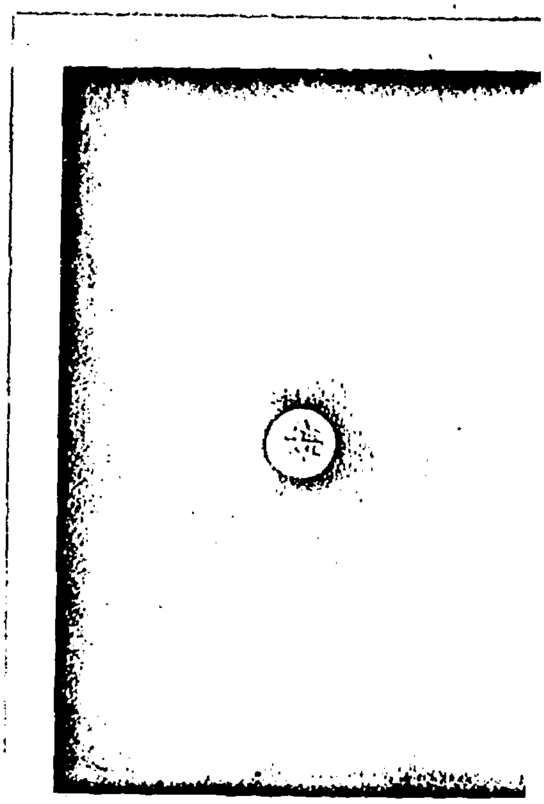

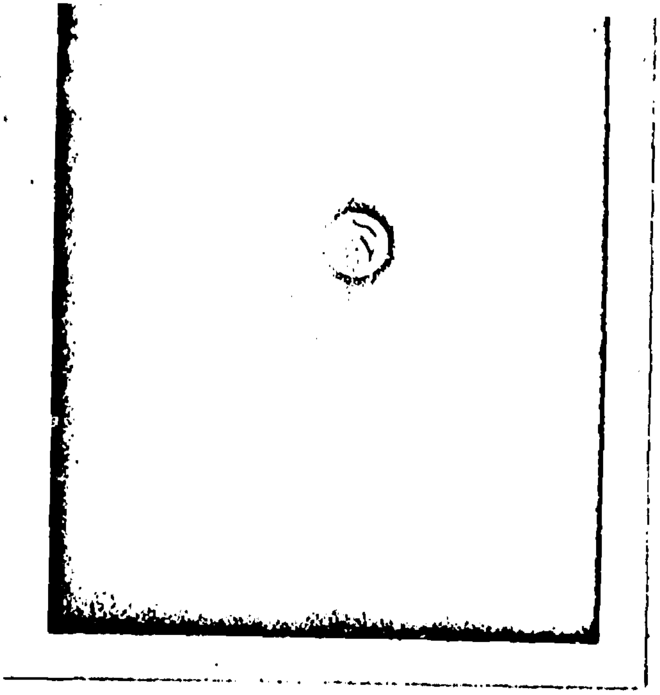

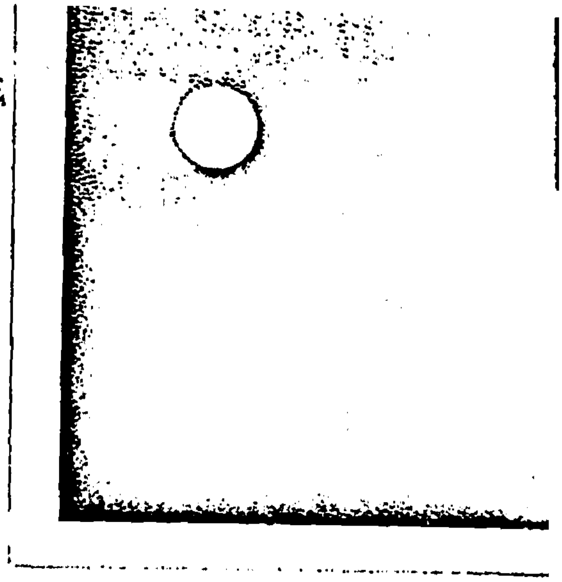

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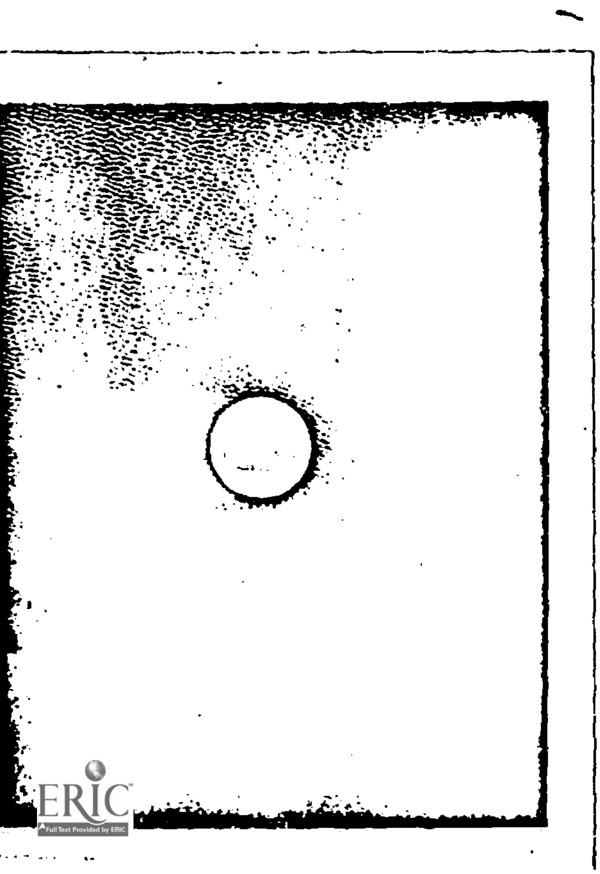

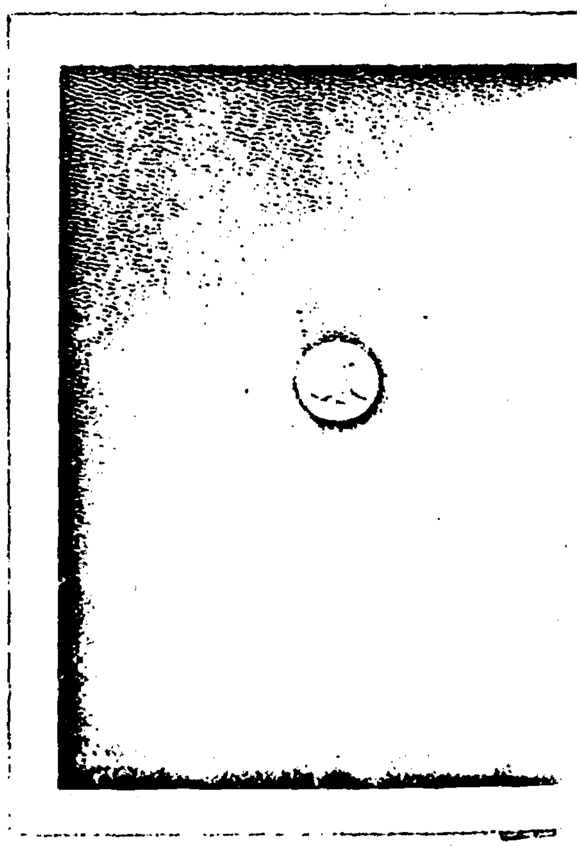

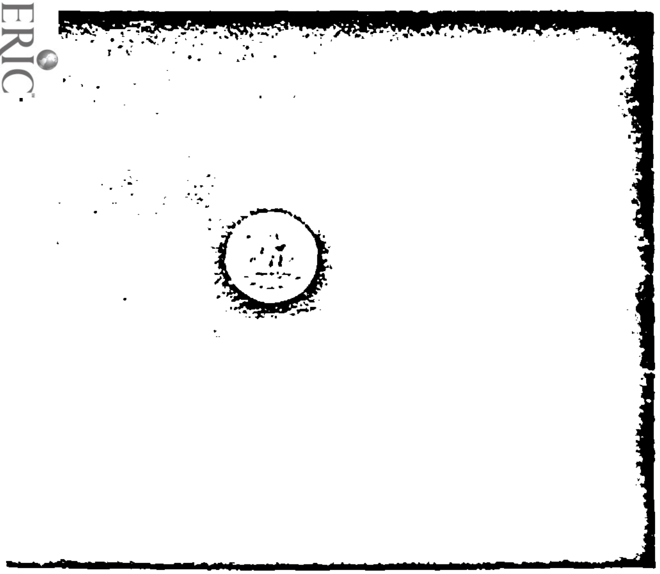

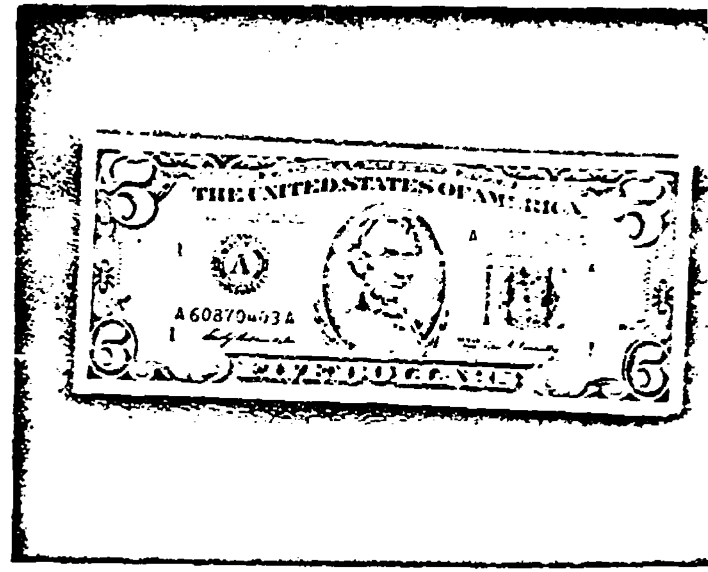
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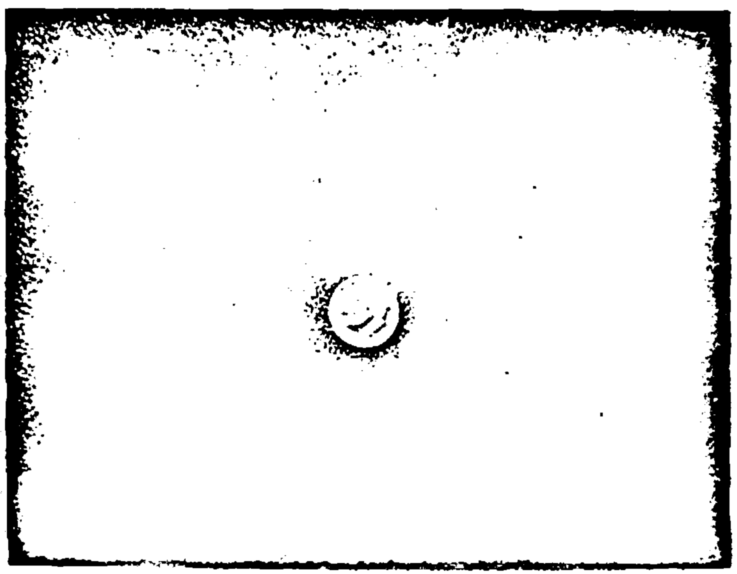
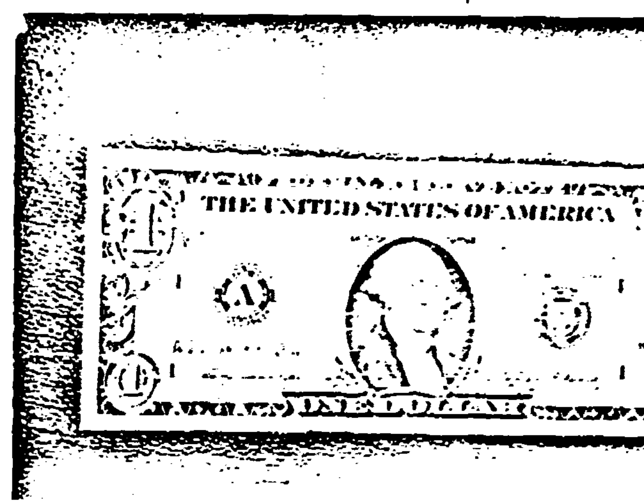
(money)

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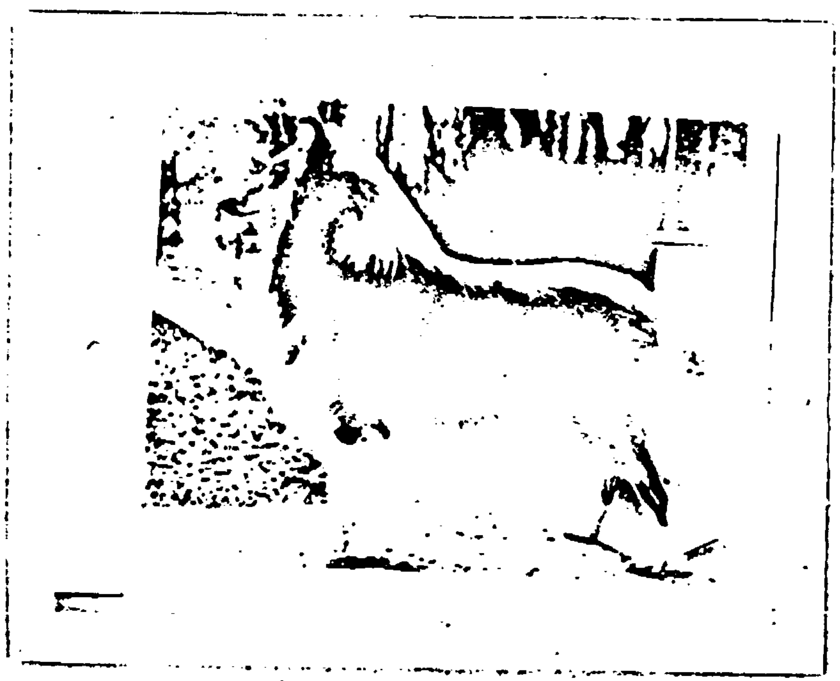

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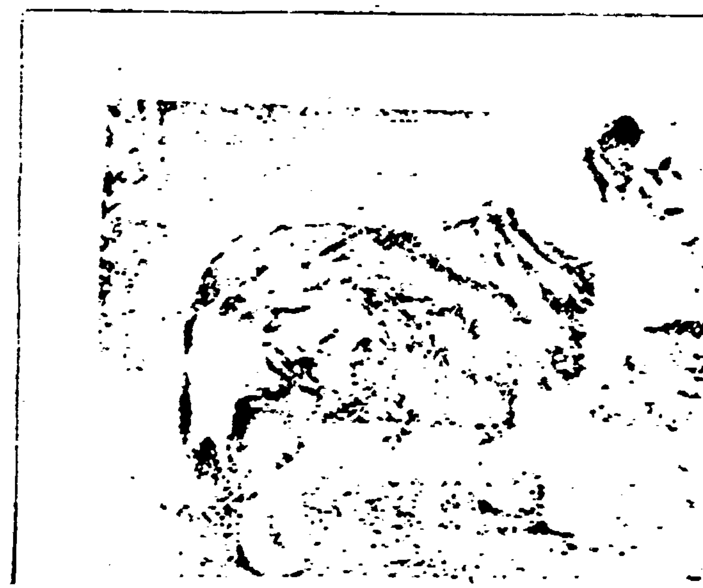

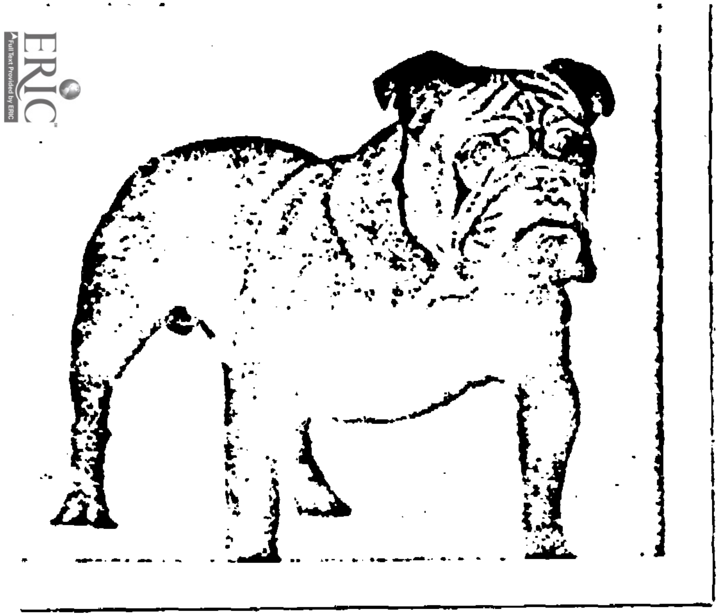

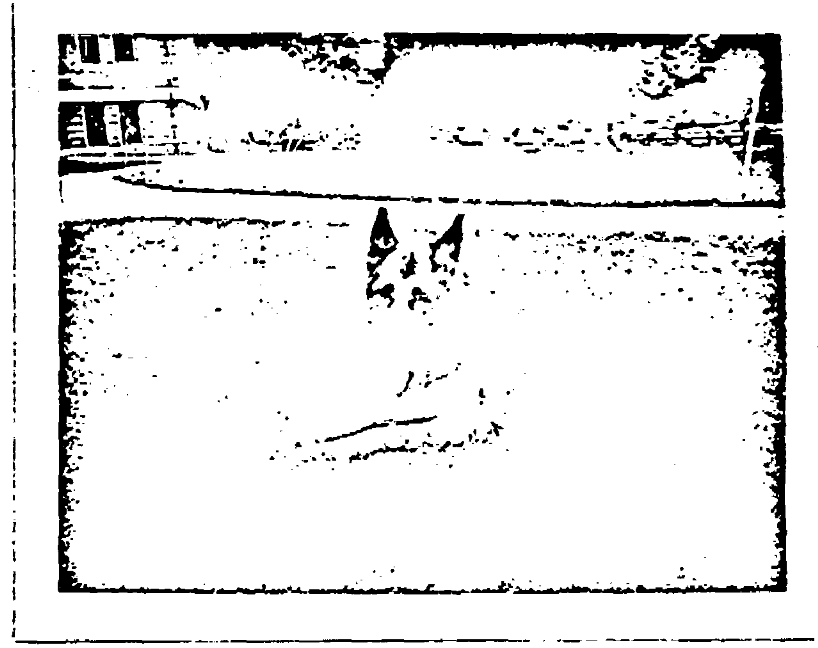

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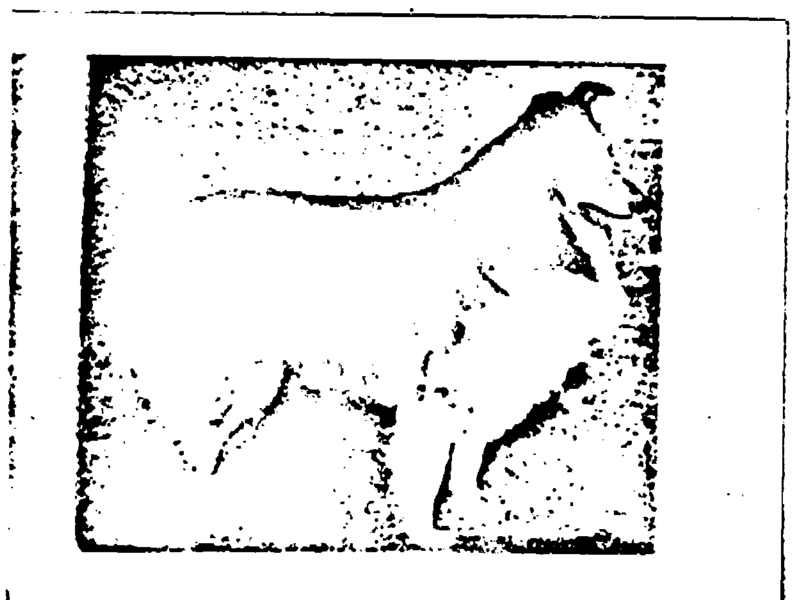

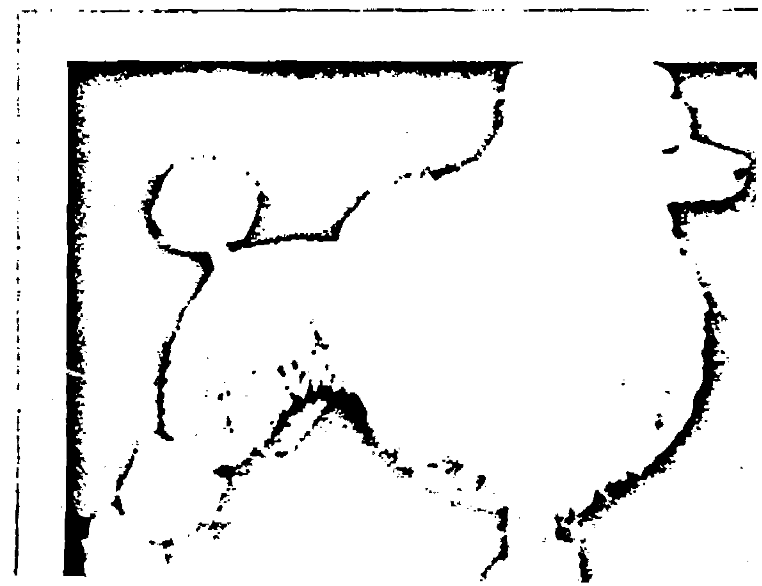

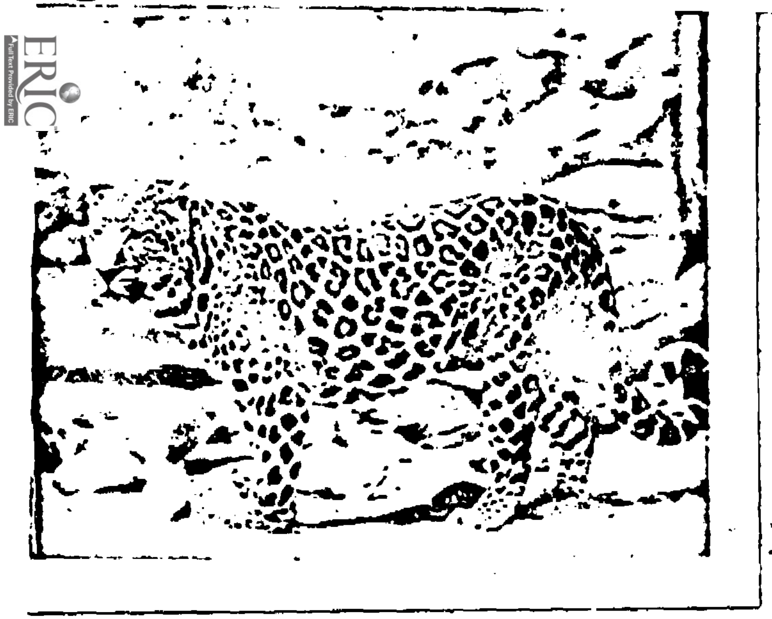

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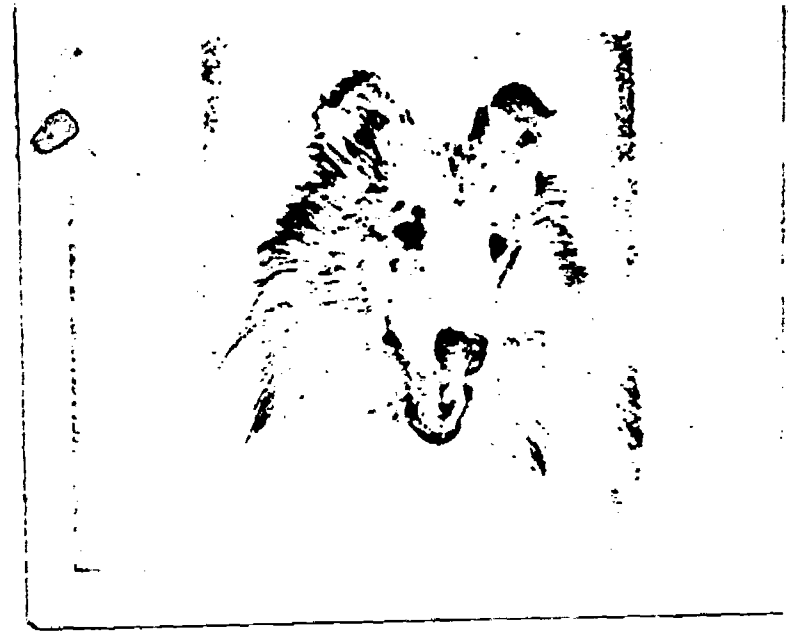
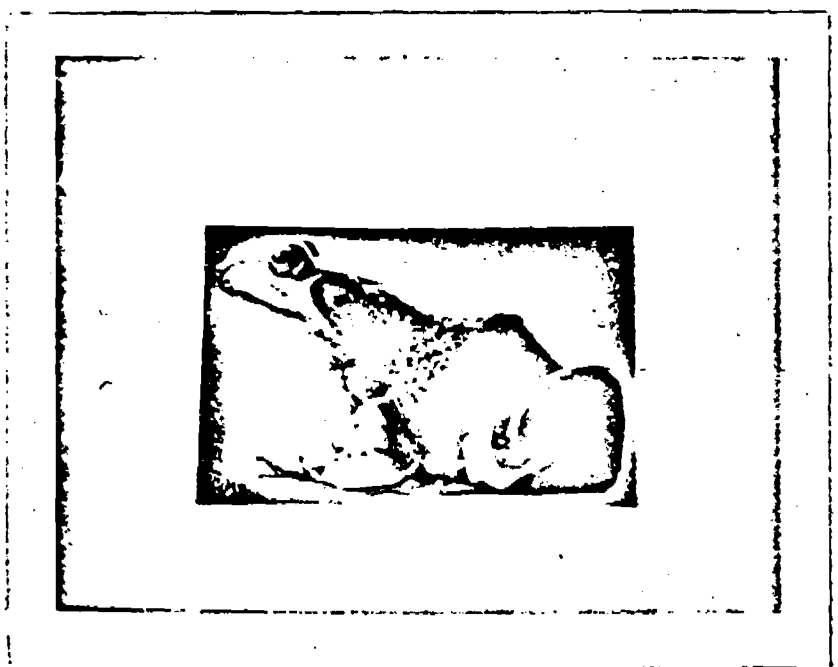


(animals)



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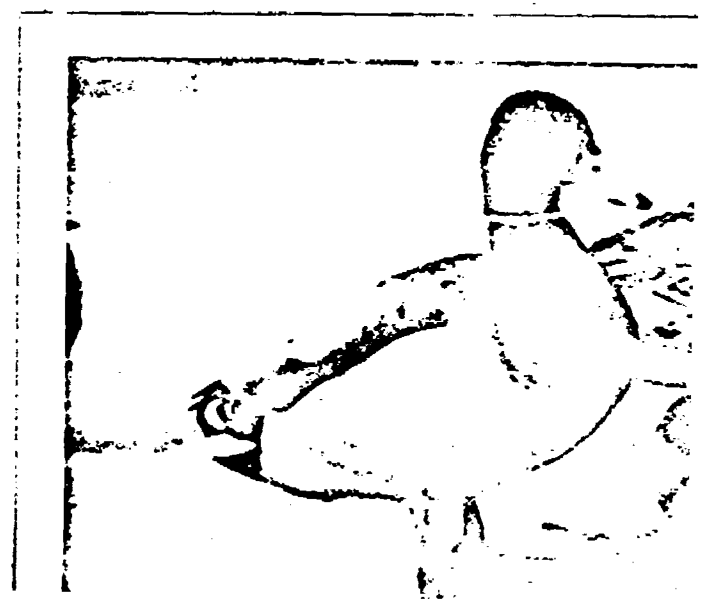

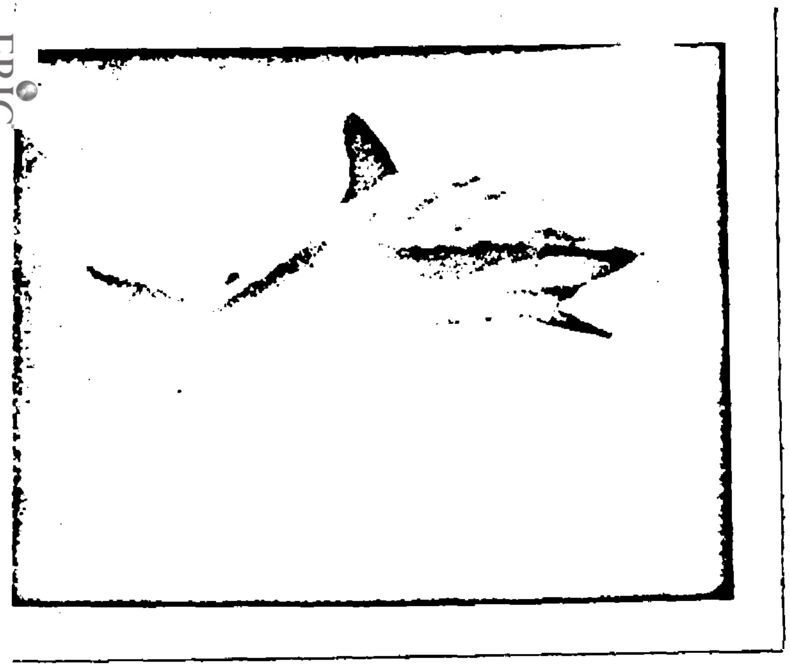

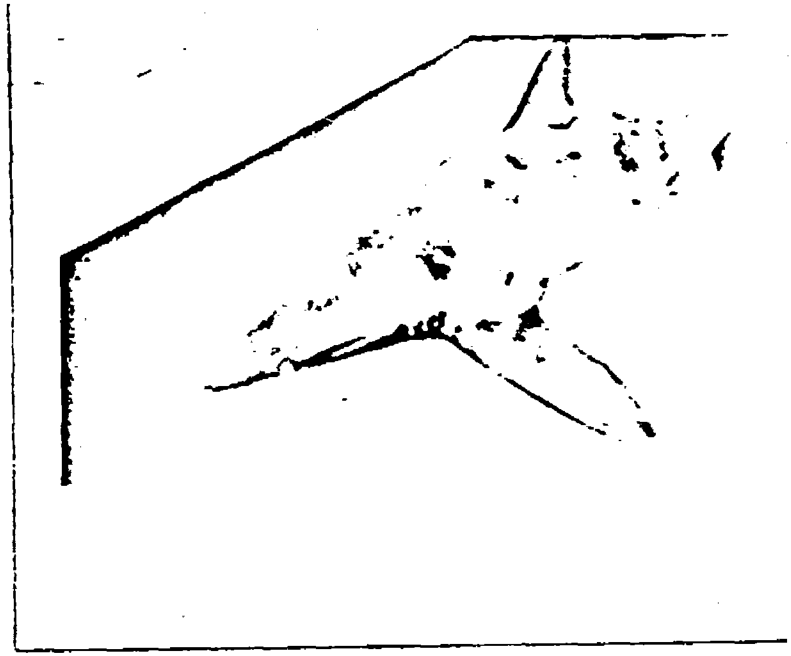

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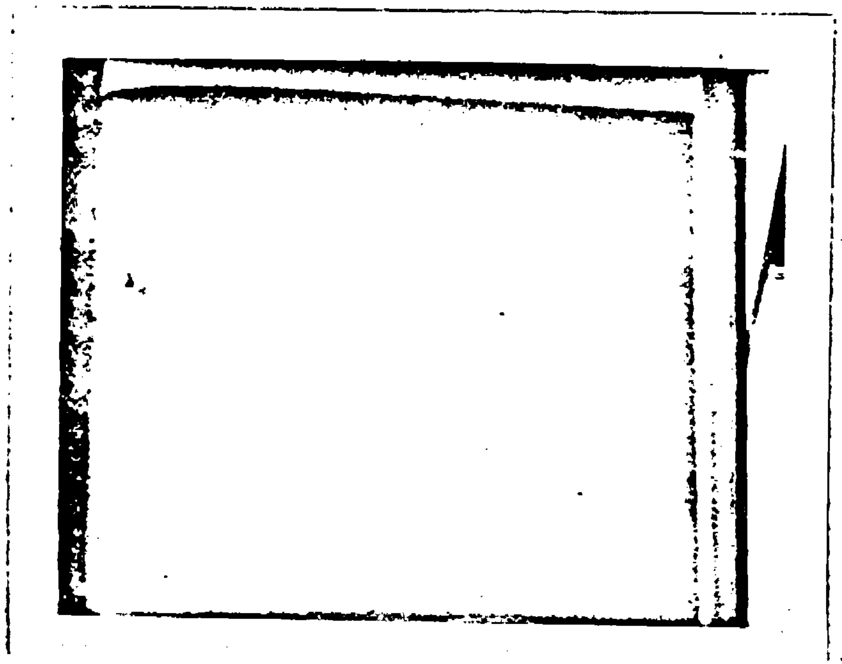

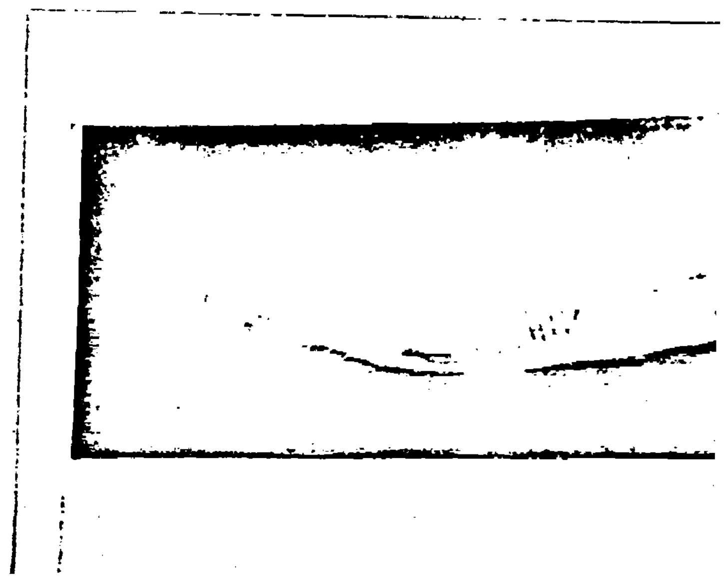

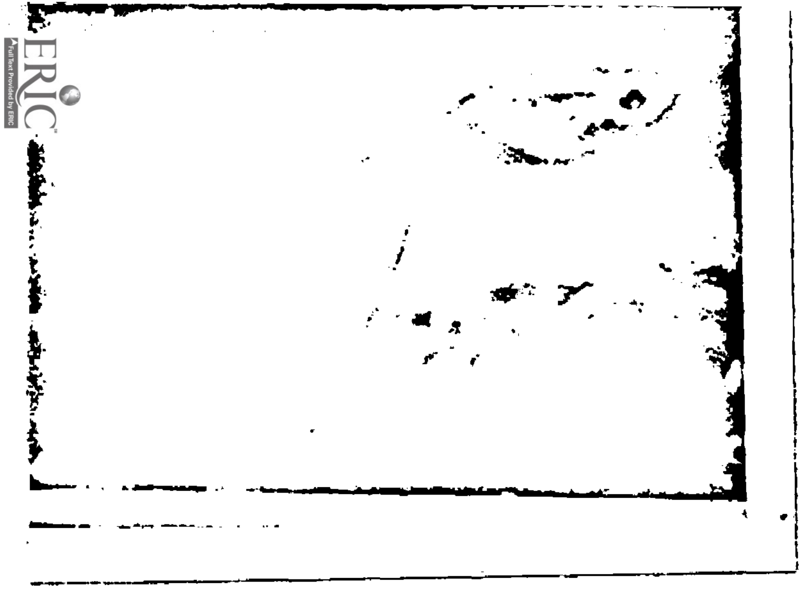

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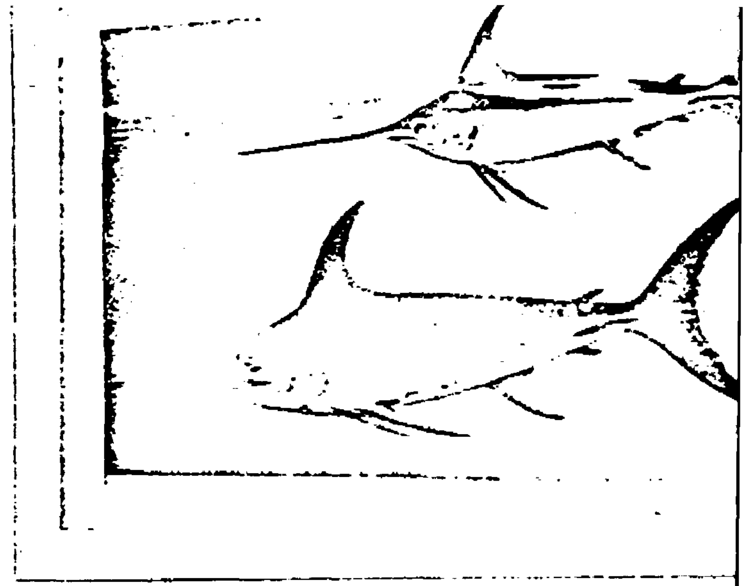

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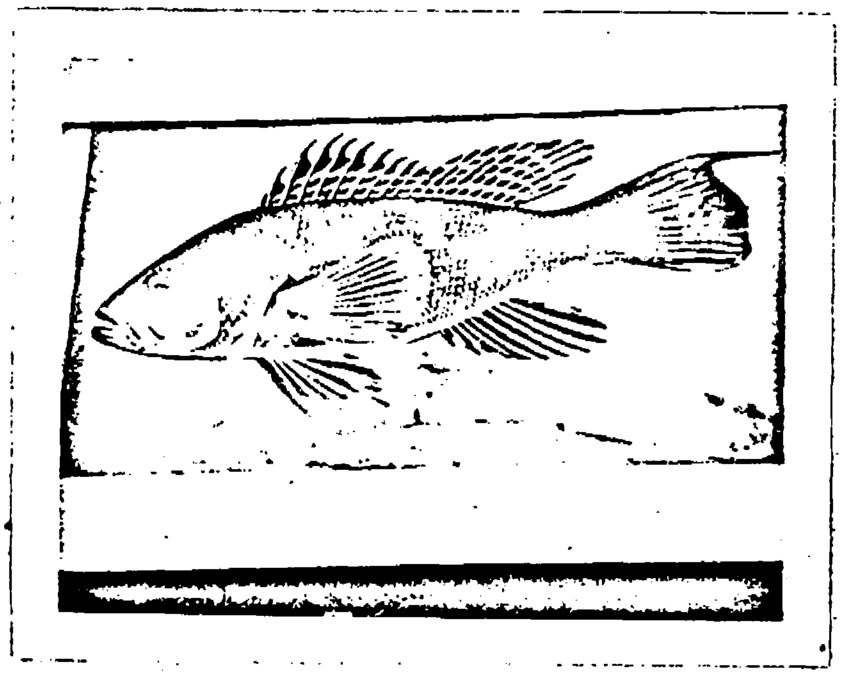

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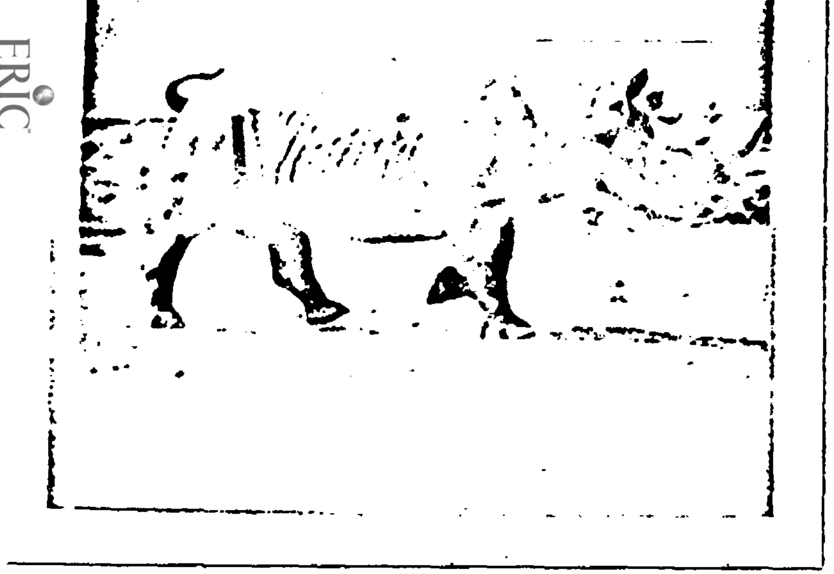

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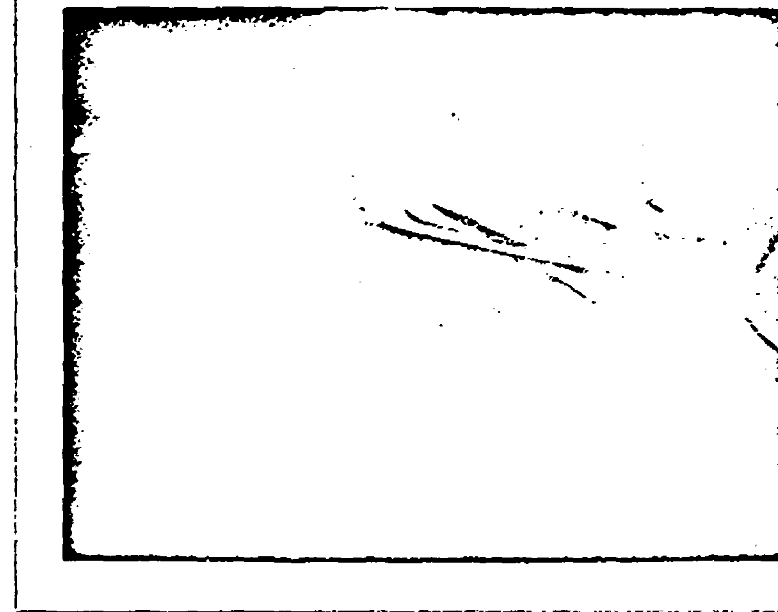

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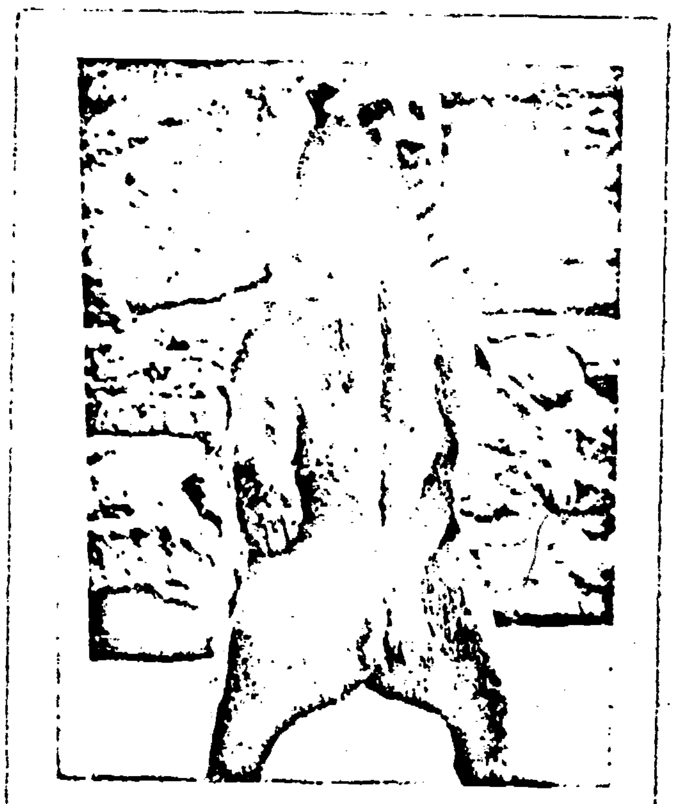

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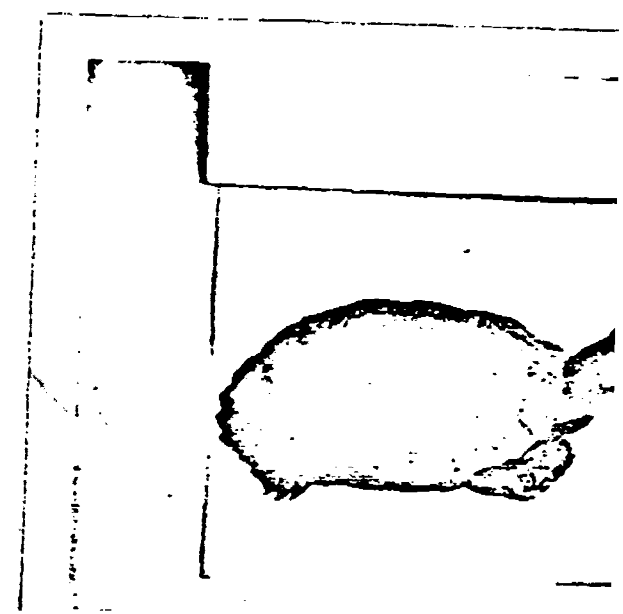

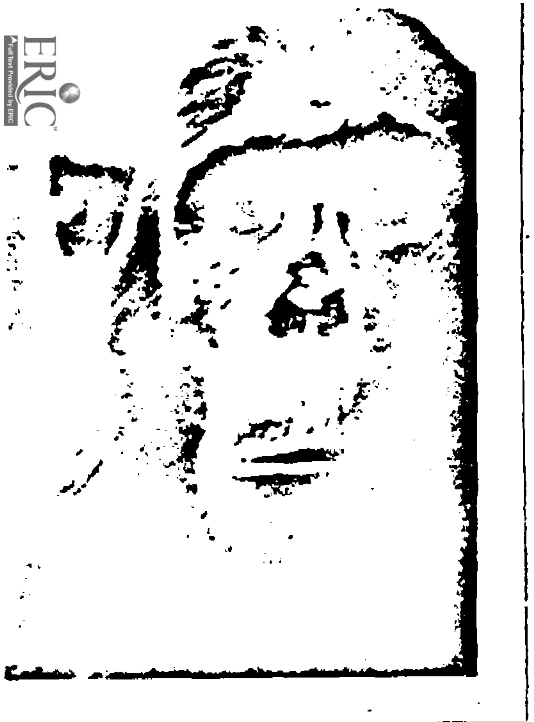

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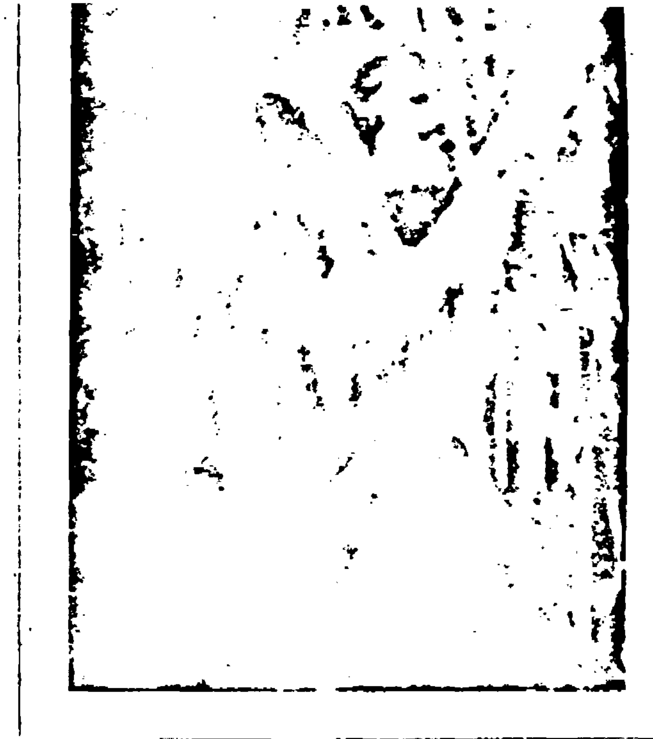
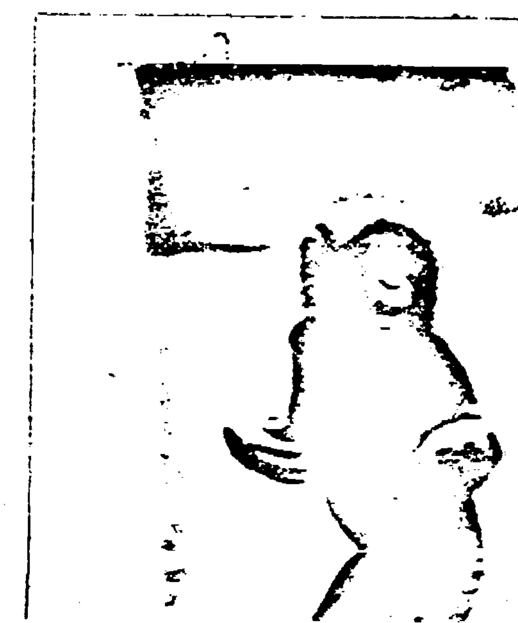
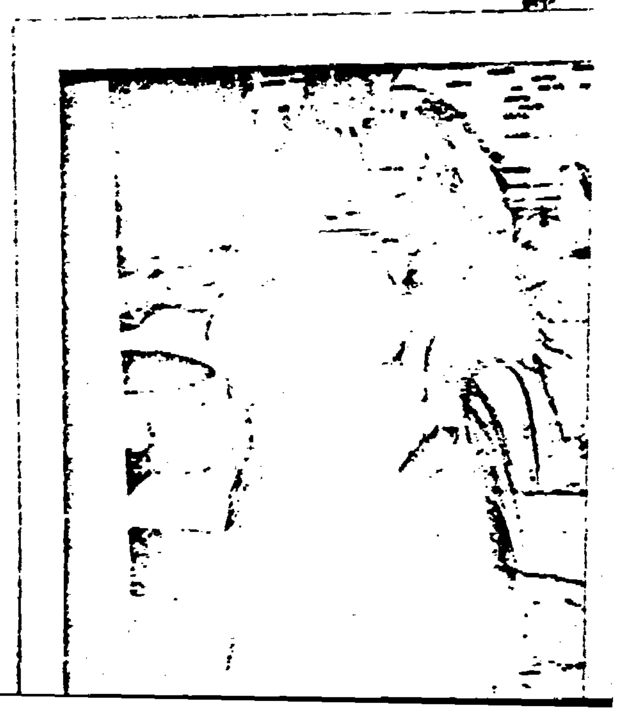


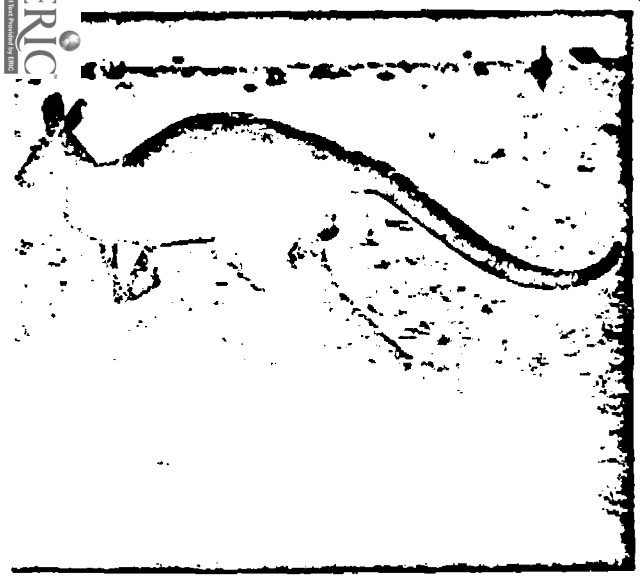
2

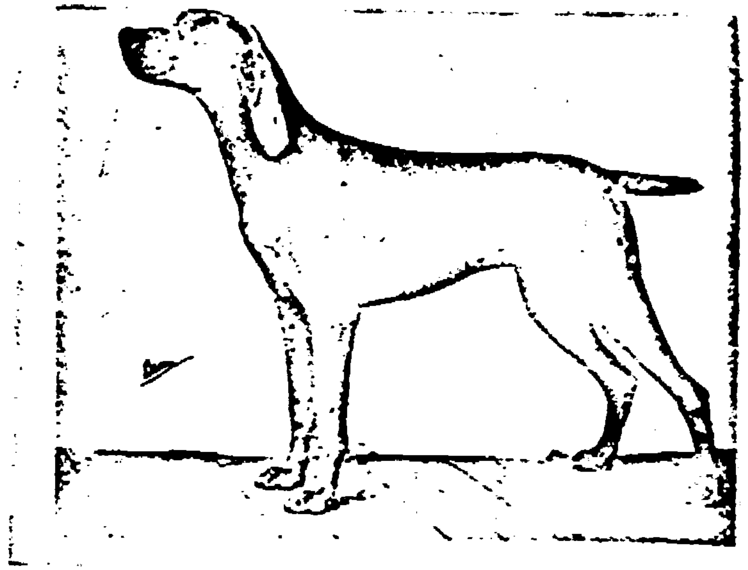
(chimpanzees)



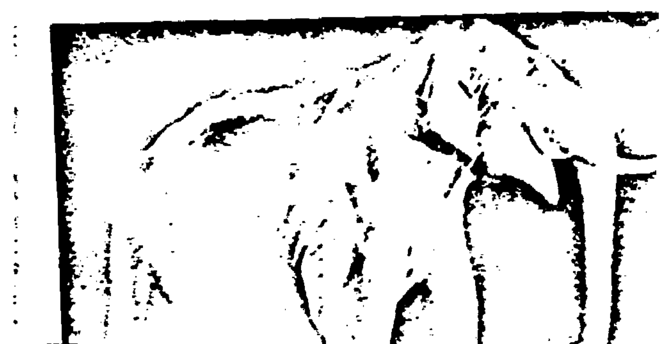
(primates)

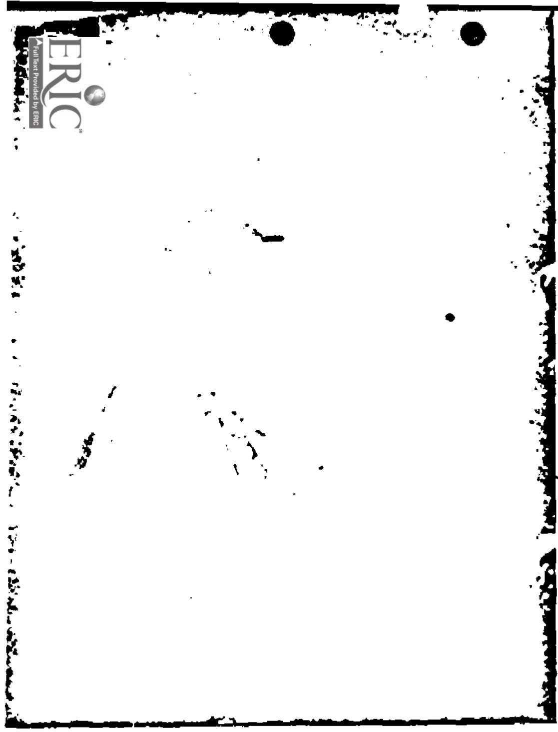


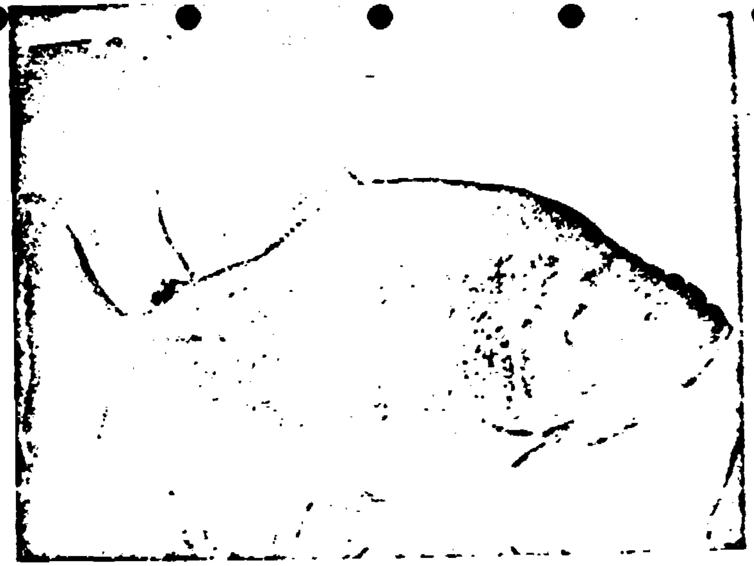




(mammals)







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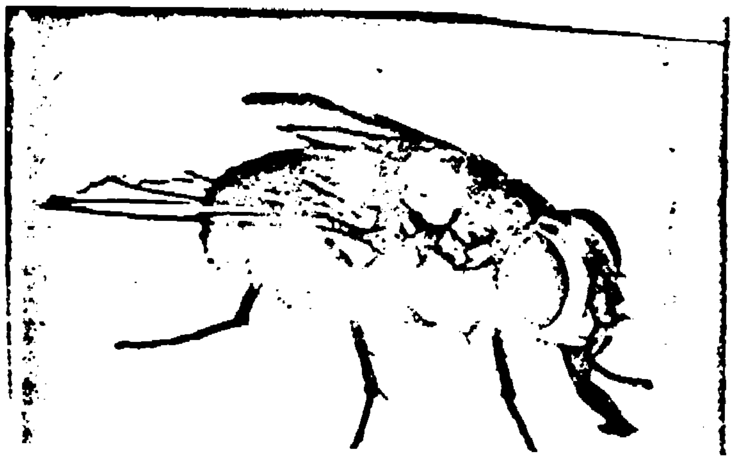
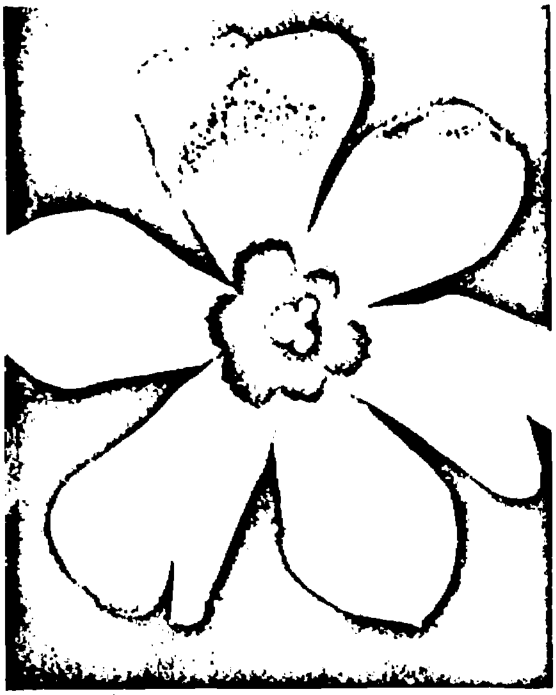
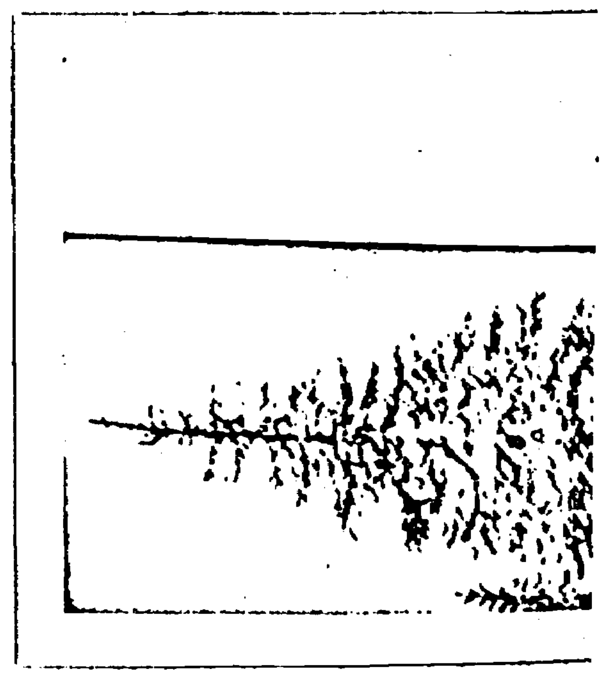
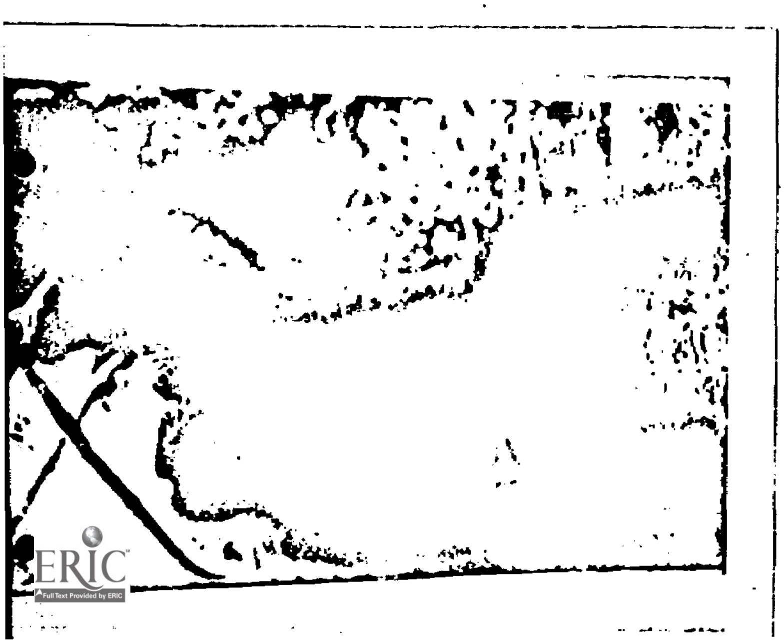
(animals)





(living things)





Except for the posters which correspond to the lowest level in each hierarchy, if a subject gave a name for a given picture of an object which was not specific enough to differentiate it from the other objects (e.g., 'dog' for each of the four dogs) then he was encouraged to give a more specific name for each of the objects if he could. Children in particular were praised for giving a name but were asked if they could think of "another name", a "different name", a "special name", etc. Also, if the subject gave a class name which was more general than our reference word (e.g., 'food' rather than 'fruit' for pear, apple, banana, and pineapple) he was again asked for a more differentiated name for all the objects. Finally, the eighth hierarchy was presented as a unit beginning with the poster for 'living things' and working down toward 'chimpanzees'. Children were given lollipops and little toys as rewards at the end of an experimental session which usually took about an hour. Adult subjects usually spent about half an hour at the task and were paid for their services.

Results

Not surprisingly adults were better able than children at producing more correct differentiated names for individual pictures and more correct class names for all four pictures on a given poster. Figs. 3 and 4 show these developmental trends graphically.

Insert Figs. 3 and 4 here

Fig. 3 shows the percentage of correct differentiated responses as a function of age. In this analysis we excluded the pictures on the posters for the lowest level in each hierarchy since for these pictures we did not expect nor did we press for differentiated names. For every other poster for each picture

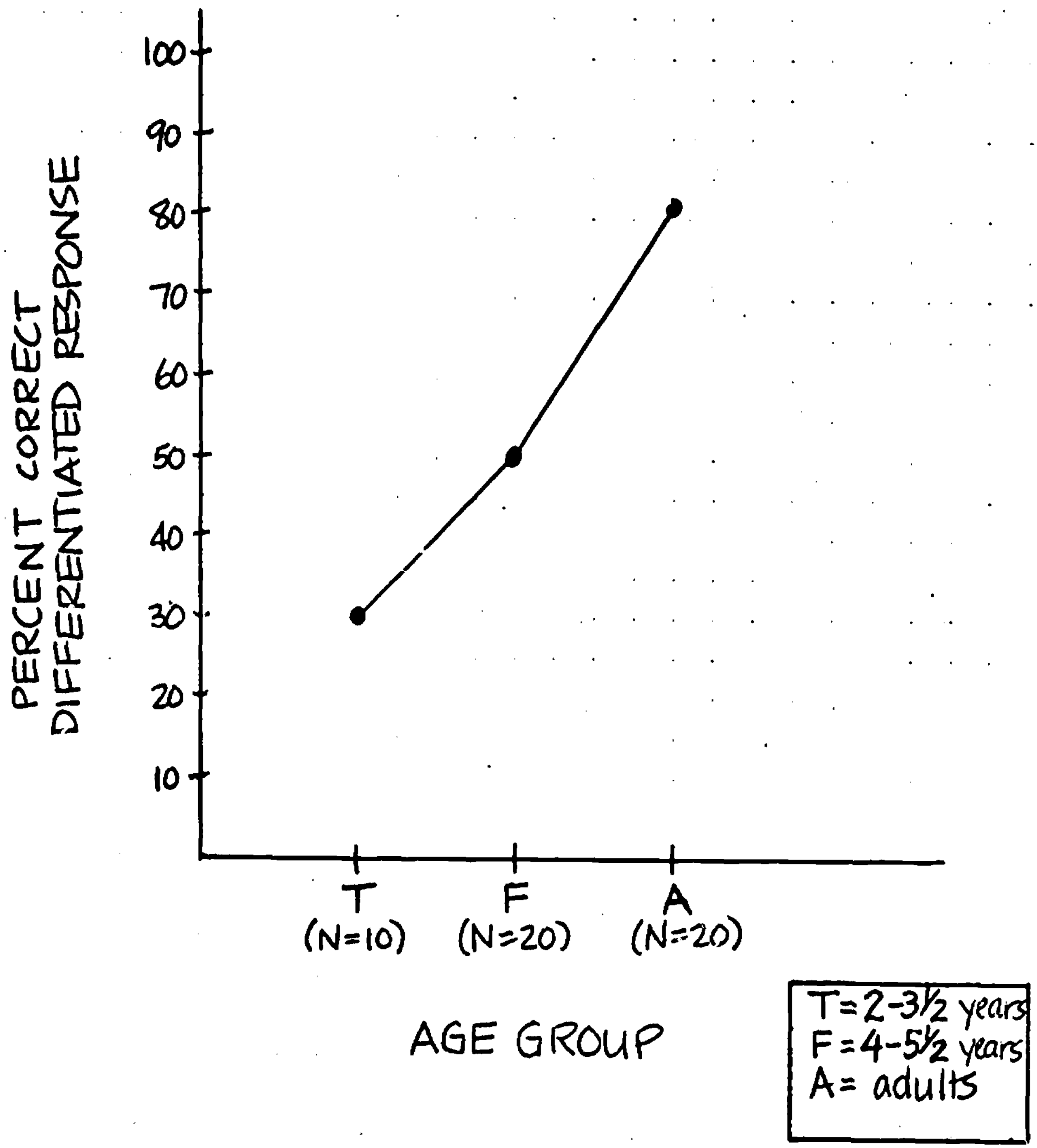


Fig. 3

Percent correct differentiated responses as a function of age.

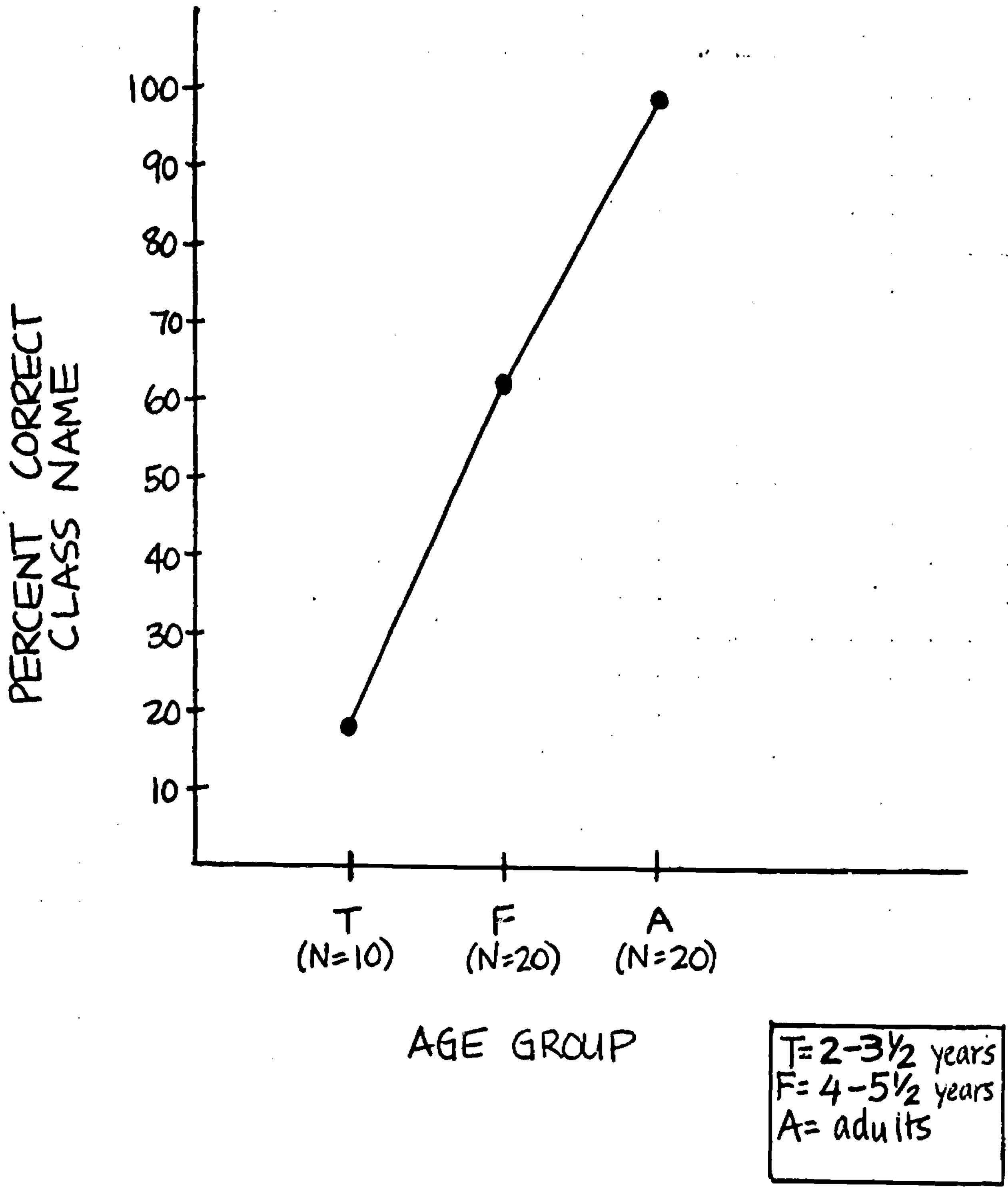


Fig. 4

Percent correct class name as a function of age.

we calculated the percentage of subjects within each age group who gave a correct response which was specific enough to differentiate it from the names for the other pictures on that poster. So, for example, for the poster with four flowers on it if the subject could only say that each picture was of a 'flower' these were not counted as correct differentiated responses since he failed to distinguish them. However, if the subject correctly named them 'daisy', 'rose', 'carnation', and 'tulip', these were counted as correct differentiated responses. If a subject named them 'daisy', 'rose', 'flower', and 'flower', he was scored as having given a correct differentiated response for 'daisy' and 'rose' but not for 'carnation' and 'tulip'. Fig. 3 shows that when the analysis is done in this way our youngest group of subjects are capable of producing only about 30% correct differentiated responses, the older children are capable of producing about 50% correct differentiated responses, and adults are capable of producing more than 80% correct differentiated responses.

Fig. 4 shows the percentage of correct class names as a function of age. In this analysis we calculated for each age group the percentage of posters for which that age group was capable of giving some class name (at any level of generality) which was superordinate to all of the objects depicted on a given poster. So, for example, for the four pictures of dogs names such as 'dogs', 'mammals', 'animals', etc. were counted as correct whereas 'collies' or 'flowers', etc. were counted as incorrect. As Fig. 4 shows, our youngest group of children is capable of giving correct class names for less than 20% of the posters whereas the older children are capable of giving more than 60% correct class names and adults give close to 100% correct class names. The trends depicted in Figs. 3 and 4 are not surprising nor especially informative. The question of real interest is for which pictures and for which classes the responses of children and adults diverged the most. Table 1 shows for each picture the percentage of children and of adults giving differentiated names and for each poster the percentage of children and adults giving correct class names.

Insert Table 1 here

For this analysis and most of the others that follow we have combined the younger and older children into one group which we call "children" and compare their performance with the adults.

First compare the percentage of children who are capable of giving correct differentiated responses with the corresponding percentages for adults. Table 1 shows that adults give more correct differentiated responses for almost all pictures than children. Excluding the "person hierarchy" which was used mainly as a demonstration, there are in fact only two exceptions (out of 64) to this general rule and they both appear to be instances of the same phenomenon. The adults in the case of pictures of a dog (pointer, 24_2) and a fish (pirahna, 25_2) attempted often to give more specific names (e.g., 'retriever', 'flounder') and were in fact wrong, whereas children were satisfied with the more general terms and therefore did better according to our criterion. Apart from these two discrepant cases adults do better than children at giving differentiated responses although children do better on some pictures than on others. For example, they are pretty good with food terms -- they do fairly well at distinguishing a pineapple from a banana from an apple from a lemon (although they are not too good on lemon) and at distinguishing an apple from lettuce from bread from a walnut (although they are not too good on walnut). They were not very good at distinguishing specific makes of cars (e.g., a Model T Ford from a Cadillac from a Volkswagon

Table 1

Percentage of children and adults giving differentiated names for individual pictures and class names for sets of pictures in first order of acquisition experiment.

Table 1

INDIVIDUAL PICTURES + CATEGORY	% DIFFERENTIATED (CORRECT) RESPONSE		% CLASS NAME (CORRECT) RESPONSE	
	CHILDREN	ADULTS	CHILDREN	ADULTS
apple				
4_2 apple				
4_3 apple				
4_4 apple				
apples (fr[illegible]t, food)			66.67	100.00
lemon	30.00	100.00		
pineapple	50.00	95.00		
apple	80.00	100.00		
$_4$ banana	93.33	100.00		
$_5$ fruit (food)			46.67	100.00
6_1 apple	96.67	100.00		
6_2 lettuce	40.00	100.00		
6_3 walnut	20.00	95.00		
6_4 bread	90.00	100.00		
6_5 food			36.67	100.00
7_1 rose				
7_2 rose				
7_3 rose				
7_4 rose				
7_5 roses (flowers, plants)			63.33	100.00
$_1$ daisy	20.00	65.00		
$_2$ rose	30.00	95.00		
$_3$ carnation	0.00	95.00		
$_4$ tulip	3.33	30.00		
$_5$ flowers (plants)			46.67	100.00
$_1$ tree (elm)	83.33	90.00		
$_2$ rose	13.33	85.00		
$_3$ rubber plant	0.00	55.00		
$_4$ cactus	13.33	90.00		
$_5$ [illegible]nts			30.00	100.00

INDIVIDUAL PICTURES + CATEGORY	% DIFFERENTIATED (CORRECT) RESPONSE		% CLASS NAME (CORRECT) RESPONSE	
	CHILDREN	ADULTS	CHILDREN	ADULTS
Volkswagon				
Volkswagon				
Volkswagon				
Volkswagon				
Volkswagons (... 5, means of transportation)			73.33	100.00
Model T Ford	0.00	45.00		
Cadillac	10.00	60.00		
Volkswagon	40.00	95.00		
Jaguar XKE	0.00	75.00		
cars (means of transportation)			63.33	100.00
Bicycle	100.00	100.00		
Volkswagon	40.00	70.00		
airplane	93.33	100.00		
train	100.00	100.00		
means of transportation			13.33	100.00
dime				
dime				
dime				
dime				
dimes (coins, money)			43.33	100.00
quarter	26.67	100.00		
dime	36.67	100.00		
nickel	23.33	100.00		
penny	46.67	100.00		
coins (money)			40.00	100.00
Quarter	16.67	100.00		
$5 bill	10.00	100.00		
dime	26.67	100.00		
$1 bill	66.67	100.00		
money			40.00	100.00

INDIVIDUAL PICTURES + CATEGORY	% DIFFERENTIATED (CORRECT) RESPONSE		% CLASS NAME (CORRECT) RESPONSE	
	CHILDREN	ADULTS	CHILDREN	ADULTS
16_1 collie				
16_2 collie				
16_3 Collie				
16_4 collie				
16_5 collies (dogs, animals)			63.33	100.00
17_1 bulldog	10.00	100.00		
17_2 German shepherd	20.00	95.00		
17_3 collie	30.00	100.00		
17_4 poodle	26.67	100.00		
17_5 dogs (animals)			63.33	100.00
18_1 leopard	23.33	80.00		
18_2 collie (dog)	30.00	95.00		
18_3 frog (toad)	76.67	100.00		
18_4 duck (bird)	96.67	100.00		
18_5 animals			36.67	100.00
19_1 Shark				
19_2 shark				
19_3 shark				
19_4 shark				
19_5 sharks (fish, animals)			63.33	100.00
20_1 guppy	0.00	15.00		
20_2 swordfish	10.00	70.00		
20_3 bass	0.00	15.00		
20_4 shark	33.33	80.00		
20_5 fish (animals)			56.67	100.00
21_1 rhinoceros	30.00	100.00		
21_2 shark	26.67	90.00		
21_3 bear (brown)	80.00	90.00		
21_4 turtle	86.67	100.00		
21_5 [illegible]imals			43.33	100.00

Table 1 (cont'd)

INDIVIDUAL PICTURES + CATEGORY	% DIFFERENTIATED (CORRECT) RESPONSE		% CLASS NAME (CORRECT) RESPONSE	
	CHILDREN	ADULTS	CHILDREN	ADULTS
1_1 boy				
1_2 boy				
1_3 boy				
1_4 boy				
1_5 boys (children, people)			43.48 (10/23)	100.00 (13/13)
2_1 girl	82.61 (19/23)	92.31 (12/13)		
2_2 boy	82.61 (19/23)	92.31 (12/13)		
2_3 girl	52.17 (12/23)	92.31 (12/13)		
2_4 boy	73.91 (17/23)	69.23 (9/13)		
2_5 children (people)			21.74 (5/23)	100.00 (13/13)
3_1 girl	69.57 (16/23)	76.15 (10/13)		
3_2 woman	30.43 (7/23)	69.23 (9/13)		
3_3 man	73.91 (17/23)	100.00 (13/13)		
3_4 boy	69.57 (16/23)	76.15 (10/13)		
3_5 people			4.35 (1/23)	100.00 (13/13)

from a Jaguar). Nor were they good at distinguishing specific kinds of dogs (e.g., a bulldog from a German Shepherd from a collie from a poodle). In most cases they were better (as were adults) at distinguishing among objects in a higher level category than objects in a lower level category. For example, they were better at distinguishing a bicycle from a VW from an airplane from a train than at distinguishing a Model T from a Cadillac from a VW from a Jaguar. Or, to take another example, they were better at distinguishing among animals -- a duck from a frog from a collie from a leopard -- than they were at distinguishing among various breeds of dogs -- a bulldog from a German Shepherd from a collie from a poodle.

Now consider the ability of children and adults to give some class name which is appropriate for each poster. The relevant percentages are shown in the two right-hand columns of Table 1. It is important to point out here that we are concerned with the ability of children to give <u>any</u> class name which is appropriate for each of the pictures on a given poster. For example, for the four pictures of collies the responses 'collies', 'dogs', 'animals', etc. are all considered to be correct class names in this analysis. In later analyses we shall be concerned with the ability of children to give just the term 'collies' which is the response most often given by adults as a class name but in this table we are using the much less stringent criterion of any appropriate response.

Table 1 shows that 100% of the adults give some correct class name to all of the posters except for one. The one exception is the poster with pictures of a monkey, a chimpanzee, a man and an orangutan on it. Eighteen out of 20 adults gave a correct class name for these pictures but two of them gave us responses "a man and three monkeys" which we did not count as correct since it was not a single superordinate term. Apart from this one exception adults have no trouble at all in generating class names for the posters.

Children have much more difficulty in producing correct class names. Generally speaking, children are better at giving some appropriate class name for the posters which correspond to the lowest level in our reference hierarchies. For example, 67% of the children can give a class name for four apples, 47% for four fruits and 37% for four different kinds of foods. Or, to take another example, 63% give a correct class name for four roses, 47% give a correct class name for four different kinds of flowers and only 30% give a correct class name for four different kinds of plants. This, however, definitely does not mean that children give the response 'roses' for four roses more often than they give the response 'flowers' for four flowers, only that they give an appropriate class name for the four roses (which is usually 'flowers') more often than they do for the four flowers. I shall try to interpret this trend later after a more detailed consideration of the actual vocabulary used by children when asked to give a class name for each set of the posters. Suffice it to say now that there is only one exception to the general rule of a monotonically non-increasing ability to give some appropriate class name with increasing level in a given hierarchy. This exception occurs for poster number 23 which had pictures of a monkey, a chimpanzee, a man, and an orangutan on it. Most children gave as a class name "one man and three monkeys" which was not counted as correct. Children both in this study and in later studies consistently refused to classify human beings as animals and this, I believe, is the reason why they had such difficulty in generating a class name for that particular poster.

Our primary motivation for conducting this study was to learn about the actual names that children use both for individual objects and for classes of objects. To this end we have computed the adult modal word (AMW) and the child modal word (CMW) for each picture and for each set of four pictures. By adult modal word, I mean that single name that the 20 adults gave most often. By child modal word, I mean that single name that children gave most often. The procedure we have used to calculate the percentage of children and of adults giving the modal word is as follows. Consider for example the way in which we arrived at the percentage of children giving the CMW for an individual picture. First, a frequency distribution showing the frequency of every name given by the children for each picture was extracted from the raw data. Then that single name which occurred most frequently in this distribution was called the CMW. The number of children who gave the CMW included both the children who used the CMW exactly and the children who used the CMW embedded in a longer word or phrase. So, for example, if the CMW was 'dog' for a given picture, all those children who gave 'dog' or some word or phrase which included 'dog' (e.g., 'doggie', 'big dog', etc.) were scored as having given the CMW. The percentage of children giving the CMW was simply calculated by dividing this number by 30 (the total number of children in the study). The percentages of adults giving the CMW and of children and adults giving the AMW were computed similarly.

Table 2 shows the adult modal words and the child modal words for each individual picture used in this experiment, and the percentage of adults and children giving each. As Table 2 shows, sometimes the adult modal word is

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Insert Table 2 here

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the same as the child modal word. For example, the AMW and CMW for a picture of an apple are both 'apple'; for a picture of a banana they are both 'banana'; for a picture of a bicycle they are both 'bicycle'; for a picture of a frog they are both 'frog', etc. However, for many pictures the adult modal word is different from the child modal word and when it is, in every case but one, it is a more differentiated term, a more specific name. Some examples are 'rose' for adults

Table 2

Adult modal words and child modal words for each picture used in first order of acquisition experiment. The percentages of adults and of children giving each are included.

<u>NOTE</u>:

AMW= adult modal word
CMW= child modal word
%A = percent of adults
%C = percent of children

Two words with a slash between them (/) indicate that for that picture two different names were given equally by either group when AMW or CMW was computed.

TABLE 2

PICTURE	AMW	%A	%C	CMW	%A	%C
4_1	apple	75.00	93.33	apple	75.00	93.33
4_2	apple	65.00	83.33	apple	65.00	83.33
4_3	apple	80.00	83.33	apple	80.00	83.33
4_4	apple	65.00	93.33	apple	65.00	93.33
5_1	lemon	100.00	30.00	lemon	100.00	30.00
5_2	pineapple	95.00	50.00	pineapple	95.00	50.00
5_3	apple	100.00	70.00	apple	100.00	70.00
5_4	banana	100.00	93.33	banana	100.00	93.33
6_1	apple	100.00	96.67	apple	100.00	96.67
6_2	lettuce	100.00	40.00	lettuce	100.00	40.00
6_3	walnut	85.00	6.67	peanut	0.00	16.67
6_4	bread	100.00	90.00	bread	100.00	90.00
7_1	rose	95.00	30.00	flower	5.00	63.33
7_2	rose	95.00	20.00	flower	5.00	70.00
7_3	rose	95.00	30.00	flower	5.00	60.00
7_4	rose	95.00	26.67	flower	5.00	66.67
8_1	daisy	65.00	20.00	flower	35.00	56.67
8_2	rose	95.00	30.00	flower	0.00	53.33
8_3	carnation	95.00	0.00	flower	0.00	60.00
8_4	pansy	35.00	0.00	flower	25.00	70.00
9_1	tree	100.00	86.67	tree	0.00	86.67
9_2	rose	85.00	13.33	flower	15.00	80.00
9_3	rubber plant	55.00	0.00	plant	40.00	43.33
9_4	cactus	90.00	13.33	plant	20.00	36.67
10_1	VW	100.00	36.67	car	0.00	53.33
10_2	VW	100.00	36.67	car	0.00	53.33
10_3	VW	100.00	33.33	car	0.00	50.00
10_4	VW	100.00	40.00	car	0.00	50.00
11_1	old car	30.00	20.00	car	50.00	63.33
11_2	Cadillac	45.00	10.00	car	40.00	73.33
11_3	VW	95.00	40.00	VW	95.00	40.00
11_4	Jaguar/Sportscar	70.00 35.00/35.00	0.00 0.00/0.00	car	5.00	76.67
12_1	bicycle	100.00	100.00	bicycle	100.00	100.00
12_2	VW	70.00	36.67	car	25.00	50.00
12_3	airplane	95.00	93.33	airplane	95.00	93.33
12_4	train	90.00	96.67	train	90.00	96.67

Table 2 (cont'd)

PICTURE	AMW	%A	%C	CMW	%A	%C
13_1	dime	90.00	36.67	dime	90.00	36.67
13_2	dime	85.00	30.00	dime	85.00	30.00
13_3	dime	85.00	26.67	dime	85.00	26.67
13_4	dime	85.00	26.67	dime	85.00	26.67
14_1	quarter	100.00	26.67	quarter	100.00	26.67
14_2	dime	100.00	36.67	dime	100.00	36.67
14_3	nickel	100.00	23.33	nickel	100.00	23.33
14_4	penny	100.00	46.67	penny	100.00	46.67
15_1	quarter	100.00	16.67	dime	0.00	30.00
15_2	$5-bill	70.00	3.33	dollar	0.00	70.00
15_3	dime	95.00	26.67	dime	95.00	26.67
15_4	dollar	100.00	63.33	dollar bill	45.00	56.67
16_1	collie	95.00	3.33	dog	10.00	73.33
16_2	collie	95.00	3.33	dog	10.00	66.67
16_3	collie	95.00	3.33	dog/Lassie	10.00/0.00	63.33/30.00
16_4	collie	95.00	3.33	dog/Lassie	10.00/0.00	63.33/30.00
17_1	bulldog	100.00	10.00	dog	0.00	76.67
17_2	German Shepherd	90.00	20.00	dog	10.00	56.67
17_3	collie	100.00	3.33	dog	0.00	63.33
17_4	poodle	100.00	26.67	dog/poodle	0.00/100.00	56.67/26.67
18_1	leopard	80.00	23.33	tiger	10.00	40.00
18_2	collie	90.00	3.33	dog	10.00	63.33
18_3	frog	100.00	70.00	frog	100.00	70.00
18_4	duck	100.00	70.00	duck	100.00	70.00
19_1	shark	95.00	23.33	fish	5.00	60.00
19_2	shark	90.00	20.00	fish	10.00	46.67
19_3	shark	90.00	23.33	fish	10.00	43.33
19_4	shark	90.00	30.00	fish	10.00	50.00
20_1	fish	55.00	73.33	fish	55.00	73.33
20_2	swordfish	70.00	10.00	fish	15.00	60.00
20_3	fish	65.00	83.33	fish	65.00	83.33
20_4	shark	80.00	33.33	fish/shark	15.00/80.00	50.00/33.33
21_1	rhinosceros	100.00	30.00	rhinoceros	100.00	30.00
21_2	shark	90.00	26.67	fish	10.00	50.00
21_3	bear	100.00	80.00	bear	100.00	80.00
21_4	turtle	100.00	86.67	turtle	100.00	86.67

PICTURE	AMW	% A	% C	CMW	% A	% C
22_1	monkey	70.00	76.67	monkey	70.00	76.67
22_2	monkey	70.00	90.00	monkey	70.00	90.00
22_3	monkey	55.00	83.33	monkey	55.00	83.33
22_4	monkey	70.00	93.33	monkey	70.00	93.33
23_1	monkey	90.00	83.33	monkey	90.00	83.33
23_2	monkey	60.00	93.33	monkey	60.00	93.33
23_3	man	90.00	83.33	man	90.00	83.33
23_4	ape	35.00	0.00	monkey	30.00	43.33
24_1	kangaroo	100.00	80.00	kangaroo	100.00	80.00
24_2	dog	75.00	93.33	dog	75.00	93.33
24_3	monkey	65.00	83.33	monkey	65.00	83.33
24_4	elephant	100.00	83.33	elephant	100.00	83.33
25_1	bird	80.00	93.33	bird	80.00	93.33
25_2	fish	70.00	90.00	fish	70.00	90.00
25_3	fly (housefly)	85.00	30.00	fly	85.00	30.00
25_4	monkey	70.00	86.67	monkey	70.00	86.67
26_1	gorilla	50.00	26.67	monkey	10.00	70.00
26_2	flower	90.00	90.00	flower	90.00	90.00
26_3	tree	70.00	86.67	tree	70.00	86.67
26_4	seagull	75.00	10.00	bird	5.00	63.33
1_1	boy	84.62	78.26	boy	84.62	78.26
1_2	boy	84.62	78.26	boy	84.62	78.26
1_3	boy	92.30	78.26	boy	92.30	78.26
1_4	boy	84.62	78.26	boy	84.62	78.26
2_1	girl	92.30	82.61	girl	92.30	82.61
2_2	boy	92.30	82.61	boy	92.30	82.61
2_3	girl	92.30	52.18	girl	92.30	52.18
2_4	boy	61.52	76.61	boy	61.52	76.61
3_1	girl	76.92	69.57	girl	76.92	69.57
3_2	old woman	46.15	4.35	nana grandmother	7.70	30.44
3_3	man	92.31	72.61	man	92.31	72.61
3_4	boy	76.92	69.51	boy	76.92	69.51

but 'flower' for children; 'cactus' for adults but 'plant' for children; 'Cadillac' for adults but 'car' for children; 'German Shepherd' for adults but 'dog' for children; 'shark' for adults but 'fish' for children; 'seagull' for adults but 'bird' for children, etc. The one instance where the child modal word was more specific than that of the adults was for the picture of an elderly lady, where the adult modal word was 'old woman' and the child modal word was 'grandmother'. Whether this particular woman was a grandmother or not I do not know, but the specificity of the children's modal word was not in fact justified.

In what cases is the child likely to give the adult modal word for a given picture? We suspected that frequency of occurrence might be a good predictor of the order of acquisition of terms of reference for reasons that will become clearer later. To test this idea we calculated rank order correlation coefficients between the percentage of children giving the AMW and the frequency of occurrence of the AMW according to six different measures of frequency of occurrence. The results will be more fully presented later but let me just say at this time that we obtained highly significant correlations ($p < .001$ for five of them; $p < .005$ for the sixth) for all measures. The highest correlations were for Rinsland (1945) which gives the frequency of occurrence of English words in child speech (Grade 1) and writing (Grade 2), ($r = .74$ for Grade 1; $r = .75$ for Grade 2) and for the General Count in Thorndike and Lorge (1944), ($r = .86$).

So far I have been comparing adult modal words and child modal words for individual pictures. We also calculated adult modal words and child modal words for each set of four pictures. These are shown along with the modal words for the individual pictures in the tree diagrams of Fig. 5, which presents the adult modal words in the left column and the corresponding child modal words in the right column. The modal words for sets of pictures are shown in boxes

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Insert Fig. 5 here

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at the nodes of the trees. We were gratified to discover that adults do by and large give as modal words for categories (i.e., for sets of four pictures) our reference words. That is, for the four pictures of apples the AMW is 'apples'; for the four pictures of fruits the AMW is 'fruit(s)'; for the four pictures of foods the AMW is 'food(s)', etc. There were only four cases out of 26 possible where the actual AMW for a class name was different from our reference words. These were (1) 'transportation' for 'vehicles', (2) 'monkeys' for 'chimpanzees', (3) 'animals' for 'mammals' and (4) for our reference word 'coins', 'coins' and 'money' were given equally often by adults. In all other cases adults gave our reference words as adult modal words. What this means is that adults clearly gave class names at different levels of generality for each hierarchy, the level of generality being determined by the set of pictures being classified.

Examination of the child modal words for categories reveals that children do not produce as many <u>different</u> correct class names for a given domain. Consider the plant hierarchy (III), for it reveals a pattern that is most typical. The CMW for four different kinds of flowers is 'flowers' which is also the AMW for four different kinds of flowers. However, for four roses the CMW is 'flowers' whereas for adults the AMW is 'roses'. Children generally cannot give the more differentiated class name even though they can recognize the pictures of roses as being 'flowers'. Moreover, the childs most frequent response when shown the poster with pictures of a tree, a rose, a rubber plant and a cactus (in response to the question "What are they all?") is "I don't know.", whereas for adults the AMW is 'plants'. This suggests that

Fig. 5

Trees showing adult modal words and child modal words for each individual picture and for each set of pictures used in experiment 1.

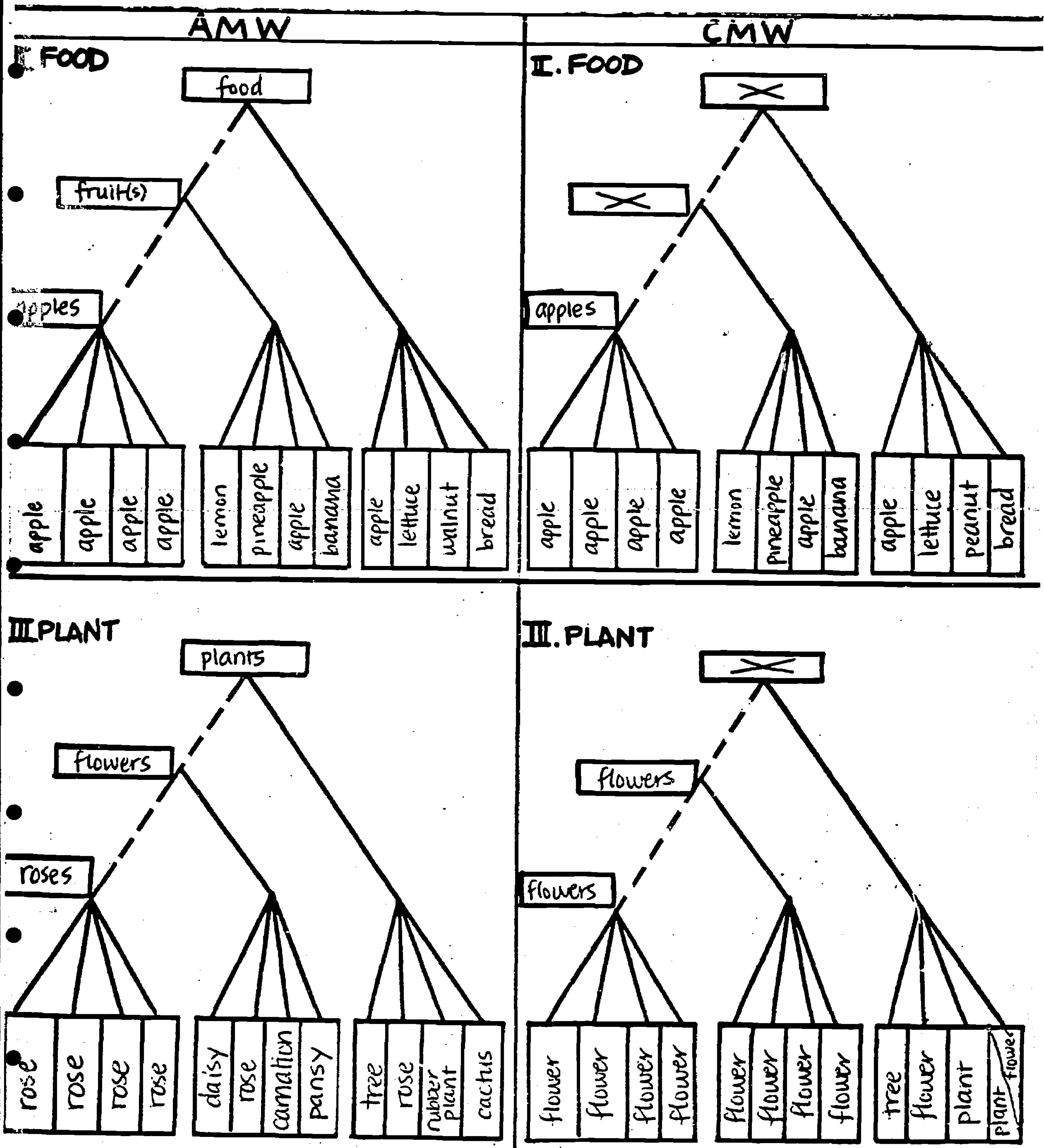
NOTE:

AMW= adult modal word
CMW= child modal word

 indicates that no response ("don't know") was the modal response

 indicates that there were two names given equally

Fig. 5



AMW
CMW
I. FOOD
food
fruit(s)
apples
apple
apple
apple
apple
lemon
pineapple
apple
banana
apple
lettuce
walnut
bread
II. FOOD
apples
apple
apple
apple
apple
lemon
pineapple
apple
banana
apple
lettuce
peanut
bread
III PLANT
plants
flowers
roses
rose
rose
rose
rose
daisy
rose
carnation
pansy
tree
rose
rubber plant
cactus
III. PLANT
flowers
flowers
flower
flower
flower
flower
flower
flower
flower
flower
tree
flower
plant
plant
flower

Fig. 5 (cont'd)

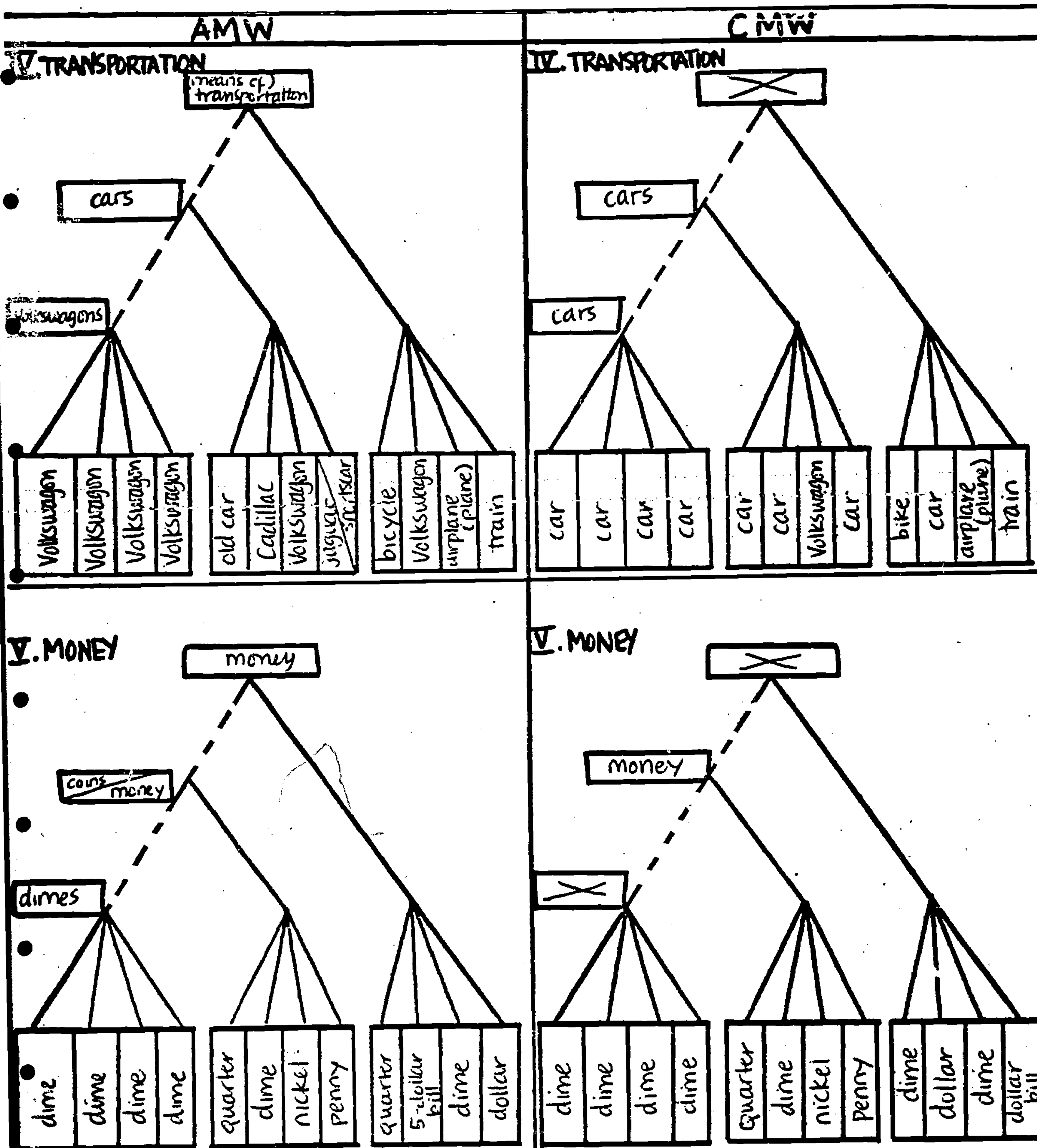

AMW
CMW
IV. TRANSPORTATION
means of transportation
cars
Volkswagens
Volkswagen
Volkswagen
Volkswagen
Volkswagen
old car
Cadillac
Volkswagen
bicycle
Volkswagen
airplane (plane)
train
IV. TRANSPORTATION
cars
cars
car
car
car
car
car
car
Volkswagen
car
bike
car
airplane (plane)
train
V. MONEY
money
coins
money
dimes
dime
dime
dime
dime
quarter
dime
nickel
penny
quarter
5-dollar bill
dime
dollar
V. MONEY
money
dime
dime
dime
dime
Quarter
dime
nickel
Penny
dime
dollar
dime
dollar bill

Fig. 5 (cont'd)

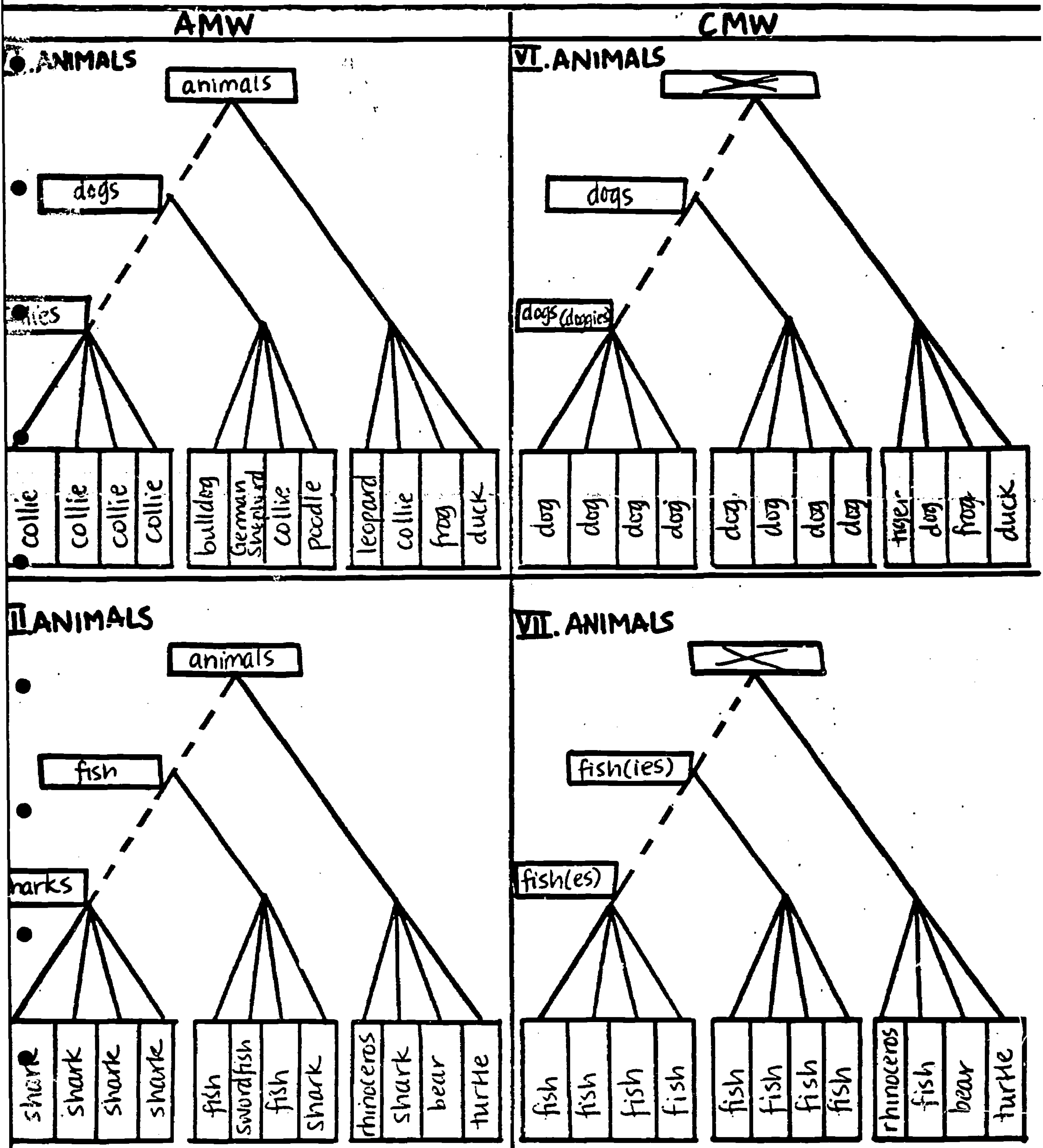
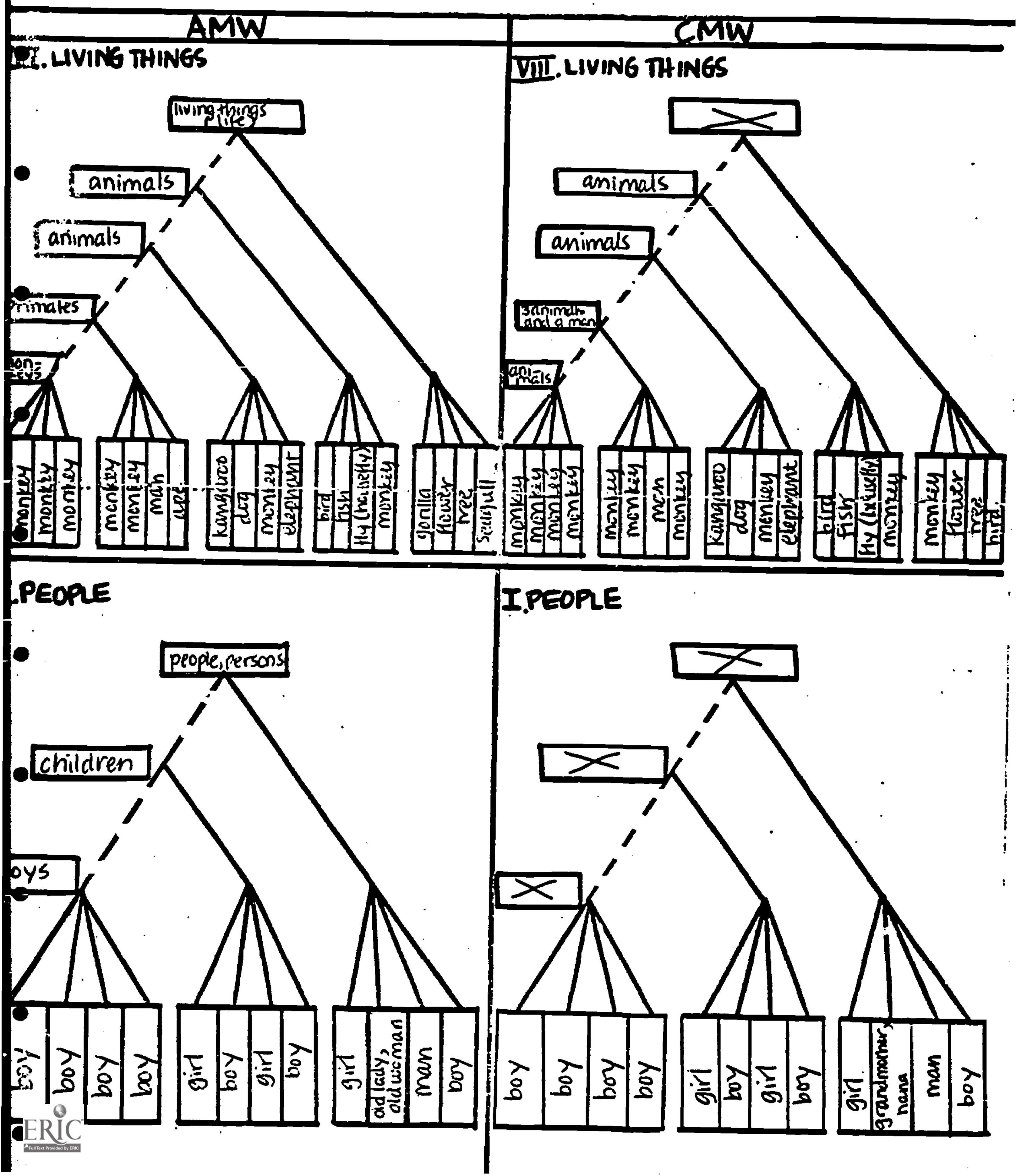

AMW
CMW
ANIMALS
animals
dogs
lies
collie
collie
collie
collie
bulldog
German Shepherd
collie
poodle
leopard
collie
frog
duck
VI. ANIMALS
dogs
dogs (doggies)
dog
dog
dog
dog
dog
dog
dog
dog
tiger
dog
frog
duck
II ANIMALS
animals
fish
harks
shark
shark
shark
shark
fish
swordfish
fish
shark
rhinoceros
shark
bear
turtle
VII. ANIMALS
fish(ies)
fish(es)
fish
fish
fish
fish
fish
fish
fish
fish
rhinoceros
fish
bear
turtle

Fig. 5 (cont'd)


AMW
CMW
LIVING THINGS
VIII. LIVING THINGS
living things life
animals
animals
Primates
animals
animals
3 animals and a man
ani-mals
monkey
monkey
monkey
kangaroo
dog
monkey
elephant
bird
fish
monkey
gorilla
flower
tree
seagull
man
PEOPLE
I. PEOPLE
people, persons
children
oys
boy
girl
old lady, old woman
man
grandmother, nana

of the three nested category labels 'roses', 'flowers', and 'plants', children first are able to produce the intermediate term 'flowers' in a context that requires this term, and only later can produce the more differentiated term 'roses' and the more general term 'plants'. The pattern is the same for the transportation hierarchy, and the two animal hierarchies. With respect to the transportation hierarchy the AMW's for four VW's, four cars, and four different means of transportation are 'Volkswagons', 'cars', and 'transportation' respectively, whereas the CMW's are 'cars', 'cars', and 'don't know'. With respect to the animal hierarchies the AMW's are 'collies', 'dogs', and 'animals', whereas for children the corresponding CMW's are 'dogs', 'dogs', and 'don't know', and where the AMW's are 'sharks', 'fish', and 'animals', the corresponding CMW's are 'fish', 'fish', and 'don't know'. Thus it appears that most children can produce the word 'dogs' in a context that requires it before 'collies' or 'animals' and 'fish' before 'sharks' or 'animals'. For these sets of nested category labels there is neither a specific to general progression nor a general to specific progression but rather children usually begin by learning an intermediate term and beyond that learn both more specialized terms and more general terms. This is not always the case in our hierarchies of course. For example, children appear to be able to produce the term 'apples' before 'fruit' or 'food' but, even though in this hierarchy children do seem to start at the most specific level with respect to the terms we were testing for, it is nonetheless safe to assume that had our lowest level been 'Delicious apples' or 'Mackintosh apples', children would not have been able to produce names at that level of specificity.

These trends are revealed perhaps more clearly in the left-hand column of Fig. 6 which shows the percent of children who give the adult modal word for

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Insert Fig. 6 here

Fig. 6

Percent of children who give the adult modal word (left) and any correct response (right) for each concept for each hierarchy studied in the first order of acquisition experiment. Frequency of occurrence of each word according to Rinsland (1945) is also shown in Fig. 6.

NOTE:

F(R)= frequency of occurrence according to Rinsland, Grade I
AMW= adult modal word
%AMW= percent of children who use the adult modal word
%Correct= percent of children who give any correct name for category
(—) indicates that there is no frequency count for that word in Rinsland, Grade I; read as "0".

Fig. 6

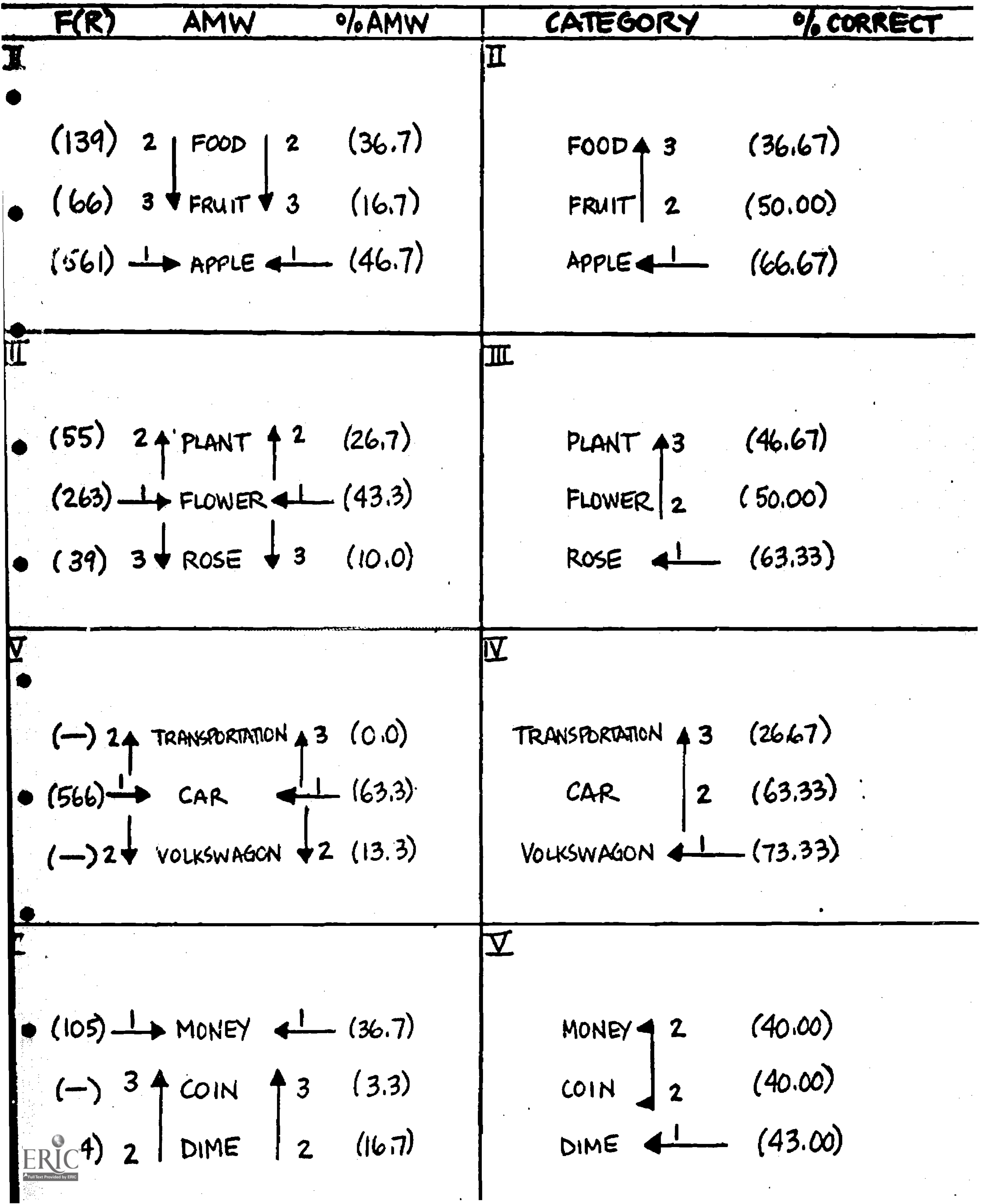
F(R)
AMW
% AMW
CATEGORY
% CORRECT
I
(139) 2 FOOD 2 (36.7)
(66) 3 FRUIT 3 (16.7)
(561) 1 APPLE 1 (46.7)
II
FOOD 3 (36.67)
FRUIT 2 (50.00)
APPLE 1 (66.67)
II
(55) 2 PLANT 2 (26.7)
(263) 1 FLOWER 1 (43.3)
(39) 3 ROSE 3 (10.0)
III
PLANT 3 (46.67)
FLOWER 2 (50.00)
ROSE 1 (63.33)
(—) 2 TRANSPORTATION 3 (0.0)
(566) 1 CAR 1 (63.3)
(—) 2 VOLKSWAGON 2 (13.3)
IV
TRANSPORTATION 3 (26.67)
CAR 2 (63.33)
VOLKSWAGON 1 (73.33)
(105) 1 MONEY 1 (36.7)
(—) 3 COIN 3 (3.3)
4) 2 DIME 2 (16.7)
V
MONEY 2 (40.00)
COIN 2 (40.00)
DIME 1 (43.00)

Fig. 6 (cont'd)

VI

F(R)		AMW		% AMW	CATEGORY		% CORRECT
(156)	2	ANIMAL	2	(36.7)	ANIMAL	2	(40.00)
(1309)	1	DOG	1	(60.0)	DOG	1	(63.33)
(—)	3	COLLIE	3	(3.3)	COLLIE	1	(63.33)

VII

F(R)		AMW		% AMW	CATEGORY		% CORRECT
(156)	1	ANIMAL	2	(43.3)	ANIMAL	3	(43.33)
(146)	2	FISH	1	(50.0)	FISH	2	(60.00)
(4)	3	SHARK	3	(13.3)	SHARK	1	(63.33)

VIII

F(R)		AMW		% AMW	CATEGORY		% CORRECT
(28)	3	LIVING THING	3	(0.0)	LIVING THING	4	(6.67)
(156)	1	ANIMAL	1	(50.0)	ANIMAL	3	(50.00)
(156)	1	ANIMAL	1	(66.7)	MAMMAL	2	(66.67)
(—)	4	PRIMATE	3	(0.0)	PRIMATE	4	(6.67)
(92)	2	MONKEY	2	(33.3)	CHIMPANZEE	1	(70.00)

I

F(R)		AMW		% AMW	CATEGORY		% CORRECT
(209)	3	PEOPLE	3	(4.35)	PEOPLE	3	(4.35)
(346)	2	CHILDREN	2	(13.04)	CHILDREN	2	(21.74)
[illegible]	1	BOYS	1	(39.13)	BOYS	1	(43.48)

each set of four pictures for each hierarchy studied in this experiment. On the assumption that the percentage of children who can give the adult modal words in a context that requires them is directly correlated with the order of acquisition of those words in development, the left-hand columns of Fig. 6 suggest that for the food hierarchy the order of acquisition is 'apple' first, 'food' second and 'fruit' third; that for the plant hierarchy the order is 'flower' first, 'plant' second and 'rose' third; that for the transportation hierarchy the order is 'car' first, 'Volkswagon' second and 'transportation' third; that for the money hierarchy the order is 'money' first, 'dime' second and 'coin' third; that in the two animal hierarchies the order is 'dog' first, 'animal' second and 'collie' third and 'fish' first, 'animal' second and 'shark' third; that for the living thing hierarchy the order is 'animal' first, 'monkey' second and 'primate' and 'living thing' later; and that for the people hierarchy the order is 'boy' first, 'children' second and 'people' third. These orders are obviously compatible with neither of the definitions of conceptual complexity outlined in the introduction to this experiment, which raises the question "What is a good predictor of these orderings?" It turns out that a very good predictor is provided by the frequency of occurrence of these words in child speech according to Rinsland (1945), Grade 1. To demonstrate the power of frequency of occurrence according to Rinsland (1945) to predict order of acquisition of category labels we have included the frequencies of the adult modal words in Fig. 6. For every hierarchy but one it can be seen that the rank order of acquisition of these category labels is perfectly predicted by the rank order of frequencies according to Rinsland (where Rinsland's data is available). This one exception occurs in hierarchy VII where children do a little better on 'fish' than on 'animal' whereas the frequency for 'animal' is slightly higher than for 'fish', about which I shall have more to say later.

We also analyzed the data for class names in a different way, briefly referred to earlier. In this analysis we calculated the total percentage of children who gave any correct response in our judgement when asked for a class name for a set of four pictures. So, for example, 'rose', 'flower', and 'plant' were all counted as correct names for the four roses in this analysis; 'Volkswagons', 'cars', 'automobiles', 'vehicles', etc. were all counted as correct for the four Volkswagons; 'means of transportation', 'vehicles', 'things you ride on', etc. were all counted as correct for the four vehicles, and so on. The results of this analysis are shown in the right-hand column of Fig. 6 which shows a very different kind of pattern from the left-hand column. Children are usually best at giving some appropriate class name for the lowest category in a hierarchy, next best for the next highest usually, and so on. This finding reminds me very much of a major finding in my monograph (Anglin, 1970) that children can see a similarity between two words such as 'boy' and 'girl' or 'boy' and 'horse' before they can see a similarity between two more dissimilar words such as 'boy' and 'flower' or 'boy' and 'chair'. I argued that this was evidence of a "concrete to abstract" progression. Although it is somewhat tempting to describe the pattern of results here as reflecting a "concrete to abstract" progression as well I do not pretend to know what is causing the appearance of a concrete to abstract progression here or, to put it another way, what the variable is that I am calling concreteness. One thing that does probably vary as you go up a given hierarchy is the perceptual similarity of the instances on a given poster, although we have not scaled these pictures for perceptual similarity. That is to say, if we were to scale the pictures for perceptual similarity we would probably find that adults would rate the four roses as being more perceptually similar than the four flowers which would be more perceptually similar than the four plants. Perhaps it is easier for children to name a category comprised of perceptually homogeneous instances than to name one comprised of perceptually dissimilar instances. Another dimension that does vary as you go up a given hierarchy is the number of appropriate names that English provides as possible responses to our demands for a class name. The terms 'collies', 'dogs', and 'animals' are all appropriate for four collies whereas 'collies' is not appropriate for four different species of dogs and neither 'collies' nor 'dogs' is appropriate for four different kinds of animals. At any rate, whatever the reasons for this trend, we know that it does not mean that children necessarily acquire specific terms invariably before more general terms as the left-hand column in Fig. 6 indicates. There may be something which it is appropriate to call a concrete to abstract progression in cognitive development, but there is not a specific to general progression in vocabulary development.

A test of the correlation between frequncy of occurrence according to Rinsland and the percentage of children who are capable of giving the adult modal word does not have to be restricted to a single hierarchy. Whereas it would be difficult to order words from the different hierarchies according to either definition of conceptual complexity, it is a simple matter to order them according to frequency of occurrence. Table 3 presents the adult modal words for each poster ordered according to their frequency

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Insert Table 3 here

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of occurrence in Rinsland (1945), Grade 1 (left-hand column). Table 3 also shows in the right-hand column the percentage of children who were capable of giving the AMW. As Table 3 shows there is a very strong positive relationship (although it is not perfect) between the frequency

Table 3

Table showing the frequency of occumence according to Rinsland (1945) of the adult modal word for each category and the percent of children giving that adult modal word in the first experiment

<u>NOTE</u>:

F(R)= frequency of occurence according to Rinsland, Grade I.
—— indicates that there is no frequency count for that word in Rinsland, Grade I; read as "0".

Table 3

F(R)*	ADULT MODAL WORD	% AMW
1309	dogs	60.00
566	cars	63.33
561	apples	46.67
263	flowers	43.33
156	animals[1]	49.17
146	fish(es)	50.00
139	food(s)	36.67
105	money	36.67
92	monkeys	33.33
66	fruit(s)	16.67
55	plants	26.67
39	roses	10.00
34	dimes	16.67
28	living, life	0.00
4	sharks	13.33
—	Volkswagons[2]	13.33
—	transportation	0.00
—	coins	3.33
—	collies	3.33
—	primates	0.00
1433	Boys	39.13
346	Children	13.04
209	people	4.35

* Frequency count for Rinsland Grade I includes singular and plural.

[1] "animal" category (for 4 instances of word use) averaged for "% Correct"

[2] "Volkswagon" does not appear in Rinsland at all.

of occurrence of the word according to Rinsland and the percentage of children who can produce it in an obligatory context. The rank order correlation coefficient between the frequency of occurrence according to Rinsland of the AMW and the percentage of children who can produce it is .95 ($p < .001$).

Experiment 2

What worried us most about experiment 1 was the possible objection that the test of the child's ability to produce category labels was not equally fair across concepts. Eleanor Heider (1973, 1973) has recently argued convincingly that the various instances of a concept are not all equally good as instances of that concept. Rather she argues that concepts have "internal structure" by which she means that categories are made up of a "core meaning" which consists of the best examples of the category and these are "surrounded by" other category members of decreasing similarity to that core meaning. Thus, instances of a concept vary along a dimension she calls centrality, with the best instances being very central and the worst instances being very peripheral. She has found that adult subjects find it a meaningful task to rate instances according to their degree of centrality to a given concept and that they tend to agree in their judgements of centrality. For example, adults tend to agree that a 'robin' and a 'sparrow' are central instances of the concept 'bird', whereas 'chicken' and 'duck' are peripheral. Moreover, in another study (see #4 <u>The Determinants of Underextension Errors</u>) we have found that adult judgements of the centrality of pictures to categories is a good predictor of the likelihood that the child will make an underextension error, that is, not include an instance in a concept. Specifically, children will often not include in their concept an instance which adults do include but which they rate as being peripheral. In fact, the centrality-peripherality dimension proves to be much more predictive of underextension errors than a familiarity-unfamiliarity dimension. So, for example, children will count as instances of the concept 'animal' either a picture of a dog (familiar-central) or of an aardvark (unfamiliar-central) but will often not include a butterfly (familiar-peripheral) or a crustacean (unfamiliar-peripheral). This suggests that a fair test of the order of acquisition of category labels done in the style of experiment 1 would involve sets of pictures which were equally central to the concepts being tested. That is to say, if we are interested in the order of acquisition of the category labels 'collie', 'dog', and 'animal', the instances (i.e., pictures) of collies should be equally central to the concept 'collie' as the pictures of dogs are to 'dog' and the pictures of animals are to 'animal'. We had noticed in experiment 1 that children were more likely to give the response 'animal' to four mammals (66.7%) than to four animals which included a bird, fish, an insect, and a chimpanzee (50%). This finding is consistent with the idea that children are better able to produce a given category label when the instances are central to that category than when they are peripheral.

To get an estimate of the extent to which the sets of pictures used in experiment 1 varied in terms of their centrality to the concepts being tested we had adult judges rate each picture in each set to the category that that set was intended to test. The results are shown in Table 4 which

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Insert Table 4 here

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presents the average adult centrality ratings for each picture used in

Table 4

Adult centrality ratings for each picture used in the first experiment on order of acquisition of category labels.

Table 4

SCALE USED: PERIPHERAL | 1 | 2 | 3 | 4 | 5 | 6 | 7 | CENTRAL

extremely — very — quite — MODERATE — quite — very — extremely

CATEGORY

APPLE		FRUIT		FOOD	
PICTURE	RATING	PICTURE	RATING	PICTURE	RATING
apple$_1$	6.5	lemon	6.2	apple	5.6
apple$_2$	6.7	pineapple	6.6	lettuce	6.2
apple$_3$	6.5	apple	6.7	walnut	4.6
apple$_4$	6.7	banana	6.7	bread	6.7
$\bar{X}$ =	6.6	$\bar{X}$ =	6.55	$\bar{X}$ =	5.78

ROSE		FLOWER		PLANT	
rose$_1$	6.5	daisy	6.7	tree	4.8
rose$_2$	6.6	rose	6.7	rose	5.7
rose$_3$	6.7	carnation	6.9	rubber plant	6.9
rose$_4$	6.5	tulip	6.4	cactus	6.3
$\bar{X}$ =	6.58	$\bar{X}$ =	6.63	$\bar{X}$ =	5.93

VOLKSWAGON		CAR		VEHICLE	
VW$_1$	6.9	Model T Ford	5.8	bicycle	6.1
VW$_2$	7.0	Cadillac	6.7	VW	6.5
VW$_3$	6.7	VW	6.5	airplane	5.9
VW$_4$	6.9	Jaguar XKE	6.2	train	6.0
$\bar{X}$ =	6.88	$\bar{X}$ =	6.30	$\bar{X}$ =	6.13

DIME		COIN		MONEY	
dime$_1$	6.9	quarter	6.9	quarter	6.0
dime$_2$	6.7	dime	6.8	$5 bill	6.6
dime$_3$	6.7	nickel	6.7	dime	5.8
dime$_4$	6.9	penny	6.6	$1 bill	6.6
$\bar{X}$ =	6.80	$\bar{X}$ =	6.70	$\bar{X}$ =	6.25

COLLIE		DOG		ANIMAL	
collie$_1$	6.5	bulldog	6.5	leopard	6.8
collie$_2$	6.9	German Shepherd	6.9	collie	6.7
collie$_3$	6.8	collie	6.8	frog	4.8
collie$_4$	6.6	poodle	5.7	duck	5.0
$\bar{X}$ =	6.70	$\bar{X}$ =	6.48	$\bar{X}$ =	5.83

Table 4 (cont'd)

SCALE USED: PERIPHERAL | 1 | 2 | 3 | 4 | 5 | 6 | 7 | CENTRAL

extremely, very, Quite, MODERATE, Quite, very, extremely

CATEGORY	SHARK		FISH		ANIMAL	
	PICTURE	RATING	PICTURE	RATING	PICTURE	RATING
	$shark_1$	7.0	goldfish	6.6	rhinoceros	6.3
	$shark_2$	7.0	swordfish	5.8	shark	4.8
	$shark_3$	6.7	bass	6.7	bear	6.9
	$shark_4$	6.9	shark	5.8	turtle	4.7
	$\bar{X}$ =	6.90	$\bar{X}$ =	6.23	$\bar{X}$ =	5.68

CHIMPANZEE		PRIMATE		MAMMAL		ANIMAL		LIVING THING	
PICTURE	RATING	PICTURE	RATING	PICTURE	RATING	PICTURE	RATING	PICTURE	RATING
$chimp_1$	6.5	monkey	6.7	kangaroo	6.6	bird	5.1	chimp	6.6
$chimp_2$	6.2	chimp	6.9	dog	6.4	fish	4.4	flower	5.8
$chimp_3$	5.3	man	6.6	chimp	6.7	insect	3.8	tree	5.6
$chimp_4$	5.7	ourangutan	6.8	elephant	6.5	chimp	6.8	seagull	6.5
$\bar{X}$ =	5.93	$\bar{X}$ =	6.75	$\bar{X}$ =	6.55	$\bar{X}$ =	5.03	$\bar{X}$ =	6.13

BOY		CHILD		PERSON	
PICTURE	RATING	PICTURE	RATING	PICTURE	RATING
boy_1	6.9	girl	6.8	girl	6.0
boy_2	6.8	boy	6.7	woman	6.3
boy_3	6.9	girl	6.9	man	6.9
boy_4	6.9	boy	6.8	boy	6.1
$\bar{X}$ =	6.88	$\bar{X}$ =	6.80	$\bar{X}$ =	6.33

experiment 1 to the category being tested. As Table 4 suggests there was, in fact, a weak but discernible tendency for the centrality ratings for pictures to decrease with increasing level in a hierarchy. For example, the four foods (an apple, lettuce, a walnut, and bread) received an average centrality rating of only 5.78 to 'food' whereas the four apples received an average centrality rating of 6.6 to 'apple' and the four fruits received an average centrality rating of 6.55 to 'fruit'. Similarly, the four plants (a tree, a rose, a rubber plant, and a cactus) received an average centrality rating of only 5,93 to 'plant' whereas the four roses received an average centrality rating of 6.58 to 'rose' and the four flowers received an average centrality rating of 6.63 to 'flower'. To take a third example, the four animals (leopard, collie, frog, and duck) received an average centrality rating of only 5.83 to the category 'animal' whereas the four collies received an average centrality rating of 6.70 to 'collie' and the four dogs received an average centrality rating of 6.48 to 'dog'. While these differences are not large they were enough to make us wonder if children might not have been able to do better on the more general terms if we had conducted a fairer test with instances of each category being equally central to their categories. Therefore, we decided to conduct a second study on the order of acquisition of category labels but this time making the test as fair as possible by seeing to it that the instances of each concept being tested were equally central to their respective concepts.

Method

We chose three representative hierarchies of concepts from experiment 1 to test again. Specifically these were:

I.		II.		III.	
I.	animal	II.	plant	III.	food
	dog		flower		fruit
	collie		rose		apple

We collected a picture pool of approximately 265 pictures of objects which were instances of these nine concepts. From these we selected 146 pictures which we thought were clear and useful for our purposes. We then asked ten adult judges (five males and five females; ages 18-28; seven students at Harvard and three working in Cambridge) to rate the pictures according to how central they were to the nine concepts under study. They were given an instruction sheet explaining what was meant by centrality and how to use a seven-point scale. Then they were asked to rate the 146 pictures according to how central the objects depicted were to our nine reference concepts. Specifically they were asked to rate 12 pictures of collies according to how central these were to the concept 'collie'; 18 dogs to 'dog'; 24 animals to 'animal'; 8 roses to 'rose'; 18 flowers to 'flower'; 18 plants to 'plant'; 12 apples to 'apple'; 13 fruits to 'fruit'; and 23 foods to 'food'. If they did not consider the object in a picture to be an instance of the concept in question they were asked to indicate this by putting an "X" on their response sheet rather than choosing a number from the seven-point scale. (This was to check to see that all of the pictures were, in fact, considered to be instances by adults.) The pictures were rated by concept with a separate rating sheet for each concept which included the seven-point rating scale at the top of each sheet. The session lasted about one-half hour and subjects found it a meaningful task and were eager to discuss its implications.

Adult ratings were then averaged for each picture. From the 146 pictures we then chose 27 (three for each of the nine concepts) such that within any given hierarchy the average centrality ratings for each set of three pictures were exactly equal. We also tried to choose pictures which would result in a high average centrality rating and with as little variability around the mean centrality as possible. Moreover, we tried to make the average centrality ratings across hierarchies as close as possible. Finally, for each of the most general concepts in the three hierarchies we chose three pictures which were rated by our adult judges as being peripheral to their respective concepts. (We decided to include some peripheral sets in order to get a feeling for the strength of the central-peripheral effect.) Thus, we had selected a total of 36 pictures which we proceeded to mount on posters with three pictures per poster. The result was a total of 12 posters, three for each of our three reference hierarchies with pictures being high and equal in centrality and three containing peripheral instances of the categories 'animal', 'plant', and 'food'.

Table 5 shows the average adult centrality ratings for each picture to

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Insert Table 5 here

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each category and the average centrality ratings for all pictures on a single poster for the stimuli used in the second experiment on order of acquisition of category labels. The following 12 pages show Xeroxes of the posters themselves.

Insert Pictures here

In the actual experiment there were two groups of subjects. First, there was a group of 20 children (9 females and 11 males) from the Living and Learning School in Woburn, Massachusetts. Their ages ranged from two years to five years. The children were all from a middle-class background, and all of them watched some T.V., and some Sesame Street in particular. The children were tested in a private staff room at the school. The second group of subjects were ten adults (six females and four

Table 5

Table showing adult centrality ratings for each picture to each category and average centrality ratings for all pictures on a single poster for the stimuli used in the second experiment on order of acquisition of category labels.

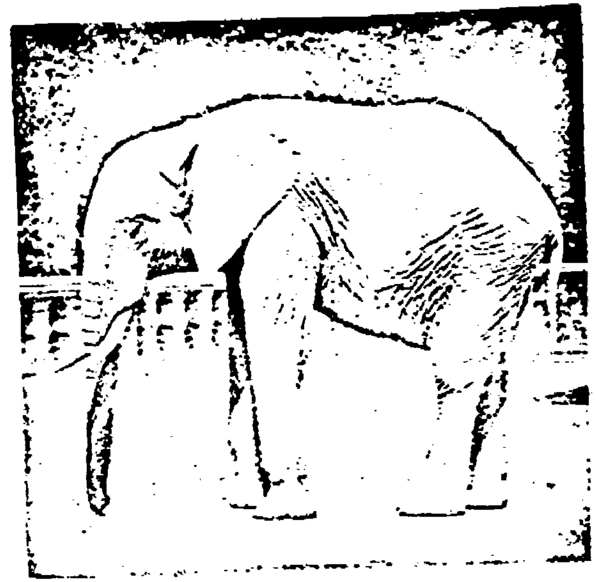
CATEGORY	PICTURE	CENTRALITY TO COLLIE	PICTURE	CENTRALITY TO DOG	PICTURE	CENTRALITY TO ANIMAL	PICTURE	Centrality to ANIMAL
	$collie_1$	6.3	dog_1 (fox terrier)	6.4	$animal_1$ (prince charles spaniel)	6.2	$animal_4$ (bullfrog)	4.0
	$collie_2$	6.1	dog_2 (Belgian sheepdog)	6.0	$animal_2$ (african elephant)	6.2	$animal_5$ (monarch butterfly)	3.2
	$collie_3$	6.3	dog_3 (siberian husky)	6.3	$animal_3$ (cat)	6.3	$animal_6$ (marsh hawk)	3.8
	$\overline{X}$ =	6.23	$\overline{X}$ =	6.23	$\overline{X}$ =	6.23	$\overline{X}$ =	3.67
		ROSE		FLOWER		PLANT		PLANT
	$rose_1$	6.0	$flower_1$ (white daisy)	6.0	$plant_1$ (mullein)	5.7	$plant_4$ (monkey puzzle tree)	3.9
	$rose_2$	6.2	$flower_2$ (snowball)	5.7	$plant_2$ (caster bean)	5.8	$plant_5$ (cactus)	4.8
	$rose_3$	5.6	$flower_3$ (calendula)	6.1	$plant_3$ (Jade)	6.3	$plant_6$ (poppies)	3.9
	$\overline{X}$ =	5.93	$\overline{X}$ =	5.93	$\overline{X}$ =	5.93	$\overline{X}$ =	4.20
		APPLE		FRUIT		FOOD		FOOD
	$apple_1$	6.5	$fruit_1$ (apple)	6.5	$food_1$ (steak)	6.0	$food_4$ (candy bar)	3.0
	$apple_2$	6.2	$fruit_2$ (banana)	6.1	$food_2$ (round bread)	6.4	$food_5$ (cake)	4.0
	$apple_3$	5.5	$fruit_3$ (strawberries)	5.6	$food_3$ (corn)	5.8	$food_6$ (onion)	3.9
	$\overline{X}$ =	6.07	$\overline{X}$ =	6.07	$\overline{X}$ =	6.07	$\overline{X}$ =	3.63

SCALE USED:

"PERIPHERAL"	1	2	3	4	5	6	7	"CENTRAL"
	extremely	very	quite	MODERATE	quite	very	extremely	

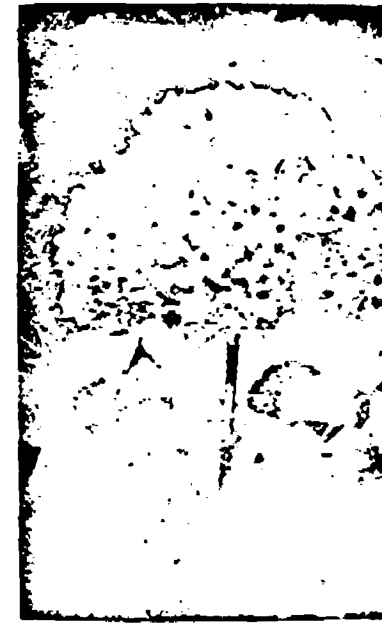
(collies)

(dogs)



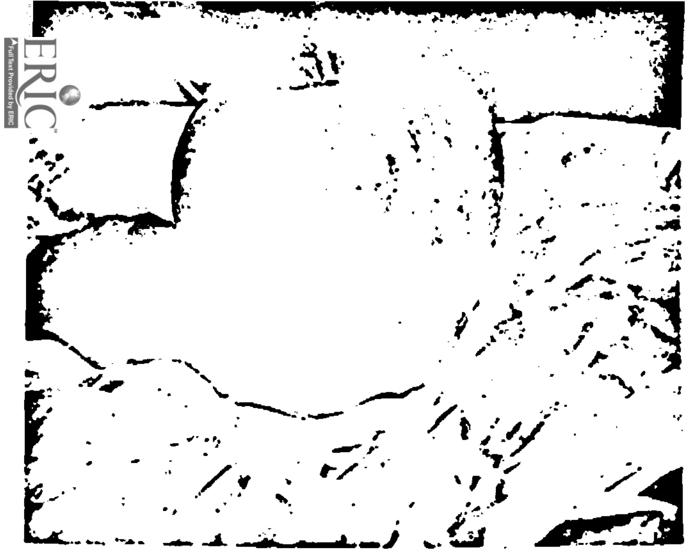
(animals)

(roses)

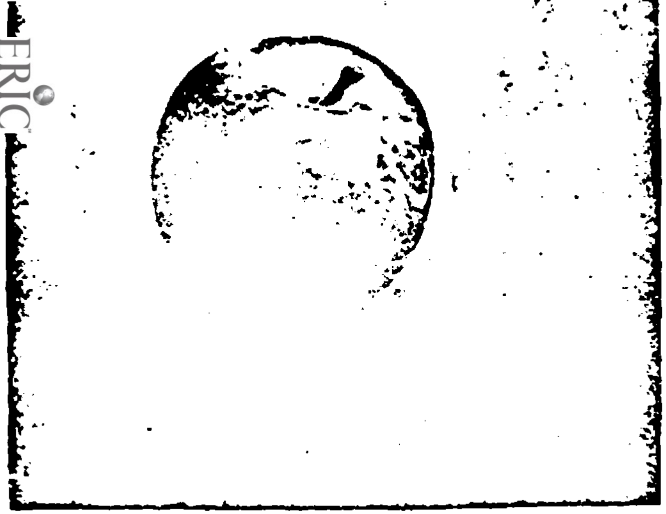


(flowers)

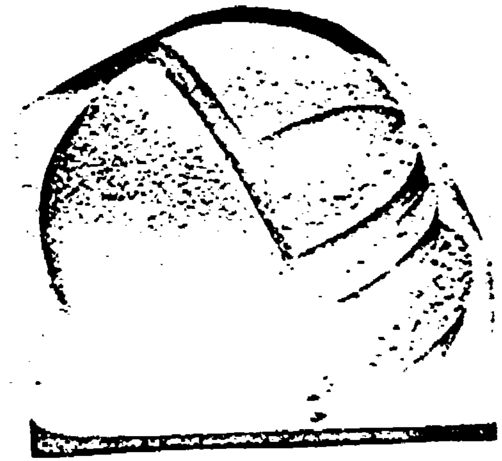
(plants)



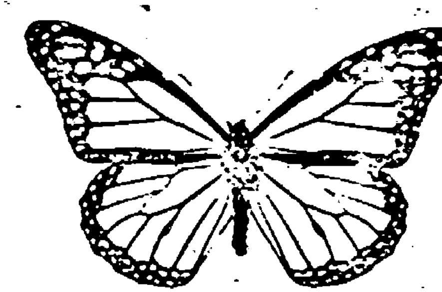
(apples)



(fruit)

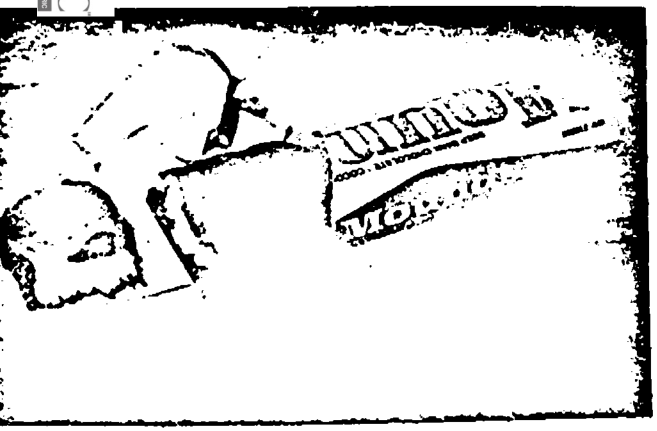


(food)



(animals -- peripheral)

(plants -- peripheral)



(food -- peripheral)

males), nine of whom were Harvard students and one of whom was a non-working woman.

The procedure was the same as for experiment 1. E began by explaining to S what would take place in the experiment, then turned on a tape recorder and began the session. The subject was shown three posters from experiment 1 (from the boy-child-person hierarchy) which were used again as a demonstration and for which they were helped if they had trouble. Then they were shown the 12 test posters in a different random order for each subject. For each poster the subject was asked to name each object in the three pictures and then to give a class name for all three pictures on a given poster. In order to elicit individual names for each picture E would point to each in turn and ask "What is this?". In order to elicit class names, after the child had attempted to name each picture, E would ask him "What are they all?". Except for the posters corresponding to the lowest level in each hierarchy, if a subject gave a name for a given picture of an object which was not specific enough to differentiate it from the other objects (e.g., 'dog' for each of the three dogs), then he was encouraged to give a more specific name if he could. Children in particular were praised for giving a name but were asked if they could think of "another name", a "special name", a "different name", etc. Also, if a subject gave a class name for a set of pictures which was more general than our reference word (e.g., 'dog' rather than 'collie' for three collies), he was again asked for a more differentiated name for all of the objects. Children seemed to enjoy the session which usually lasted about half an hour and they were given lollipops and little toys as rewards. Adult subjects took about ten minutes at the task and were paid for their services.

Results

In discussing the results of this experiment I would like to focus on the nine posters which contained pictures equated for centrality. Suffice it to say here that with respect to the posters containing peripheral instances children were not as good at giving a class name for these as they were for posters containing central instances, although the differences were not as great as anticipated. Specifically, 30% of the children gave the class name 'animals' for the three peripheral animals whereas 50% of the same children gave the class name 'animals' for the three central animals; 10% gave the class name 'plants' for the three peripheral plants whereas 15% gave the class name 'plants' for the three central plants; and 30% gave the class name 'food' for the three peripheral foods whereas 40% gave the class name 'food' for the three central foods. We suspect that these differences would have been larger had we used instances such that the differences between the peripherality and centrality of the instances were greater than they were. (It is worth noting that the central-peripheral variable was least effective in the case of plants and, in fact, the difference between the average adult ratings for the "central" plants [5.93] and that for the "peripheral" plants [4.20] was smallest in this case.)

For each of the pictures on the nine "central" posters and for each of these sets of three pictures we calculated the adult modal word and the child modal word in exactly the same way as we had in experiment 1. Fig. 7 presents tree diagrams showing the adult modal

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Insert Fig. 7 here

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words (left column) and the child modal words (right column) for each

Fig. 7

Trees showing adult modal words and child modal words for each individual picture and for each set of pictures used in experiment 2.

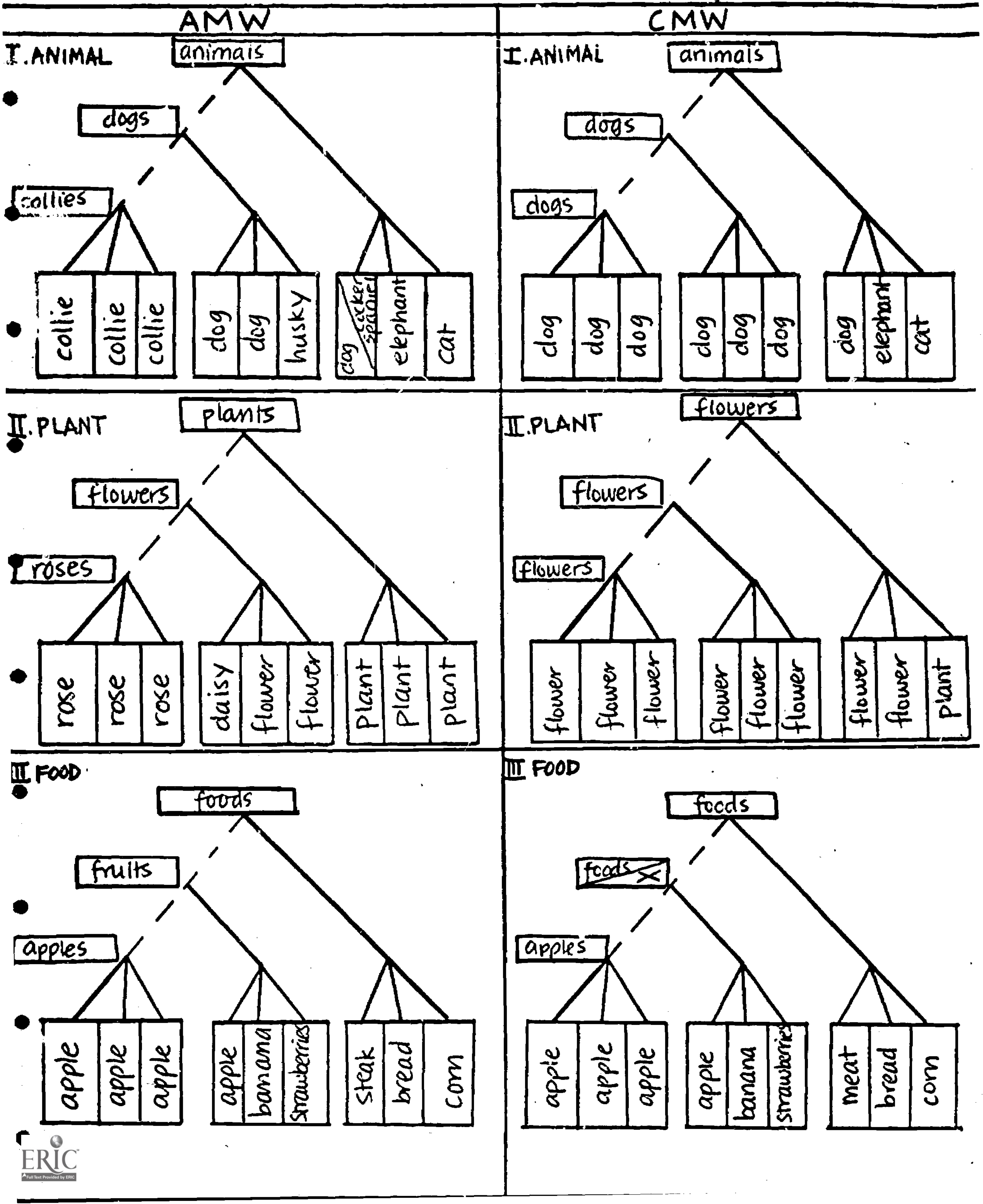
<u>NOTE</u>:

AMW= adult modal word
CMW= child modal word

 indicates that no response ("don't know") was the modal response

 indicates that there were two names given equally

Fig. 7


AMW
CMW
I. ANIMAL
animals
dogs
collies
collie
collie
collie
dog
dog
husky
dog
cocker spaniel
elephant
cat
I. ANIMAL
animals
dogs
dogs
dog
dog
dog
dog
dog
dog
dog
elephant
cat
II. PLANT
plants
flowers
roses
rose
rose
rose
daisy
flower
flower
plant
plant
plant
II. PLANT
flowers
flowers
flowers
flower
flower
flower
flower
flower
flower
flower
flower
plant
III FOOD
foods
fruits
apples
apple
apple
apple
apple
banana
strawberries
steak
bread
corn
III FOOD
foods
foods
apples
apple
apple
apple
apple
banana
strawberries
meat
bread
corn

individual picture and for each set of pictures used in experiment 2 (except for the peripherals). With respect to the individual pictures, just as was the case in experiment 1, whenever there is a difference the AMW is always a more differentiated term than the CMW. So, for example, the AMW for a picture of a collie is 'collie' whereas the CMW is 'dog'; the AMW for a picture of a Siberian Husky is 'husky' whereas the CMW is 'dog'; the AMW for a picture of a rose is 'rose' whereas the CMW for that picture is 'flower'; the AMW for a picture of a steak is 'steak' whereas the corresponding CMW is 'meat', etc.

With respect to class names (i.e., for sets of three pictures) it can be seen that the adult modal words correspond exactly to our reference words. That is, the AMW for three collies is 'collies'; for three dogs is 'dogs'; for three animals is 'animals'; for three roses is 'roses'; for three flowers is 'flowers'; for three plants is 'plants'; for three apples is 'apples'; for three fruits is 'fruits'; and for three foods is 'foods'. The CMW for class names follows roughly the same pattern as for experiment 1 but these children seem to be a little more advanced -- in particular, they are better in this experiment at producing two of the general terms 'animals' and 'foods'. Still, it can be seen that children do not have command of the variety of class names at different levels of generality for a given domain that adults do. Three collies for children are all 'dogs' rather than the more specific 'collies'; the three roses are all 'flowers' for children rather than the more discriminating 'roses'; the three fruits are all 'foods' or 'don't know' for children rather than the more discriminating 'fruits'. It is interesting that the child modal word for the three plants is 'flowers' (vs. 'plants' for adults). In this study and in others we have found that the child's tendency to overgeneralize the word 'flower' (to other kinds of plants) is more striking than for any other concept we have investigated. (See, for example, #3 On the Extension of the Child's First Terms of Reference.) This also usually involves undergeneralization of the concept 'plant'.

Fig. 8 shows the percentage of children who give the adult modal

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Insert Fig. 8 here

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word in the left-hand column and any correct response in the right-hand column for each concept for each hierarchy studied in the second order of acquisition experiment. This analysis has been done in the same way as it was for the first experiment (see Fig. 6) and the trends are the same as well. Consider the left-hand column. Again, on the assumption that the percentage of children who can give the adult modal words in a context that requires them is directly correlated with the order of acquisition of those words in development, the left-hand column of Fig. 8 suggests that for the animal hierarchy the order of acquisition is 'dog' first, 'animal' second and 'collie' third, that for the plant hierarchy the order is 'flower' first, 'plant' second and 'rose' third, and that for the food hierarchy the order is 'apple' first, 'food' second and 'fruit' third. These are exactly the same orderings that emerged from the first experiment and again, therefore, each ordering is predicted by the rank order of the frequency of occurrence of the adult modal word in Rinsland (1945), Grade 1, as the arrows on the left in Fig. 8 indicate.

Fig. 8 also shows in the right-hand column that when the data are analyzed in terms of the ability of the child to give any appropriate superordinate response for a set of three pictures (rather than just the AMW) children generally do best at giving some appropriate class name for the lowest level in the hierarchy and do less well on the higher levels (ignoring ties).

Fig. 8

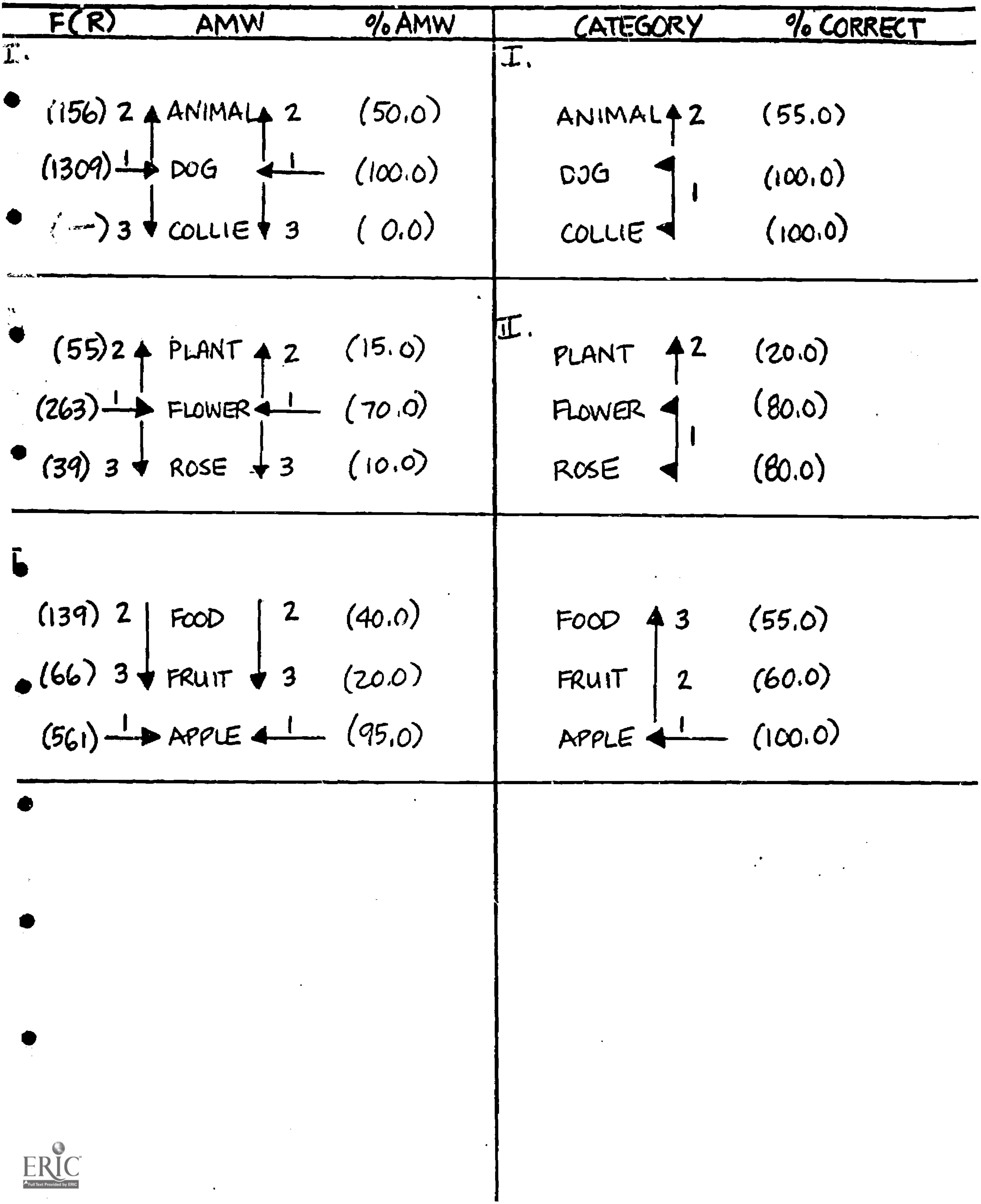
Percent of children who give the adult modal word (left) and any correct response (right) for each concept for each hierarchy studied in the second order of acquisition experiment. Frequency of occurrence of each word according to Rinsland (1945) is also shown in Fig. 8.

NOTE:

F(R) = frequency of occurence according to Rinsland, Grade I
AMW = adult modal word
%AMW = percent of children who use the adult modal word
%CORRECT = percent of children who give any correct name for category

(—) indicates that there is no frequency count for that word in Rinsland, Grade I; read as "0".

Fig. 8


F(R)
AMW
% AMW
CATEGORY
% CORRECT
I.
(156) 2
ANIMAL 2
(50.0)
(1309) 1
DOG 1
(100.0)
(—) 3
COLLIE 3
(0.0)
I.
ANIMAL 2
(55.0)
DOG
1
(100.0)
COLLIE
(100.0)
(55) 2
PLANT 2
(15.0)
(263) 1
FLOWER 1
(70.0)
(39) 3
ROSE 3
(10.0)
II.
PLANT 2
(20.0)
FLOWER
1
(80.0)
ROSE
(80.0)
(139) 2
FOOD 2
(40.0)
(66) 3
FRUIT 3
(20.0)
(561) 1
APPLE 1
(95.0)
FOOD 3
(55.0)
FRUIT 2
(60.0)
APPLE 1
(100.0)

One thing that worried us about this experiment is that when asked to name the individual pictures children were sometimes unable to in certain cases and gave incorrect responses which were inconsistent with the class name that we were testing. This was most notable in the case of two of our food pictures, specifically the picture of a steak and the picture of bread. The pictures were quite unambiguous to our adult subjects but were ambiguous for a few of our children. One child, for example, called the picture of a steak a 'rock' and one child called the picture of bread a 'shell'. If the child really saw the picture of a steak as a 'rock' then one could argue that this child could not be expected to give the class name 'food' for pictures of the steak, bread and corn, since a rock is not a kind of food. For this reason we reanalyzed the data calculating the percent of children who gave the adult modal word based only on children who gave responses to the individual pictures which were consistent with (i.e., instances of) the category word. We were not sure whether we should count the response 'don't know' as consistent or inconsistent with the category word so we did the analysis both ways, in one case counting 'don't know' as consistent with the category word and in the other case counting 'don't know' as inconsistent. Table 6 shows the percentage of children giving the adult modal word for each concept for each of the three hierarchies studied

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Insert Table 6 here

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in the second experiment according to these two methods of analysis (Method 2 and Method 3) and also, for comparison, for the straightforward method (Method 1) reported in Fig. 8. Table 6 also shows the results of these three methods of analysis for these three hierarchies based on data from experiment 1. As Table 6 shows, the rank order of the percentage of children who can give the AMW for the

Table 6

Table showing the percentage of children giving the adult modal word for each concept for each hierarchy studied in experiment 2 according to three different methods of analysis. Results of the same three methods of analysis for these three hierarcnies are also shown based on the data from experiment 1.

NOTE:

F(R)= frequency of occurrence according to Rinsland, Grade I
AMW= adult modal word

%AMW= percent of children who use the adult modal word, computed by three methods:

method 1: total number of children who give the adult modal word divided by the total number of children;

method 2: total number of children who give the adult modal word divided by the total number of children who gave 3 (experiment 2) or 4 (experiment 1) names for the individual pictures which were consistent with the category word, when "don't know" is considered consistent, and a child's data was deleted if he gave any inconsistent response for any of the individual pictures;

method 3: total number of children who give the adult modal word divided by the total number of children who gave 3 (experiment 2) or 4 (experiment 1) names for the individual pictures which were consistent with the category word, when "don't know" is considered inconsistent, and a child's data was deleted if he gave any inconsistent response for any of the individual pictures.

(—) indicates that there is no frequency count for that word in Rinsland, Grade I; read as "0".

Table 6

	EXPERIMENT 2			EXPERIMENT 1		
	% AMW			% AMW		
F(R) AMW	method 1	method 2	method 3	method 1	method 2	methoc
(156) 2 ↑ ANIMAL	50.0 ↑ 2	50.0 ↑ 2	50.0 ↑ 2	36.7 ↑ 2	36.7 ↑ 2	38.5 ↑
(1309) 1 → DOG	100.0 ← 1	100.0 ← 1	100.0 ← 1	60.0 ← 1	67.9 ← 1	78.3 ←
(—) 3 ↓ COLLIE	0.0 ↓ 3	0.0 ↓ 3	0.0 ↓ 3	3.3 ↓ 3	3.6 ↓ 3	3.7 ↓
(55) 2 ↑ PLANT	15.0 ↑ 2	15.0 ↑ 2	15.8 ↑ 2	26.7 ↑ 2	31.0 ↑ 2	36.0 ↑ 2
(263) 1 → FLOWER	70.0 ← 1	87.5 ← 1	87.5 ← 1	43.3 ← 1	43.3 ← 1	52.0 ← 1
(39) 3 ↓ ROSE	10.0 ↓ 3	11.8 ↓ 3	12.5 ↓ 3	10.0 ↓ 3	13.8 ↓ 3	11.1 ↓ 3
(139) 2 | FOOD	40.0 | 2	47.1 | 2	61.5 | 2	36.7 | 2	39.3 | 2	50.0] 2
(66) 3 ↓ FRUIT	20.0 ↓ 3	21.1 ↓ 3	21.4 ↓ 3	16.7 ↓ 3	26.9 ↓ 3	50.0] 2
(561) 1 → APPLE	95.0 ← 1	95.0 ← 1	95.0 ← 1	46.7 ← 1	52.0 ← 1	52.0 ← 1

three concepts within a given hierarchy is the same for all three methods of analysis and is predicted by the rank order of frequency of occurrence of the words in Rinsland (1945), Grade 1. The only case for which there is a slight discrepancy is for the food hierarchy where method 3 in experiment 1 results in equal percentages of children giving the AMW's 'food' and 'fruit' whereas in the other five cases the percentage of children giving 'food' is higher than the percentage giving 'fruit'.

Since we had approximately equated for the average centrality of instances to the concepts being tested not only within but also across hierarchies we decided to see how good a predictor frequency of occurrence according to Rinsland (1945) was for the percentage of children capable of giving each of the nine concepts. Table 7 shows the nine words

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Insert Table 7 here

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ordered according to frequency of occurrence in Rinsland (the left column) and the percentage of children capable of producing those words in a context that requires them according to the three methods of analysis. As Table 7 shows, the percentage of children capable of giving the word is a perfectly decreasing monotonic function of the frequency of occurrence of that word for methods 1 and 2, and only one point is out of line for method 3. This means that for methods 1 and 2 the rank order correlation coefficient between frequency of occurrence of the word in Rinsland and the percentage of children capable of producing those words is equal to 1.00.

Since frequency of occurrence was proving to be a good predictor of the percentage of children capable of giving the adult modal word in both experiments 1 and 2, we decided to calculate correlation coefficients for both experiments for both the individual pictures data and for the

Table 7

Table showing relationship between frequency of occurrence of words according to Rinsland (1945) and percentage of children and adults who produce those words in a context that requires them. Data from experiment 2.

NOTE:

F(R)= frequency of occurrence according to Rinsland, Grade I
AMW= adult modal word
%A= percent of adults who gave the adult modal word

%AMW(children)= percent of children who gave the adult modal word, computed by three methods:

method 1: total number of children who give the adult modal word divided by the total number of children;

method 2: total number of children who give the adult modal word divided by the total number of children who gave 3 names for the individual pictures which were consistent with the category word, when "don't know" is considered consistent, and a child's data was deleted if he gave any inconsistent response for any of the individual pictures;

method 3: total number of children who give the adult modal word divided by the total number of children who gave 3 names for the individual pictures which were consistent with the category word, when "don't know" is considered inconsistent, and a child's data was deleted if he gave any inconsistent response for any of the individual pictures.

(—) indicates that there is no frequency count for that word in Rinsland, Grade I; read as "0".

Table 7

F(R)	AMW	%A	% AMW (children)		
			method 1	method 2	method 3
309	dogs	100.0	100.0	100.0	100.0
561	apples	100.0	95.0	95.0	95.0
263	flowers	100.0	70.0	87.5	87.5
56	animals	80.0	50.0	50.0	50.0
139	foods	100.0	40.0	47.1	61.5
66	fruits	90.0	20.0	21.1	21.4
55	plants	100.0	15.0	15.0	15.8
89	roses	90.0	10.0	11.8	12.5
(—)	collies	70.0	0.0	0.0	0.0

category data between the percentage of children giving an adult modal word and the frequency of occurrence of that word based on six different measures of frequency of occurrence. Specifically, the measures of frequency of occurrence were taken from Rinsland (1945), Grade 1; Rinsland, Grade 2; Thorndike and Lorge (1944), General Count; Thorndike and Lorge, Juvenile Count; Kucera and Francis (1967) and Howes (1966). I will not trouble the reader with the fine details, of which there were many, of how we calculated the correlation coefficients. Table 8 shows the raw and rank order correlation coefficients between the frequency of occurrence of

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Insert Table 8 here

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the AMW for each of these measures and the percentage of children who give the AMW. For experiment 1 all of the correlations are significant for Rinsland Grades 1 and 2 and for Thorndike and Lorge (General and Juvenile Counts). The correlations for Howes and Kucera and Francis are not as strong but all are positive and half of them are significant. For experiment 2 Rinsland (Grades 1 and 2) is clearly the best predictor of the order of acquisition of category labels.

Discussion

There is neither a unidirectional specific to general progression in vocabulary development nor a unidirectional general to specific progression. Rather, the child usually first learns words which categorize a given domain at some intermediate level of generality and only later learns more specific terms and more general terms. Thus, vocabulary development is characterized by the trends of differentiation and hierarchic

Table 8

Table showing raw and rank order correlations between the percentage of children giving an adult modal word and the frequency of occurrence of that word. Correlation coefficients were computed for the two experiments for category data and individual pictures data for 6 different measures of frequency of occurrence.

			RINSLAND I	RINSLAND II	THORNDIKE + LORGE - G	THORNDIKE + LORGE - J	KUCERA + FRANCIS	HOWES
EXPERIMENT 1	CATEGORY DATA N = 19	1. Raw	(****) +0.70	(***) +0.58	(*) +0.45	(*) +0.49	+0.09	+0.29
		2. Ranked	(*** +0.95	(**** +0.91	(*) +0.44	(*) +0.44	+0.37	(*) +0.39
	INDIVIDUAL PICTURES N=44	1. Raw	(****) +0.47	(*) +0.29	(****) +0.49	(****) +0.54	+0.20	(*) +0.26
		2. Ranked	(****) +0.74	(***) +0.75	(****) +0.86	(****) +0.55	(****) +0.53	(***) +0.40
EXPERIMENT 2	CATEGORY DATA N=9	1. Raw	(***) +0.84	(*) +0.72	+0.22	+0.39	+0.04	+0.22
		2. Ranked	(****) +1.00	(****) +0.97	+0.00	+0.16	+0.17	+0.26
	INDIVIDUAL PICTURES N=15	1. Raw	+0.50	(*) +0.47	+0.25	+0.25	−0.10	+0.09
		2. Ranked	(**) +0.62	(***) +0.67	+0.26	+0.28	+0.17	−0.04

Note: (*) represents significance of r_{xy} at the following levels:

(****) < 0.001
(***) < 0.005
(**) < 0.01
(*) < 0.05

integration which may be processes of cognitive development more generally (cf. Werner, 1948).

This means that neither of the definitions of conceptual complexity in terms of intension or of extension outlined in the introduction is a good predictor of the order of acquisition of category labels. This may, of course, mean that those definitions of conceptual complexity were misguided and there is still the possibility that some alternative definition of conceptual complexity, possibly one that acknowledges the existence of "natural kinds", is predictive.

What does appear to be a good predictor of the order of acquisition of category labels is frequency of occurrence, in general, and frequency of occurrence in child speech, in particular (e.g., according to Rinsland [1945]). It may strike the reader as not especially surprising that the words used most often by another generation of children are, in fact, the words learned first by children today, but it is not tautologous and the realization that frequency of occurrence is predictive may provide clues as to the determinants of the order of acquisition of category labels.

Frequency of occurrence emerges as a predictor of the order of acquisition of vocabulary not only in the studies reported here but in others as well. (See, for example, #2 The Naming Practices of Mothers and #3 On the Extension of the Child's First Terms of Reference.) In another study in which we asked children to define words and to "tell us everything that they could" about the words, we found that children could generate more predicates for more frequently occurring words. Frequency of occurrence is also correlated with the difficulty of vocabulary items on the Stanford-Binet Intelligence Scale (Terman and Merrill, 1960). Table 9 shows raw and rank order correlation

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Insert Table 9 here

Table 9

Table showing correlations between frequency of occurrence and difficulty of vocabulary item on the Stanford Binet. Correlation coefficients (raw and ranked) are shown for all 45 words on the Stanford Binet and for the 21 names of objects. The results for three different measures of frequency are shown.

	RINSLAND	THORNDIKE-LORGE	KUCERA + FRANCIS
45 words	raw = −0.41 ranked = +0.78	raw = −0.60 ranked = +0.80	raw = −0.34 ranked = +0.68
21 words	raw = −0.43 ranked = +0.82	raw = −0.61 ranked = +0.78	raw = −0.69 ranked = +0.77

coefficients between the difficulty of vocabulary items on the Stanford-Binet and the frequency of occurrence of those items according to Rinsland (1945), Thorndike and Lorge (1944), and Kucera and Francis (1967).

To argue that there is a high correlation between frequency of occurrence of words in child speech and the order of acquisition of those words is not, of course, equivalent to explaining the order of acquisition of those words. For one thing, we lack a clear understanding of exactly why some words are more frequently occurring than others. Nonetheless, identification of frequency of occurrence as a predictor of order of acquisition gives us a clear hypothesis as to which words are the first verbal concepts acquired by children and which words are acquired only later. Specifically, according to this hypothesis the first n category labels to be acquired by children are the n most frequently occurring words in Rinsland (1945). Is it not possible that by examining these first n words we can make some progress toward discerning the origins of the child's first verbal concepts?

As a first step in this direction we took from Rinsland (1945), Grade 1 the 275 most frequently occurring names of objects and sorted them into semantic categories on the basis of similarity of meaning (cf. Miller, 1967, 1969). Elizabeth Smith and I took turns sorting these words into semantic categories until we finally agreed on a single classification scheme. For comparison we also sorted the 275 most frequently occurring words in the Thorndike and Lorge (1944) General Count and the 275 most frequently occurring words in Howes (1966). The results are shown in Table 10.

Insert Table 10 here

As it turned out, the words from the three frequency of occurrence tables

Table 10

Table showing the 275 most frequently occurring names of objects in Rinsland, Thorndike and Lorge, and Howes. The words have beencategorized by two adult judges into 22 semantic categories.

CATEGORY	RINSLAND	THORNDIKE-LORGE	HOWES
ANIMALS	(36) animal fish pony bear fly puppy bee fox rabbit bird goldfish rat bunny horse reindeer butterfly hen robin cat kitten snake chicken kitty squirrel cow monkey sheep dog mouse tiger duck pet turkey elephant pig turtle	(7) animal bear bird dog fish fly horse	(5) dog fish fly horse lobster
PEOPLE	(35) ⓐ KIN (16) aunt grandfather mother brother grandma papa cousin grandmother sister dad grandpa uncle daddy mama father mamma (11) ⓑ NONKIN/DESCRIPTION baby people boy woman children friend girl kid lady man men	(57) ⓐ KIN (10) brother sister daughter son family uncle father wife husband mother (23) ⓑ NONKIN/DESCRIPTION baby girl people boy human person child Indian woman children lady women enemy lord neighbor fellow master fool man friend member gentleman men	(73) ⓐ KIN (12) brother mother dad parents daughter sister family son father uncle husband wife (27) ⓑ NONKIN/DESCRIPTION baby fellow neighbor boy folks Negro child fool man children friend men Catholic American Russia Communist German patien Cuban kid person couple girl people customer guy woman

(cont'd)

CATEGORY	RINSLAND	THORNDIKE-LORGE	HOWES
1. TOYS, GAMES, SPORTS	(24) ball balloon bat bell bicycle block card doll drum football game gun horn jack-o'-lantern marbles scooter sled sleigh swing toy tricycle skate slide wagon	(3) ball game race	(8) ball card doll equipment football game race sport
BODY PARTS	(16) back ear eye face feet finger foot hair hand head heart leg mouth nose side teeth	(25) arm back blood body ear eye face feet finger foot hair hand head heart knee leg lip mouth neck nose shoulder side skin tear wing	(15) arm back blood eye face feet foot hand head heart knee leg muscle side teeth
CLOTHING	(15) bow cap chain coat dress gloves handkerchief hat shoe stocking suit sweater tie watch clothes	(10) chain clothes coat dress hat ring shoe suit tie watch	(6) belt clothes outfit suit tie watch
FURNITURE, PARTS OF HOUSE	(15) bath bed chair door fireplace floor kitchen porch room seat step table wall window yard	(14) bed chair door floor gate hall kitchen room seat step table wall window yard	(13) bed chair door downstairs floor kitchen room step table upstairs wall window yard

CATEGORY	RINSLAND	THORNDIKE LORGE	HOWES
ELEMENTS	(13) air clay fire ice light rain rock sand snow water weather wind wood	(22) air coal earth fire gold ice iron light oil rain rock silver smoke snow soil stone storm water wave weather wind wood	(8) air fire gas ice light rock water weather
BUILDINGS PLACES OF OCCUPATION	(11) @ General (11) barn building church farm home circus hospital house school shop store ⓑ Proper Names (0)	(15) @ General (15) bank building church college company court farm home house market office school shop station store ⓑ Proper Names (0)	(28) @ General (24) apartment bank building church camp court company college factory home hospital hotel house lab library lodge market office school shop station store stage university ⓑ Proper Names (4) M.I.T. Northeastern Harvard B.U.
GEOGRAPHIC	(10) @ General (10) country garden ground hill park place river spot star sun	(40) @ General (31) bay city cloud country field forest garden ground hill island land mountain nation ocean place plain river sea shore sky spot star state stream sun town valley village world	(43) @ General (22) area bay beach city coast country field ground hill island land mountain overseas park place river space spot state town

Table 10 (cont'd)

ATEGORY	RINSLAND	THORNDIKE-LORGE	HOWES
EOGRAPHIC, cont'd)	(b) PROPER NAMES (0)	(b) PROPER NAMES (9) America New York Chicago Washington England Europe France Germany London	(b) PROPER NAMES (21) America Europe Massachusetts Boston Florida Mississippi California France Puerto Cape Germany Rhode China Hampshire Rico Cuba Japan Russia England Mass. York
TOOLS	(9) bag board stick basket brick string box paint wheel	(8) bag case post board machine stick box paint	(6) bag case block stick board machine
VEHICLES	(7) airplane engine truck boat ship car train	(4) boat train car ship	(9) boat engine trailer bus ship train car plane truck
VEGE-TION	(7) flower leaf tree grass plant hay seeds	(6) branch plant flower rose grass tree	(1) plant
TERMS F UANTITY	(6) bit part lot piece pair set	(9) amount lot set bit part stock group piece supply	(10) amount lot supplies section bit part set group piece unit
RRENCY	(6) bill dollar nickel cent money penny	(5) bill dollar quarter cent money	(5) bill dollar quarter cent money
SCHOOL ITEMS	(6) desk paper pen book tablet pencil	(2) book paper	(2) book paper

Table 10 (cont'd)

...GORY	RINSLAND	THORNDIKE-LORGE	HOWES
...RITTEN ...MMUN- ...ATION	(5) letter valentine newspaper story page	(4) letter story note page	(3) letter newspaper story
...CHEN- ...ARE	(5) bowl dishes stove cup glass	(2) cup glass	(0)
MEDIA ... TRAVEL	(4) bridge street road track	(3) bridge street road	(5) bridge road street dock route
MEDIA ... COMMUN- ...ATION, ...USEMENT	(3) picture song radio	(3) picture song record	(6) picture record movie phone T.V. television
...ENERAL ...ERMS	(2) kind thing	(8) article material sort being matter thing kind object	(8) article matter thing being sort type kind stuff
...APONS	(0)	(0)	(2) bomb missile
...FICULT ... ...GORIZE ...ISC.)	(13) cage nest candle number color word flag sentence hole tickets line parade name	(20) art line shade circle mark shape color music sign cross name sound figure number square form point word hole scene	(12) cross point figure sign line sound mark term mess word name number

fell into 22 semantic categories although there were a few words from each table which were "difficult to categorize" (#23). These categories we have labeled 'animals', 'people', 'food', 'toys, games, and sports', 'body parts', 'clothing', 'furniture, parts of the house', 'elements', 'buildings, places of occupation', 'geographic terms', 'tools', 'vehicles', 'vegetation', 'terms of quantity', 'currency', 'school items', 'written communication', 'kitchenware', 'media for travel', 'media for communication, amusement', 'general terms' and 'weapons'. Table 10 shows that there are words from Rinsland which fall into each of these categories except 'weapons'. The majority of the words (i.e., more than 60%) from Rinsland fall into the seven categories 'animals' (36), 'people'(35), 'food' (27), 'toys, games, and sports' (24), 'body parts' (16), 'clothing' (15), 'furniture and home parts' (15). These categories accord well with classification of the nouns in the child's early spontaneous vocabulary (see, for example, Nelson, 1973, pp. 29-34). The fact that there are so many words in certain domains (e.g., 'animals', 'people', 'food', etc.) suggests that for these domains children very early learn a great number of words for classifying them and are not restricted to just a few terms.

A lot of the most frequently occurring words in child speech are the same as the most frequently occurring words taken from the adult counts. As noted earlier, there are words from each list which fall into each of the 22 semantic domains except for one. Another point of similarity across lists is that within these domains the list for children is just as likely to include a class name for that domain (e.g., 'animal', 'food', 'money', 'plant', 'clothes', 'place', 'building', 'toy', 'game') as are the lists for adults. Nonetheless, there are differences and these may be instructive. For example, the list for children contains many more words in certain domains (e.g., animals -- 36 for children, 7 and 5 for adults; toys -- 24 for children, 3 and 8 for adults) than do the lists for adults. On the other hand, the list for children contains far fewer terms for other domains than the lists for adults (e.g., geographic terms -- only 10 for children vs. 40 and 43 for adults; buildings -- only 11 for children vs. 15 and 28 for adults; general terms -- only 2 for children vs. 8 and 8 for adults). The distribution of words in the 'people' category is especially interesting. The list for children includes more kin terms (16) than the lists for adults (10 and 12). Notably lacking among the kin terms in the child's list, however, but present in both lists for adults are the terms 'wife' and 'husband'. Apart from kin terms other kinds of terms for people (non-kin descriptions, occupations, groups, and proper names) are more frequent in the lists for adults than the list for children.

Intuitively as a first approximation both the distribution of the most frequently occurring words in the list for children and the differences between this list and the lists for adults suggest that the most frequently occurring words for children are ones which are likely to be important to them in their day-to-day commerce with the world. Many of the categories which include the greatest number of terms for the children's list cover basic activities which are presumably important to the child in his early years (e.g., social interaction [people] , eating [food] , play [toys] , etc.). Moreover, it seems reasonable that since children do not normally work for a living, or travel as much as adults that they would not have as many occupational terms or geographic terms. Thus, the distribution of words in the child's list, by and large, seems to be consistent with the notion that these words denote objects that serve important functions in the child's life. Not all of these terms, of course, fit neatly into an interpretation of function or usefulness. Particularly, it is unclear why there are so many animal terms for children according to this interpretation. But as a rough characterization it would seem fair to say that a large number of the most frequently occurring names of objects according to Rinsland (1945) are words which denote objects which are likely to be important to the child in his daily activities. If our hypothesis is correct, that the most frequently occurring words in Rinsland are, in fact, the child's first category labels, then it would appear that the child first learns terms for objects that are useful to him and important to him which, after all, is not that startling.

2. The Naming Practices of Mothers (J. Anglin)*

When we use a name to refer to an object whether consciously or inadvertently we place that object in a category or class of objects which share the same category label. The word 'dog' refers to collies, terriers, poodles and several other species of dogs just as the word 'flower' refers to roses, tulips, carnations and several other kinds of flowers. A given object can be named in several different ways and each name serves to classify it at a certain level of generality. This particular dog might be called 'Lassie", a 'collie', a 'dog', a'mammal', **an 'animal'**, a 'being', an 'object', or an 'entity'. The name 'Lassie' is very specific and like all proper names focuses on the uniqueness of the object being named. It is a generic term only in that it applies to the same object over transformations in space and time. It singles out a particular being and distinguishes it from all of the other objects in the world. 'Collie' is a relatively specific or concrete name which applies to and groups together the members of a certain breed of dogs and distinguishes these from other breeds such as pointers, spaniels and poodles. 'Dog' is a more general name which groups the several breeds of dogs and distinguishes them from other kinds of animals such as cats, cows, horses and men. The name 'animal' groups this dog together with a great variety of living things such as cats, men, birds, fish and insects and distinguishes it from other forms of life such as trees, flowers, and shrubs as well as from the inanimate things of the world. The word 'being' serves to group it with all living things and to distinguish it from inanimate matter. The word 'object' serves to group it with the other things in a physical world and to distinguish it from the concepts of a mental world such as 'idea' and

*I am grateful to Ruth Berger and to Kay Tolbert for helping to collect the data for these experiments.

'truth' which can neither be pointed to nor touched.

Of the indefinitely large number of ways we could group this object with other objects in the world only a very few of the possibilities are sanctified with a name in English. In day to day discourse the terms 'Lassie', 'collie', 'dog' and possibly 'animal' are the terms used to denote this particular object. 'Mammal' is a term which is usually used in an academic environment, and 'being' and 'entity' are terms which are usually reserved for the philosopher.

Other things being equal an adult will often name an object as specifically or "concretely" as possible, presumably because a specific term conveys more information. If you tell me that a 'collie' bit you or a 'dog' bit you I know more than if you tell me that an 'animal' bit you or an 'entity' bit you. In a previous study (See #1 The Order of Acquisition Labels) adults when asked to name pictures of objects usually gave very specific names such as 'rose', 'Volkswagon' and 'collie'. Children, however, when asked to name the same pictures usually gave somewhat more general and less discriminating responses such as 'flower', 'car' and 'dog'. It seems reasonable that often children will learn the names of objects from adults in general and at least in their early preschool years from their mothers in particular. This speculation raises the question of why it is that the child does not learn the specific names which adults seem to use when they name objects. Is it possible that mothers tailor their naming practices for their children in a way which accords with the character of the child's vocabulary?

Roger Brown in an exceptionally penetrating paper (1958b) has argued that in fact parents will sometimes make an effort to take into account the utilities of a child's life in transmitting vocabulary to them. One of his examples is that some parents will, at first, call every sort of coin 'money' for their children since the young child does not need to know specific denominations of coins until he gets into the business of buying and selling. Brown points to three factors which may be of importance in determining the choice of a word by an adult for a child. The first is the brevity principle by which he means that the parent will tend to supply the child with shorter rather than longer words. The second is the frequency principle by which he means that adults will tend to use names which are commonly occurring. If frequently occurring words are in fact the words which are most likely to be useful to the child as I argued in another study (See #1 On the Order of Acquisition of Category Labels), then it makes sense that a parent would be inclined to provide the child with words which are relatively frequently occurring. For example, an adult will probably label a spoon with the more frequently occurring term 'spoon' for the child rather than the less frequently occurring term 'silverware', since the child will find it useful to distinguish spoons from knives and forks at the dinner table. There is of course a correlation between frequency and brevity (Zipf's law, 1935). Words which are commonly occurring tend to be short. Sometimes, however, the frequency-brevity principle will not hold even for the names provided by adults for their children. For example, an adult will tend to name an object 'pineapple' rather than 'fruit', 'hammer' rather than 'tool', or 'grasshopper' rather than 'insect', even though these terms are longer and less frequent than the alternatives. That is to say, there is a tendency to use a more specific or concrete term, presumably because the more specific term conveys more information. While frequency and brevity are positively related, specificity or concreteness is often negatively correlated with frequency and brevity. For example, 'pineapple' is longer (has more syllables) and less frequent (according to Thorndike and Lorge [1944]) than'fruit' or 'thing'.

The purpose of the following two experiments was to see whether or not mothers actually do tailor their choice of names of objects for their children and whether they do sometimes name objects differently for their children than for other adults. Frequency, brevity, and concreteness are systematically pitted against one another in every possible combination in order to determine the relative contributions of these three factors in determining the vocabulary supplied by adults to their children.

Method

Experiment 1: In the first experiment mothers named pictures of objects both for their 2-year old children and for the experimenter. The pictures had been placed in a loose-leaf binder, one per page, and the mothers were asked to name the first picture, to turn the page, to name the next picture and so on until she had named each of the pictures. She was to go through this procedure twice, once naming the pictures for her child and once naming them for the experimenter. As she named them for either her child or the experimenter she was to be sure that the person for whom she was naming them could see the pictures and was paying attention. Ten of the mothers named the pictures first for the experimenter and then for their children. The other 10 mothers named the pictures first for their children and then for the experimenter.

There were 24 pictures in all. Xeroxes of the pictures are shown on the next 24 pages. The pictures had been selected so that in the writer's

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Insert Pictures here

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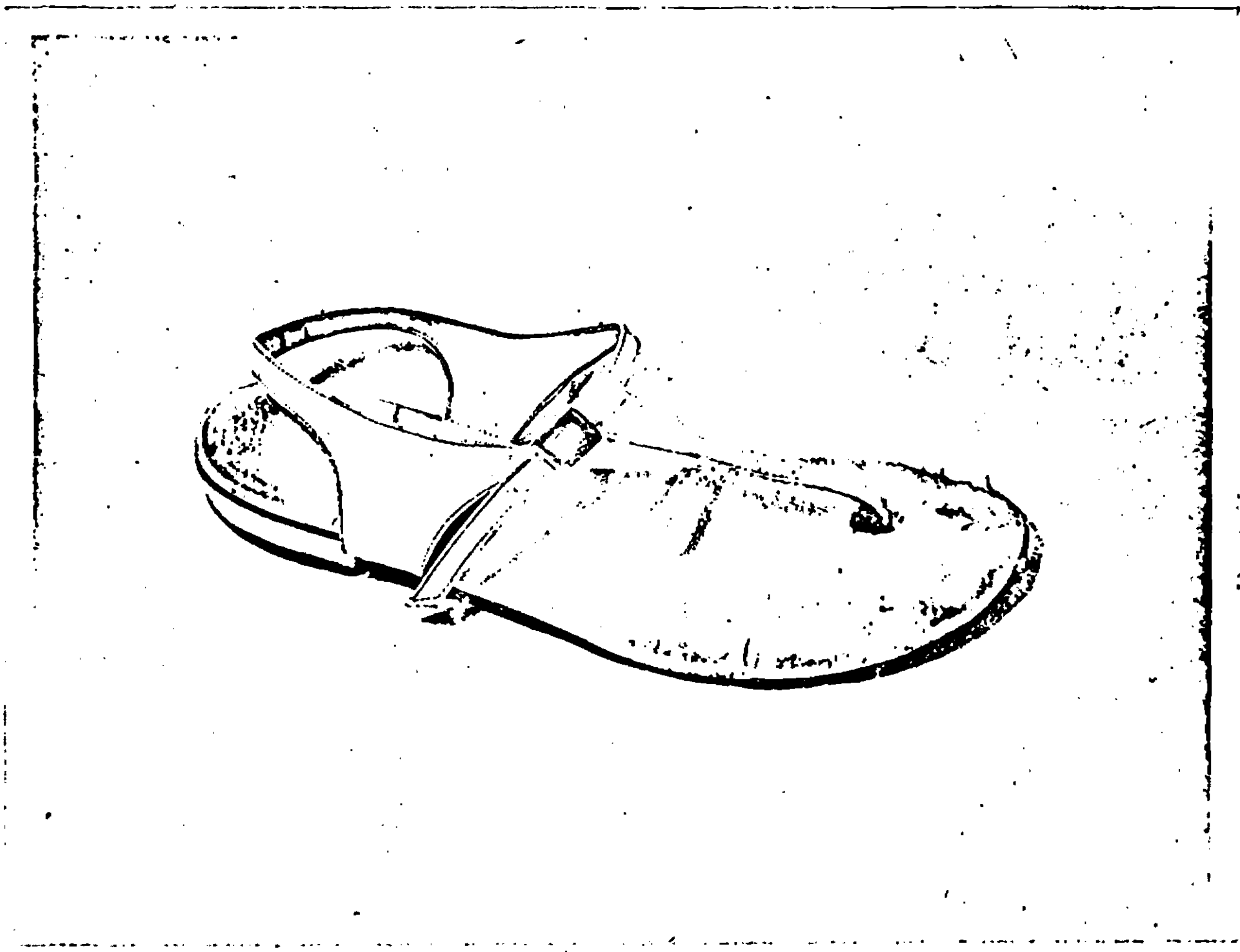
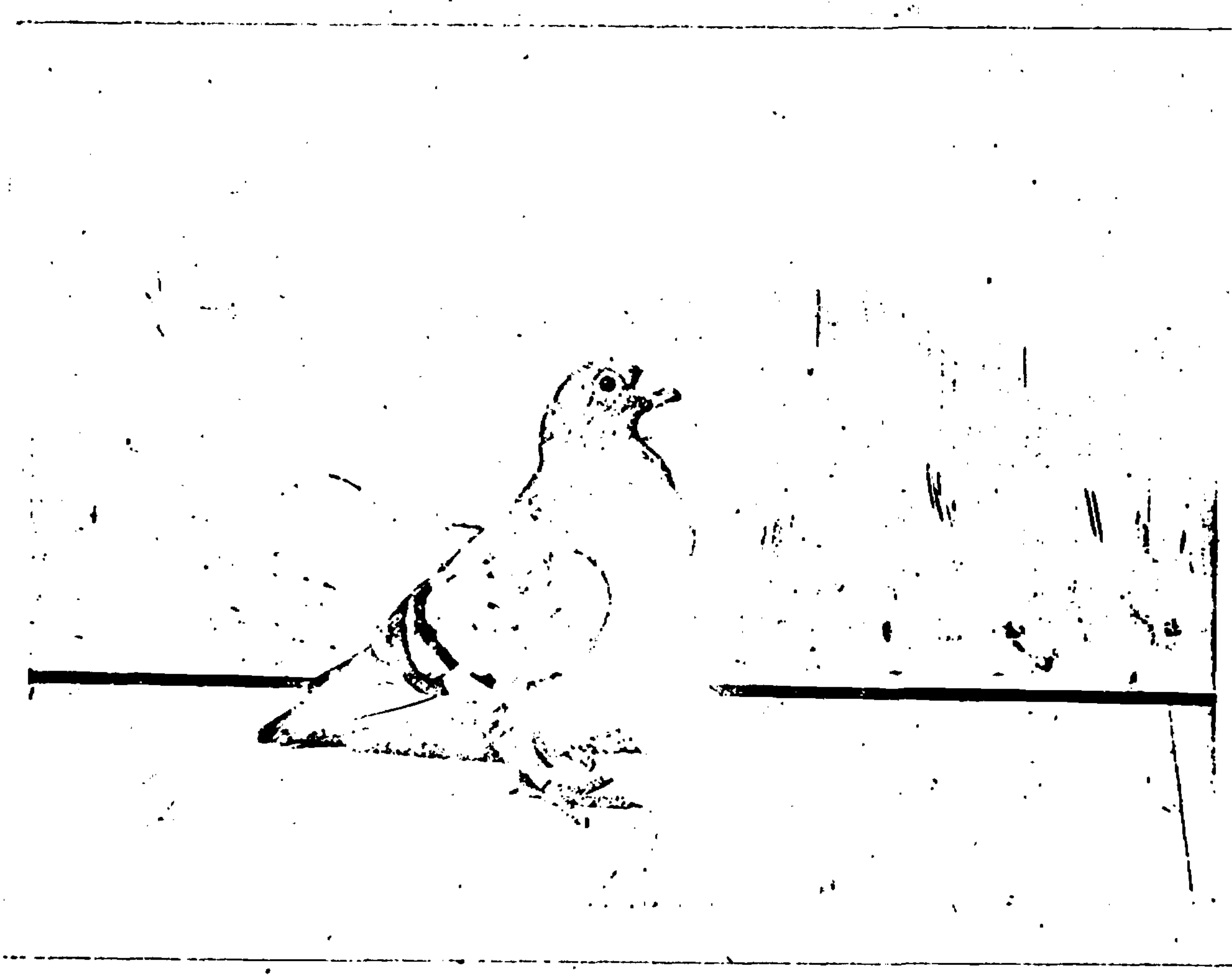
judgement at least two names were appropriate for each picture. The pair of names fell into 4 different types: (a) In the first the choice

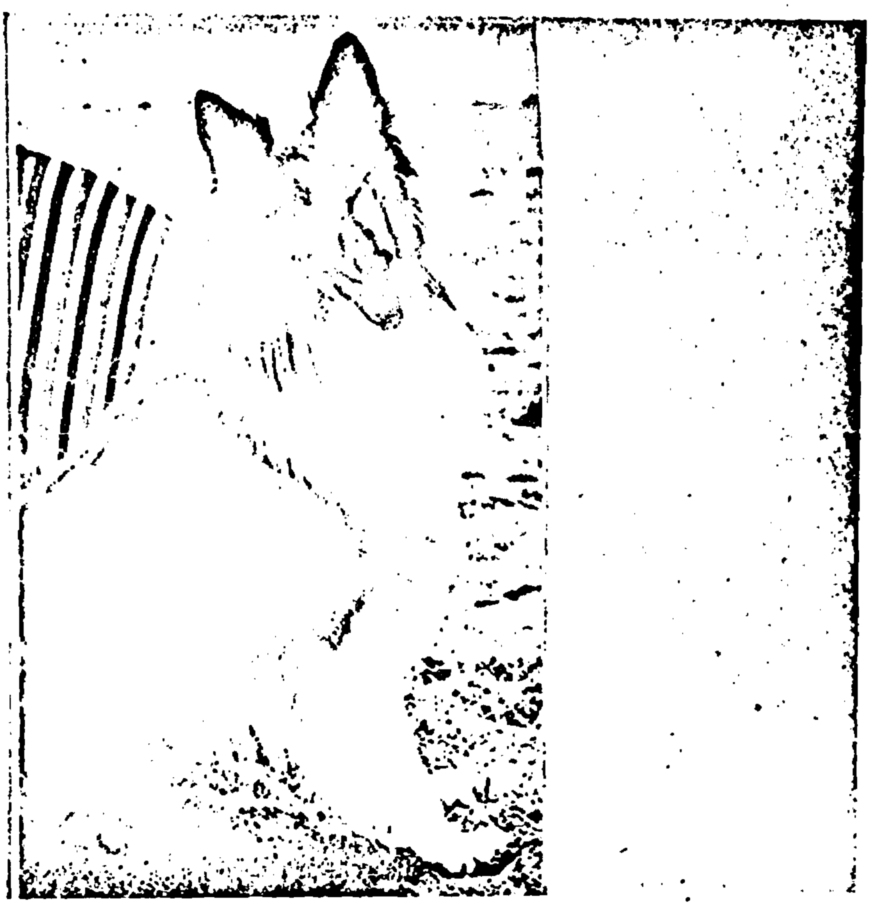
Pineapple



Sandal

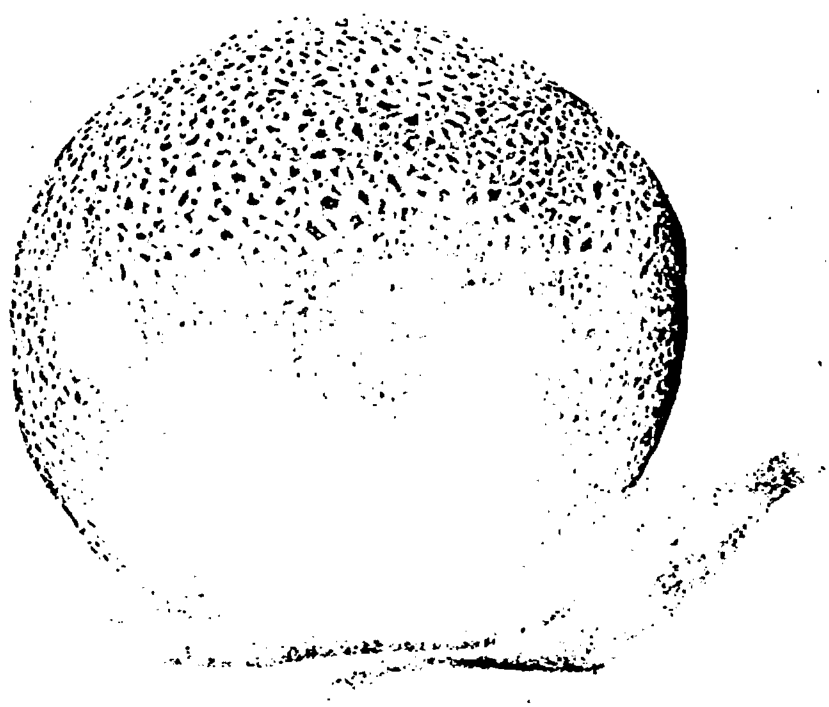


Pigeon

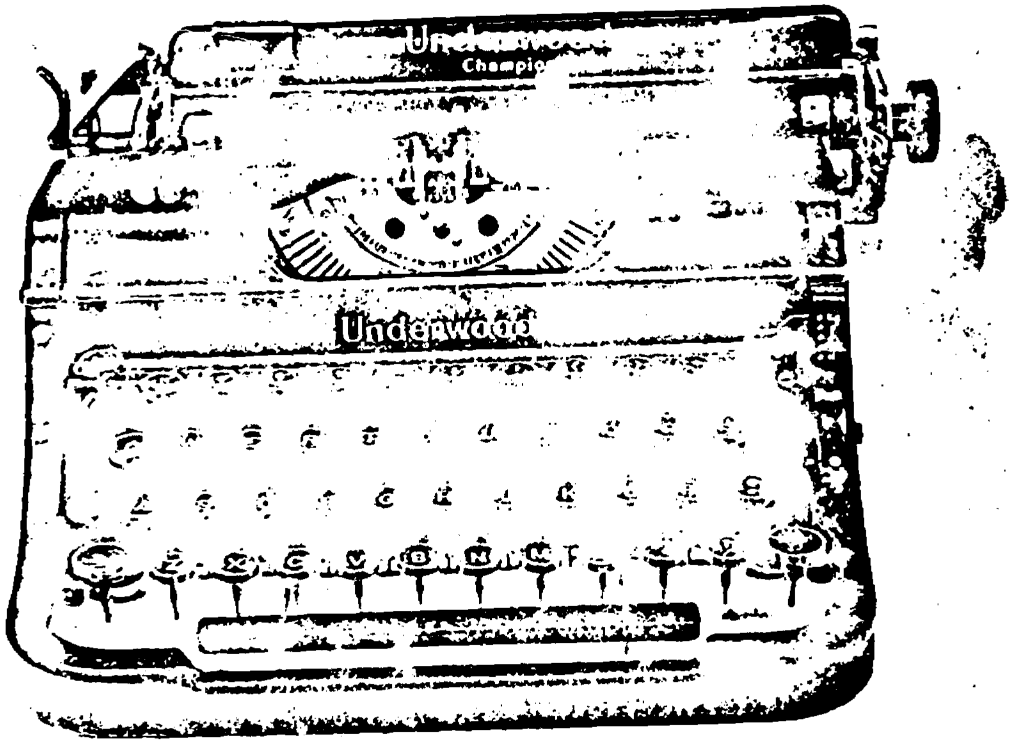


Collie

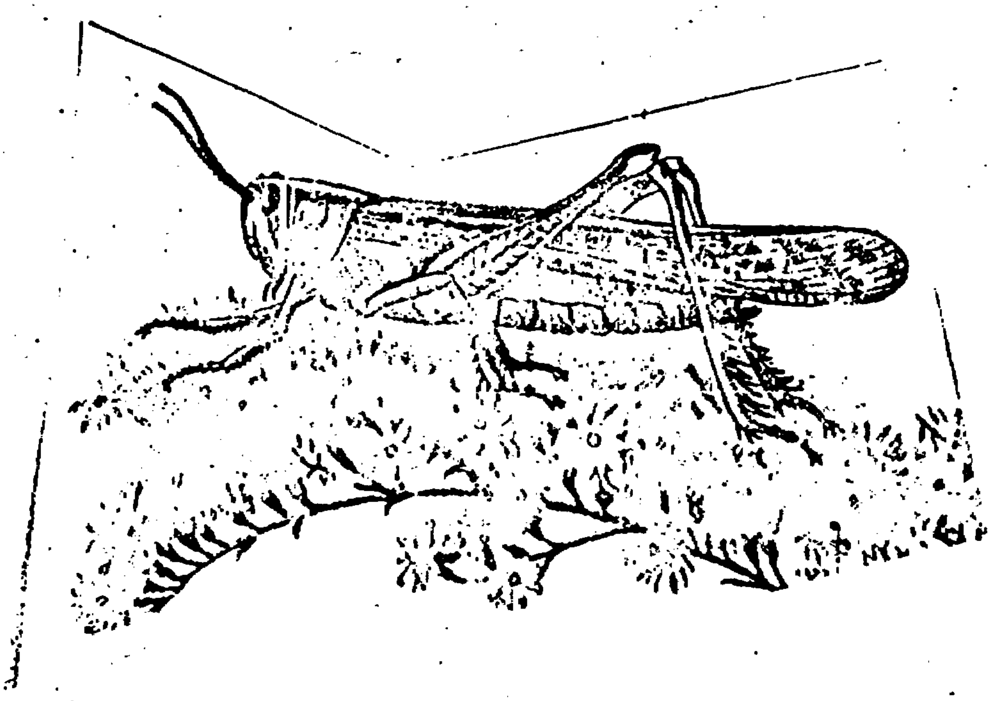
Carnation



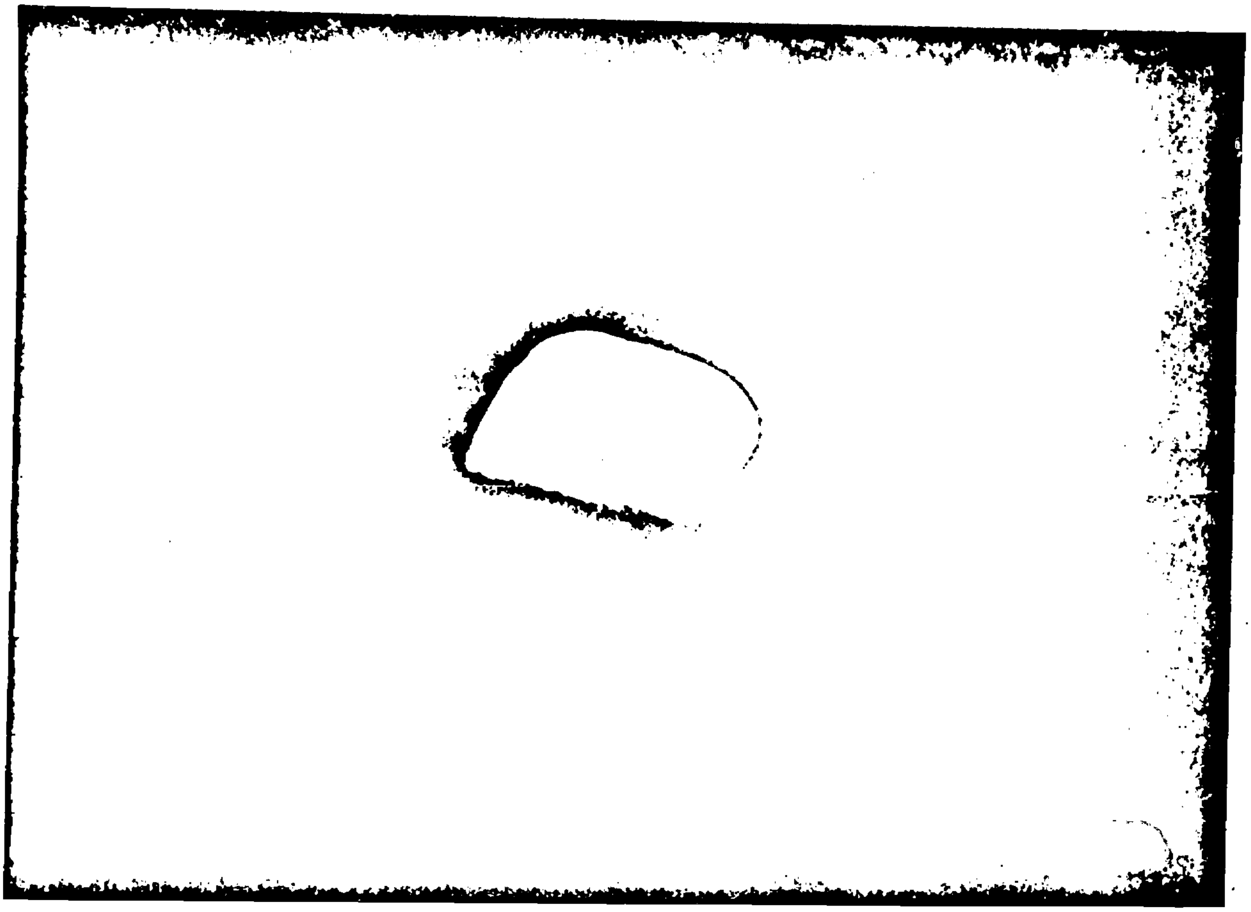
Cantaloupe



Typewriter



Grasshopper



Mint

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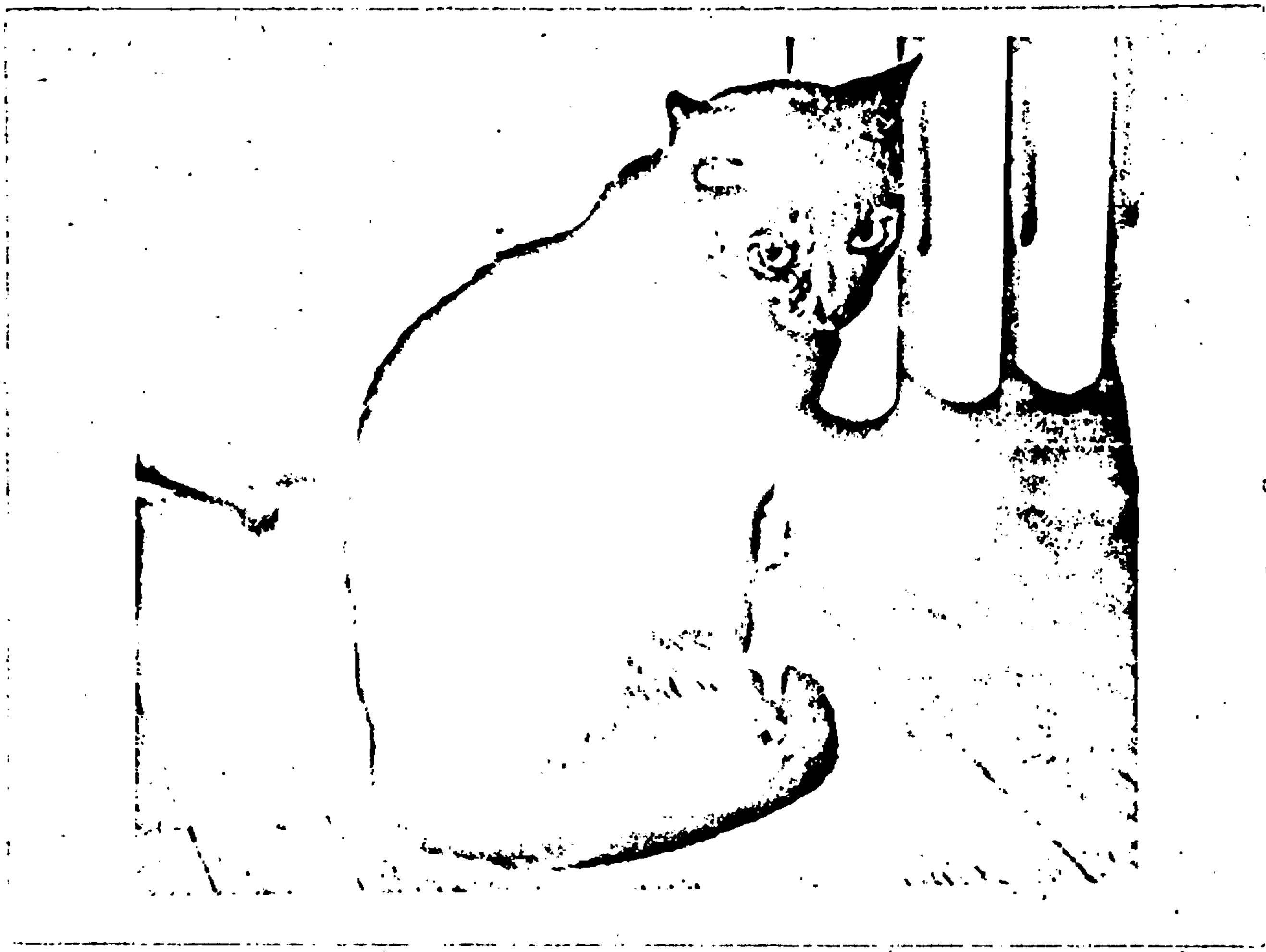
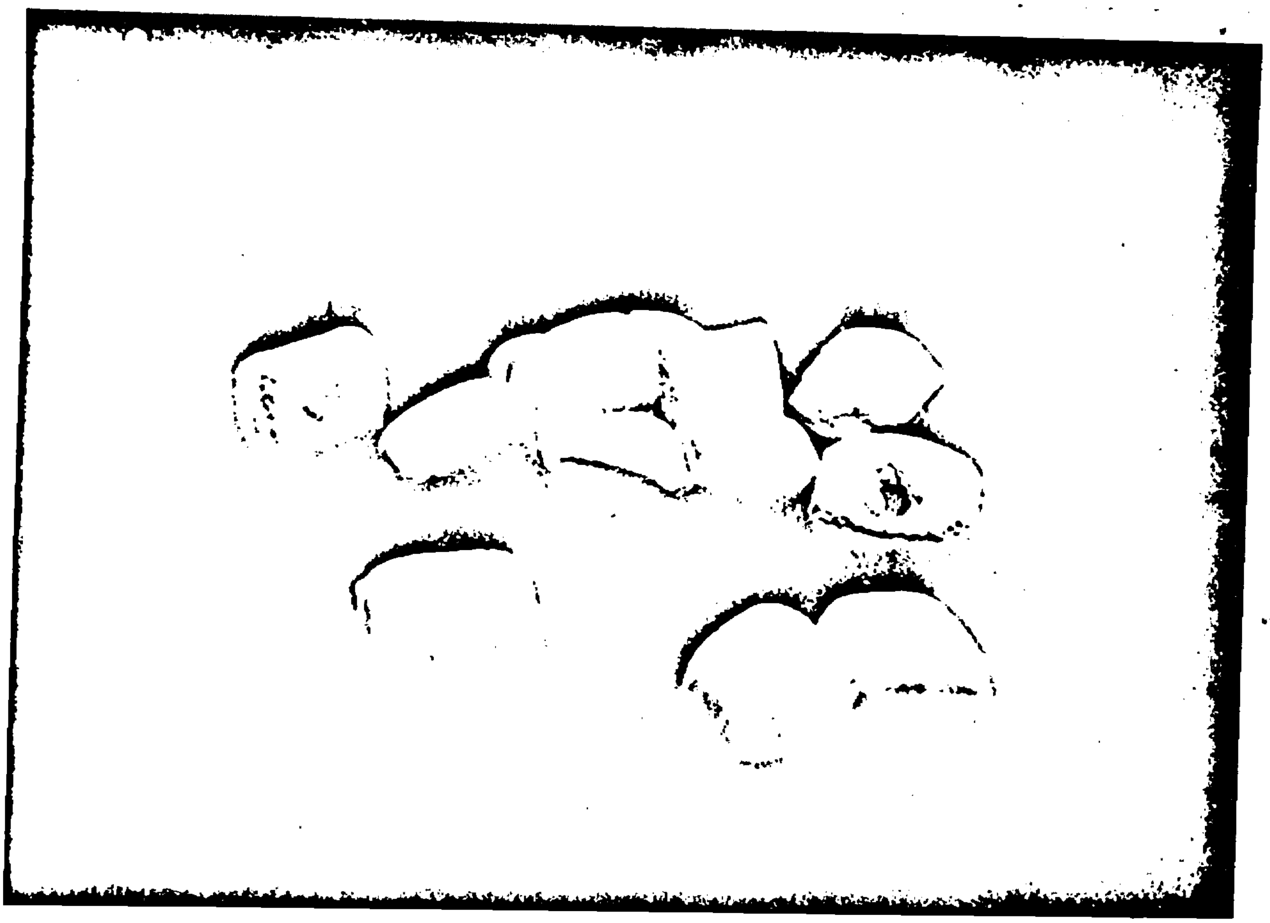
Dime

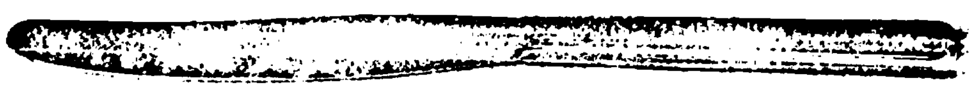
Ant



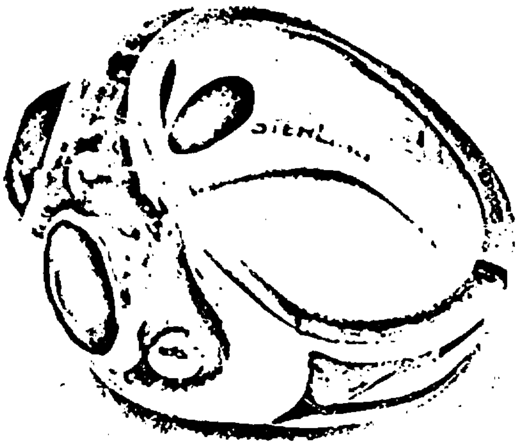
Cat



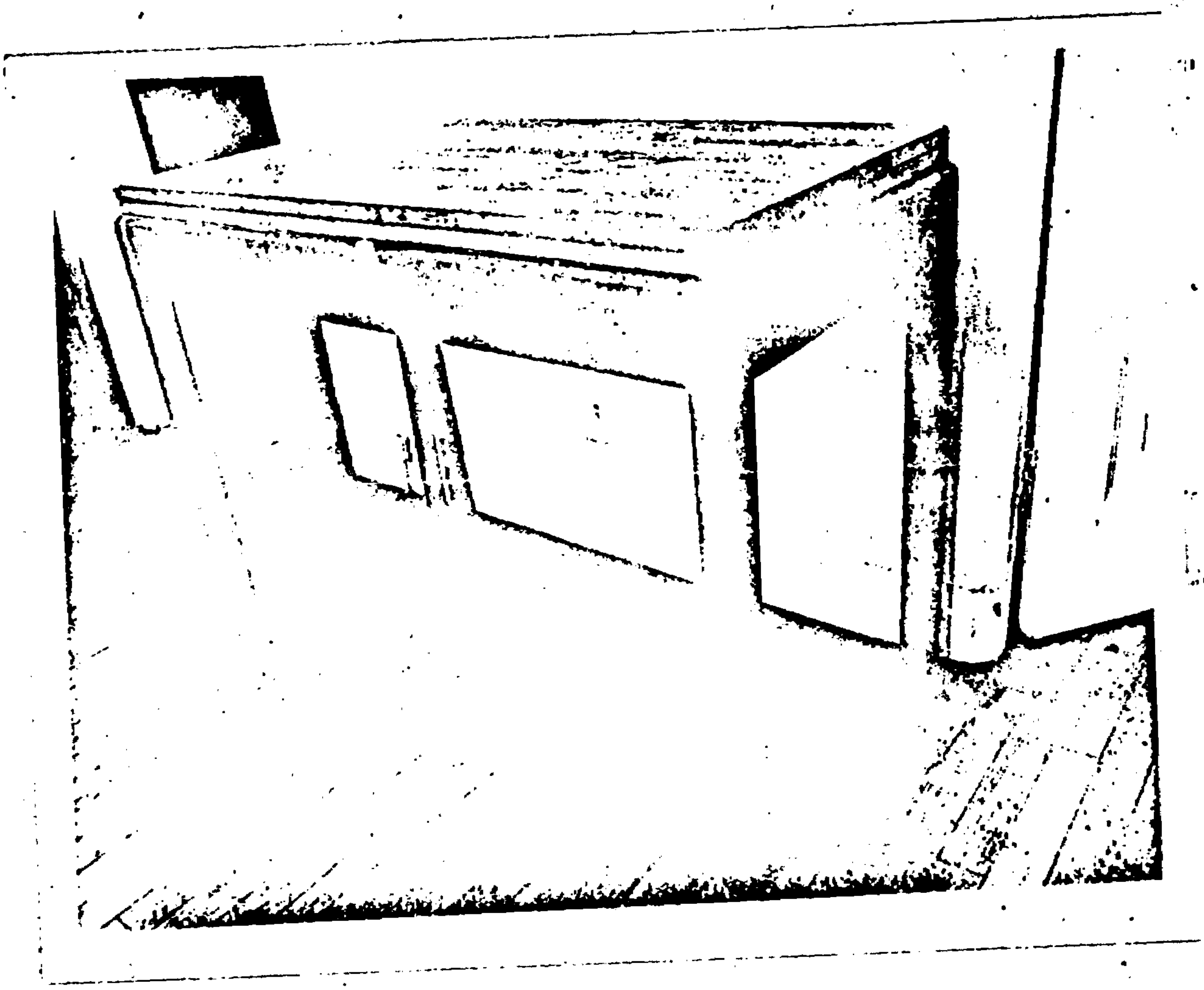
Mints



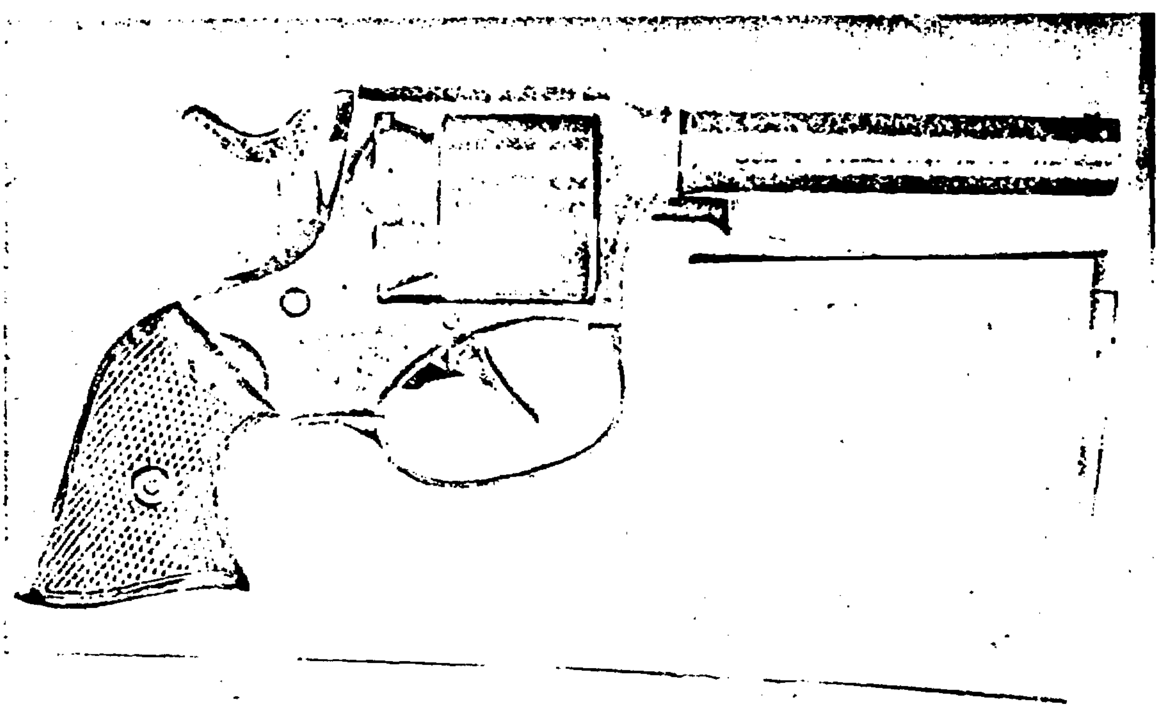
Knife



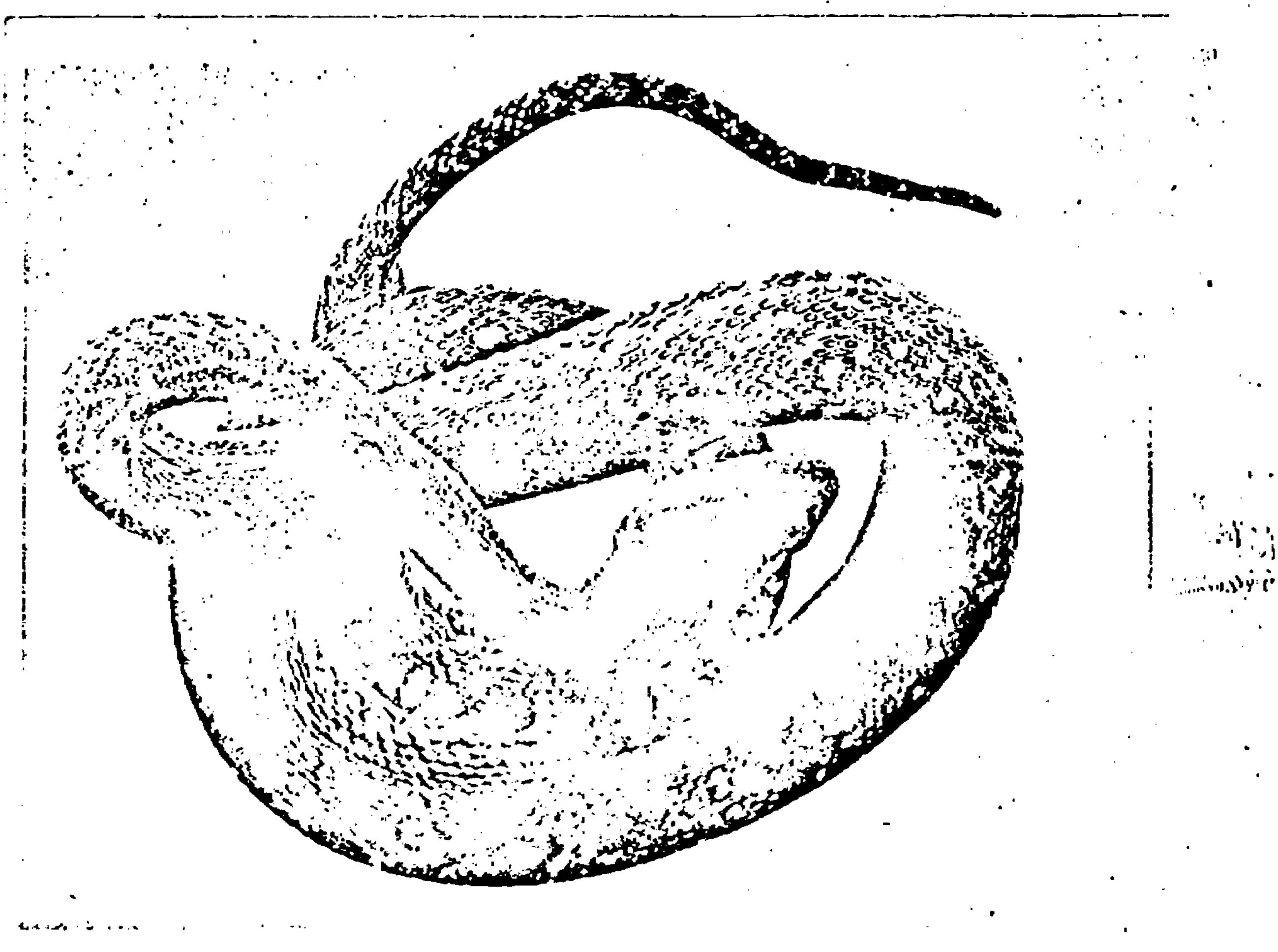
Ring



Table



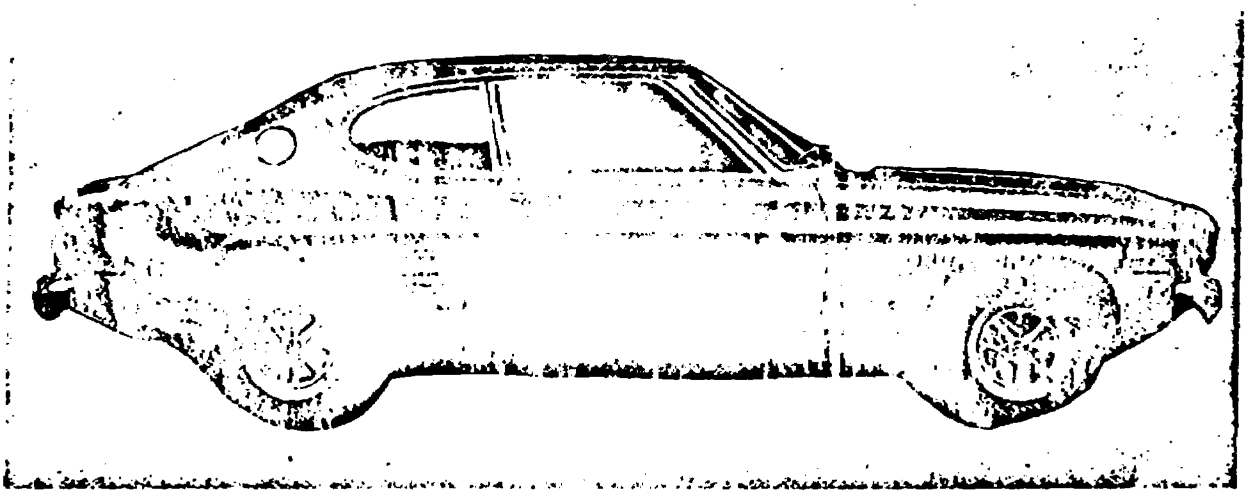
Gun



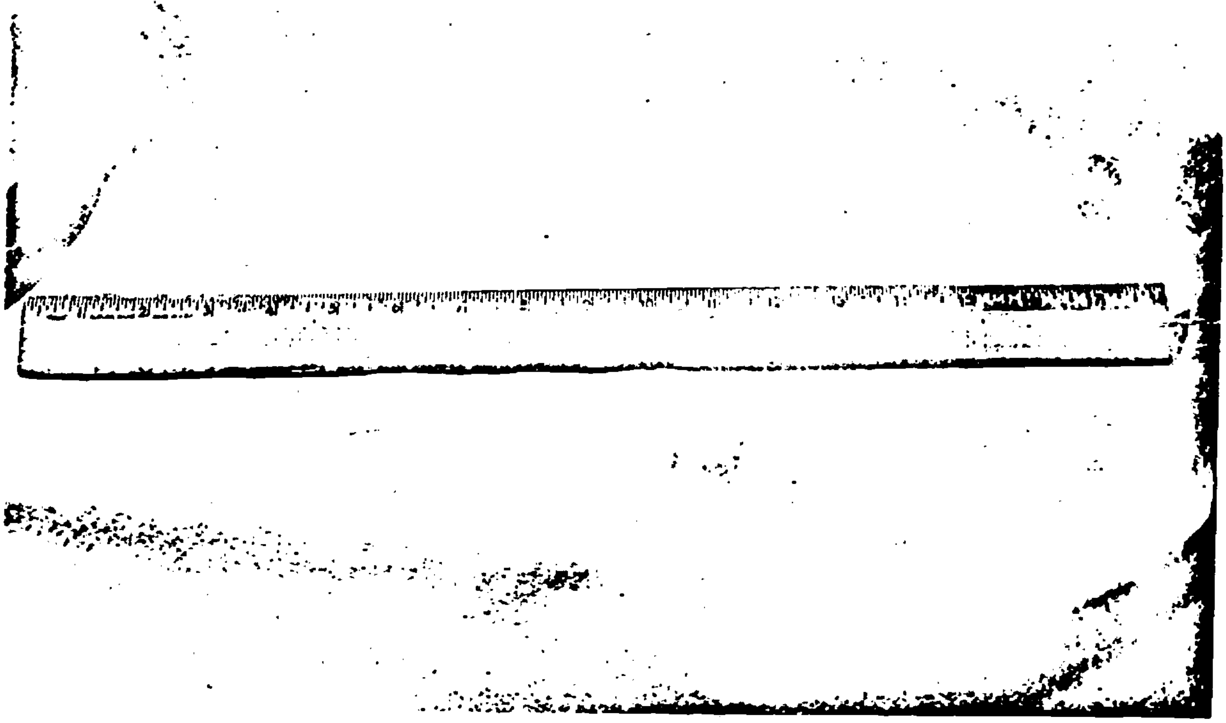
Snake

Elephant

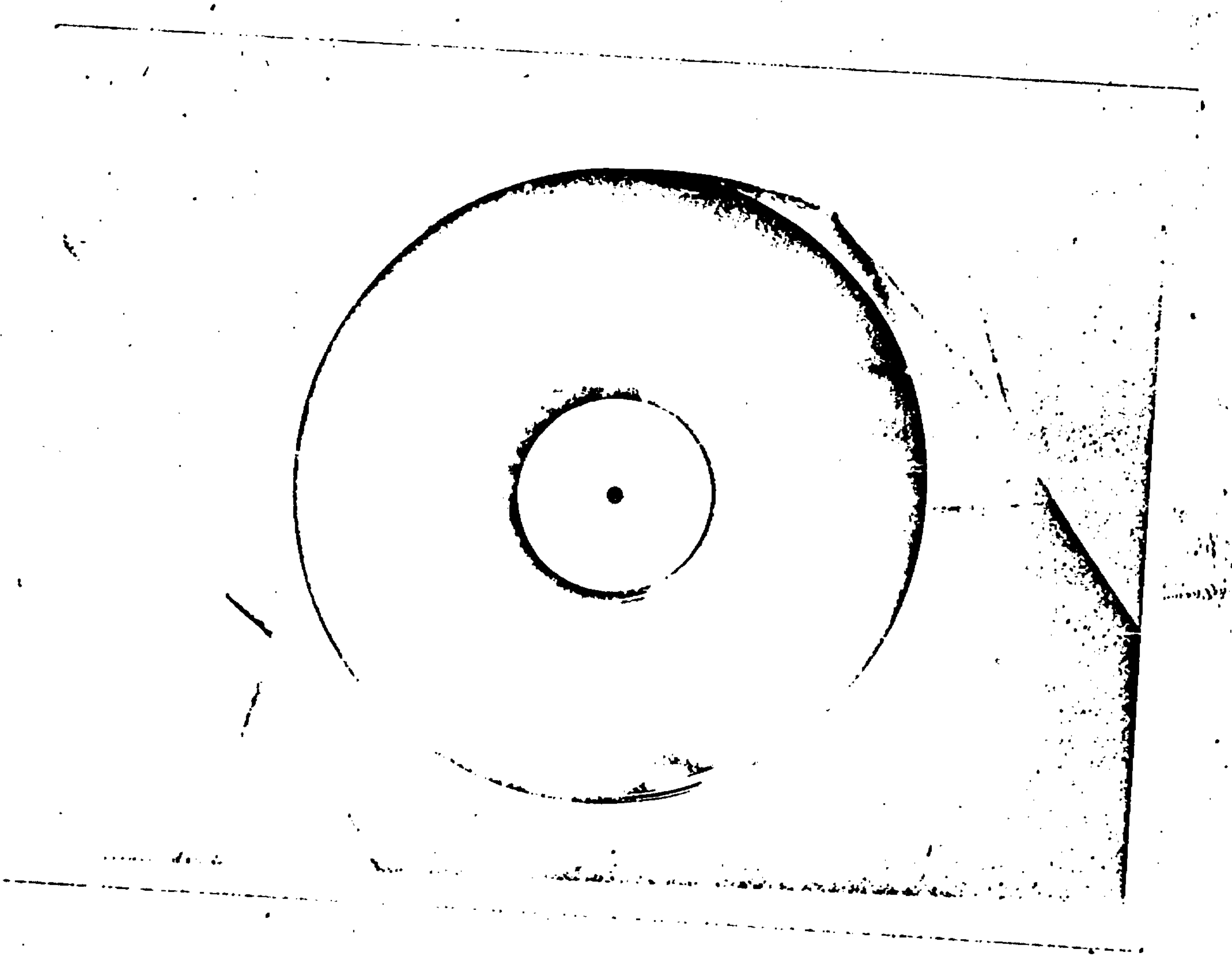
Refrigerator



Car



Ruler



Record

was between a specific, long, infrequent word vs. a general, short, frequent word. (A word was considered to be more specific than another if it was subordinate to it; longer if it contained more syllables; less frequent if it had a lower general frequency count according to Thorndike and Lorge [1944].) For example, 'collie' is specific, long, and infrequent relative to 'dog' which is by comparison general, short, and frequent. (b) In the second the choice was between a specific, short, and infrequent word vs. a general, long, and frequent word -- for example 'mint' vs. 'candy' or 'dime' vs. 'money'. 'Mint' is specific, short and infrequent relative to 'candy' which is general, long, and frequent by comparison. (c) In the third the choice was between a specific, short, frequent word vs. a general, long, infrequent word -- for example, 'knife' vs. 'silverware' or 'gun' vs. 'weapon'. (d) In the fourth set of word-pairs the choice was between a specific, long, and frequent word vs. a general, short, and infrequent word. It should be pointed out that these particular word-pairs took a long time to think of since shortness and generality are both usually signs of high frequency. Nonetheless, we did manage to come up with five such word pairs -- for example, 'refrigerator' vs. 'appliance' or 'elephant' vs. 'mammal'. These four categories of word pairs exhaust the possible combinations of the 3 variables under study.

Table 1 shows the vital statistics for the words being tested for in the mother-naming experiments. In addition to showing whether a word in a

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Insert Table 1 here

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pair was relatively specific or general, the number of syllables in each word, and the frequency count for each word according to Thorndike and Lorge (1944), Table 1 also shows the frequency of each word according to

Table 1

Vital statistics for words being tested for in the mother-naming study.

<u>Legend</u>:

#Syllab. = Number of syllables
F(T-L) = Frequency of occurrence of word according to Thorndike and Lorge (1944)
F(R) = Frequency of occurrence of word according to Rinsland (1945)

S-G? = Specific or General?

(a) Specific Long Infrequent

	S-G?	#syllab.	F(T-L)	F(R)
pineapple	S	3	15	3
sandal	S	2	5	—
pigeon	S	2	34	2
collie	S	2	3	—
carnation	S	3	1	1
cantaloupe	S	3	—	1
typewriter	S	3	12	3
hammer	S	2	34	15
grasshopper	S	3	14	5

General Short Frequent

	S-G?	#Syllab.	F(T-L)	F(R)
fruit	G	1	AA	57
shoe	G	1	AA	46
bird	G	1	AA	240
dog	G	1	AA	1198
flower	G	2	AA	73
fruit	G	1	AA	57
machine	G	2	AA	29
tool	G	1	40	5
insect	G	2	40	1

(b) Specific Short Infrequent

	S-G?	#Syllab.	F(T-L)	F(R)
mint	S	1	13	—
dime	S	1	11	33
ant	S	1	38	8
cat	S	1	A	1366
mints	S	1	13	—

General Long Frequent

	S-G?	#Syllab.	F(T-L)	F(R)
candy	G	2	32	269
money	G	2	AA	105
insect	G	2	40	1
animal	G	3	AA	32
candy(ies)	G	2	32	269 (1)

c) Specific Short Frequent

	S-G?	#Syllab.	F(T-L)	F(R)
knife	S	1	A	31
ring	S	1	AA	31
table	S	2	AA	187
gun	S	1	A	104
snake	S	1	28	47

General Long Infrequent

	S-G?	#Syllab.	F(T-L)	F(R)
silverware	G	3	2	—
jewelry	G	3	12	—
furniture	G	3	A	33
weapon	G	2	42	—
reptile	G	2	8	—

d) Specific Long Frequent

	S-G?	#Syllab.	F(T-L)	F(R)
elephant	S	3	35	64
refrigerator	S	5	11	3
automobile	S	4	A	36
ruler	S	2	32	4
record	S	2	AA	1

General Short Infrequent

	S-G?	#Syllab.	F(T-L)	F(R)
mammal	G	2	6	—
appliance	G	3	1	—
vehicle	G	3	13	—
gauge	G	1	5	—
disk	G	1	8	—

Rinsland (1945), Grade 1. We have included this information because we found that, of various frequency counts, Rinsland proved to be the best predictor of the child's vocabulary (See #1 On the Order of Acquisition of Category Labels). As it turned out, for 20 of the word pairs, if one word of a pair was more frequent according to Thorndike and Lorge (1944) then it was also more frequent according to Rinsland (1945). However, for 4 of the word pairs being tested for in these experiments the more frequent word according to Thorndike and Lorge was actually less frequent according to Rinsland. These 4 word pairs are 'hammer' - 'tool', 'grasshopper'-'insect', 'ant'-'insect' and 'cat'-'animal'. For example, 'cat' is infrequent relative to 'animal' according to Thorndike and Lorge (A vs. AA)*, but it is frequent relative to 'animal' (1366 vs. 32) according to Rinsland. Had we been aware at the time when we were designing this study of the strength of the correlation between frequency of occurrence according to Rinsland (1945) and the order of acquisition of category labels we would not have included these particular word-pairs.

Experiment 2: In the second experiment, 20 different mothers were tested. The procedure was comparable to that of experiment 1 except that this time the two names for a picture were written on a small slip of paper which was placed underneath the picture for which they were appropriate. Rather than naming the pictures spontaneously the mothers were asked to choose one of the pair of names in telling either the child or the experimenter what the object was. Again, half of the mothers chose names for the experimenter first, and then for their children; the other half chose names for their child first and then for the experimenter.

To see whether or not a child's names for this set of pictures would

*A means at least 50 per million but not so many as 100 per million;
AA means 100 or more per million.

correspond to the way the mothers had named them for their children in experiments 1 and 2 we asked 18 different children to name the objects depicted in the pictures. These 18 children were between the ages of 3 and 5 and were from homes in Cambridge, Massachusetts.

Results

The results for experiments 1 and 2 are presented in Table 2 which shows the number of times mothers chose either of the words in a pair

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Insert Table 2 here

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for all the word-pairs under study when naming the pictures for the experimenter and for their children. Also shown in Table 2 is the number of times the 18 different children named the pictures with either of the words in a pair for each of the word-pairs under study.

Consider each of the 4 types of word-pairs under study in turn. The first page of Table 2 (i.e., [a]) shows the results for pictures for which the names could be either specific, long, and infrequent or general, short, and frequent. For 5 of these pictures mothers clearly chose the specific, long, infrequent name more often for both the experimenter and their children. Thus, even though 'pineapple' is both longer and less frequent than 'fruit', mothers almost always called a picture of a pineapple a 'pineapple' rather than 'fruit' (cf. Brown, 1958b). So too for pictures of a cantaloupe, a typewriter, a hammer, and a grasshopper. These were called 'cantaloupe', 'typewriter', 'hammer', and 'grasshopper' much more often than the alternatives ('fruit', 'machine', 'tool', 'insect') even though the alternatives are shorter and more frequent. Thus it can be seen that mothers will sometimes supply their children with a specific word

Table 2

Table showing the number of times mothers chose the words under study for the experimenter and for their children in the two experiments on mothers' naming practices. Also shown are the number of times 18 different children named the pictures with the words under study.

Table 2

(a)

	SPECIFIC LONG INFREQUENT					GENERAL SHORT FREQUENT						OTHER		
	Adult-Adult		Adult-Child		Child-Adult		Adult-Adult		Adult-Child		Child-Adult	A-A	A-C	C-I
	1	2	1	2	N=18		1	2	1	2	N=18	1	1	N=1
pineapple	20	20	20	18	11	fruit	0	0	0	2	0	0	0	7
sandal	13	15	4	3	5	shoe	7	5	16	17	12	0	0	1
pigeon	15	16	8	5	3	bird	5	4	10	15	15	0	2	0
collie	6	10	1	0	0	dog	14	10	13	20	14	0	6	4
carnation	9	11	1	0	0	flower	11	9	20	19	18	0	0	0
cantaloupe	14	19	10	15	1	fruit	0	1	0	5	0	6	10	17
typewriter	20	19	20	19	18	machine	0	1	0	1	0	0	0	0
hammer	20	19	19	20	18	tool	0	1	1	0	0	0	0	0
grasshopper	20	19	19	18	12	insect	0	1	0	2	0	0	1	6

Table 2 (cont'd)

(b)

SPECIFIC SHORT INFREQUENT | GENERAL LONG FREQUENT | OTHER

	Adult-Adult 1	Adult-Adult 2	Adult-Child 1	Adult-Child 2	Child-Adult N=18		Adult-Adult 1	Adult-Adult 2	Adult-Child 1	Adult-Child 2	Child-Adult N=18	A-A 1	A-C 1	C-A N=1
* mint	7	13	4	1	0(1)	candy	7	7	8	19	0(4)	6	8	18(
* dime	15	18	5	7	1	money	1	2	11	13	2	4	4	15
ant	18	17	16	19	3	insect	0	3	1	1	0	2	3	15
cat	18	19	9	20	18	animal	0	1	0	0	0	2	11	0
* mints	9	16	4	4	4	candy(ies)	9	4	14	16	2	2	2	12

Table 2 (cont'd)

	SPECIFIC SHORT FREQUENT						GENERAL LONG INFREQUENT					OTHER		
	Adult-Adult		Adult-Child		Child-Adult		Adult-Adult		Adult-Child		Child-Adult	A-A	A-C	C-A
	1	2	1	2	N=18		1	2	1	2	N=18	1	1	N=18
knife	20	20	20	20	18	silverware	0	0	0	0	0	0	0	0
ring	20	20	20	20	10	jewelry	0	0	0	0	0	0	0	8
table	20	20	20	20	17	furniture	0	0	0	0	0	0	0	1
gun	16	19	20	19	15	weapon	0	1	0	1	0	4	0	3
snake	18	19	20	20	17	reptile	0	1	0	0	0	2	0	1

Table 2 (cont'd)

SPECIFIC LONG FREQUENT	Adult-Adult 1	Adult-Adult 2	Adult-Child 1	Adult-Child 2	Child-Adult N=18	GENERAL SHORT INFREQUENT	Adult-Adult 1	Adult-Adult 2	Adult-Child 1	Adult-Child 2	Child-Adult N=18	OTHER A-A 1	OTHER A-C 1	OTHER C-A N=1
elephant	20	20	20	20	18	mammal	0	0	0	0	0	0	0	0
refrigerator	19	20	18	20	15	appliance	0	0	0	0	0	1	2	3
automobile	0	20	0	20	0	vehicle	0	0	0	0	0	20	20	18
ruler	20	20	20	20	1	gauge	0	0	0	0	0	0	0	17
record	19	20	19	20	17	disk	0	0	0	0	0	1	1	1

even at a cost in length and frequency. In these five cases mothers usually name the objects depicted in the pictures in the same way for both adults and children. However, there are systematic differences between the way in which mothers name the other 4 pictures for an adult and for their children. Mothers most often call a picture of a sandal a 'sandal' for an adult but a 'shoe' for their child. They most often call a picture of a pigeon a 'pigeon' for an adult but a 'bird' for their child. They often call a picture of a collie a 'collie' for an adult but virtually never call it a'collie' for their children, but rather either 'dog' or the diminutive 'doggie'. And half of them call a picture of a carnation a 'carnation' for an adult whereas they almost invariably call it a 'flower' for their child. Thus it can be seen that in some cases mothers will choose a shorter and more frequent term as a name for their children, thereby sacrificing specificity, whereas they usually choose the most specific name for an adult.

A gain in both frequency and brevity will sometimes be sufficient to sway a mother to choose a less specific term for her child. How about a gain in either frequency or in brevity alone? The answers to this question are suggested by the second and fourth pages of Table 2. The second page of Table 2 (i.e., [b]) shows the results for pictures for which the names could be either specific, short, and infrequent or general, long, and frequent. The pattern of results here is similar to the pattern of results just considered. For two of the pictures mothers clearly chose the specific, short, and infrequent (at least according to Thorndike and Lorge) term more often for both the experimenter and their children. Thus, mothers called a picture of an ant an 'ant' and a picture of a cat a 'cat' far more often than 'insect' and 'animal' for both the experimenter and their children. However, the other three pictures revealed again differences between the mothers' naming practices for adults and for their children. A picture of a mint was more often called a 'mint' for adults but more often called 'candy' for children. The picture of a dime was more often called 'dime' for adults but 'money' for children. And the picture of a number of mints was most often called 'mints' for adults but 'candy(ies)' for children. Thus it seems that in some cases a gain in just frequency will be sufficient to sway a mother in her choice of a name for her child even though it involves a cost in both specificity and brevity.

The third page of Table 2 (i.e., [c]) shows the results for pictures for which the names could either be specific, short, and frequent or general, long, and infrequent. It should come as no surprise that for all pictures in this set mothers almost invariably chose the specific, short, frequent name over the general, long, and infrequent name for both the experimenter and their children. The specific, short, frequent names have everything going for them (i.e., specificity, brevity, and frequency) and indeed it would have come as a surprise if mothers had not chosen these terms for either the experimenter or their child.

Finally, consider the last page of Table 2 (i.e., [d]) which shows the results for pictures for which the names could either be specific, long, and frequent or general, short, and infrequent. For this set of pictures mothers never chose the general, short, infrequent name for either the experimenter or their children. For 4 out of 5 pictures they almost invariably give the specific, long, and frequent names ('elephant', 'refrigerator', 'ruler', and 'record') in both experiments 1 and 2. For the picture of a car when they were asked to name it spontaneously in experiment 1 they always said 'car' rather than 'automobile' but in experiment 2,when forced to choose between 'automobile' and 'vehicle',they always chose 'automobile'. Thus, at least for these word-pairs,a gain in brevity alone is <u>never</u> enough to sway a mother to sacrifice specificity and frequency in choosing a name for her child.

When the eighteen 3 to 5 year old children were asked to name the pictures they sometimes had difficulty. This was probably due to two factors: (1) their limited vocabulary and (2) the ambiguity of certain pictures, especially the pictures of a single mint and of a group of mints. Nonetheless, in 23 out of 24 cases they used the same names as the ones that the mothers had used most often <u>when naming the pictures for their children</u>. This of course means that for some of the pictures they did not use the names that the mothers had used most often <u>when naming the pictures for the experimenter</u>. Thus, for example, mothers tended to name a picture of a sandal a 'sandal' for adults but a 'shoe' for children, or a picture of a pigeon a 'pigeon' for adults but a 'bird' for children. The children's words for these pictures were most often 'shoe' and 'bird', thus corresponding with the mothers' names for children rather than their names for adults. The one exception to this general rule was in the case of the picture of several mints for which 4 children gave the name 'mints' whereas only 2 used the word 'candies', which had been the preferred name of mothers for their children. Apart from this one slight exception the children's names for the pictures accord better with the way in which mothers named them for their children than with the way they named them for an adult.

Discussion

Although the child's vocabulary is often described as 'concrete', it is in fact only relatively so. It is true that the child lacks very general terms such as 'object', 'article', 'matter', etc., which are very frequently found in the vocabulary of adults. But at the same time he also lacks very specific terms such as 'collie', 'carnation', 'Volkswagon' and so forth. His words tend to cluster at some intermediate level of generality which classifies the world into categories which are not too big but then again not too small.

When an adult names an object for another adult she often uses as specific a term as possible, presumably because a specific term conveys more information. It seems reasonable to assume that the child will learn many of his category labels from listening to his mother name the various objects in his world. This raises the question of why the child does not learn the very specific terms (e.g., 'collie', 'pigeon', 'sandal')that mothers often use when they name objects. At least part of the answer seems to be that when naming objects <u>for their children</u> mothers will not as often use these specific terms. Rather a mother will sometimes tailor her choice of a name for an object for her child, thus supplying him with vocabulary at an intermediate level of generality.

A mother will not always choose the most frequently occurring word when naming objects for her children. In some cases she will favor a more specific term over a more frequently occurring alternative (e.g., 'pineapple' vs. 'fruit'). But whenever there is a difference between the way in which a mother names an object for her child and for an adult, it is always in the direction of the more frequently occurring but less specific word for the child and of the less frequently occurring but more specific term for the adult.

In addition to the tendency to supply a child with a frequently occurring word there may also be a tendency to supply the child with a shorter word rather than a longer word as Brown (1958b) has argued; but on the basis of this study it would not appear to be as strong a factor. Usually of course frequency and brevity are correlated and so when the adult names a particular object a 'car' rather than an'automobile' it is not clear whether this preference is related to a preference for frequently occurring words or for short words or for both. However, in this study which attempted to disentangle the relative contribution of these factors it was seen that mothers would sometimes choose a word whose only advantage seemed to be that it was frequently occurring when naming objects for their children (e.g., 'money' over 'dime'; 'candy' over 'mint') whereas they never chose a word whose only advantage was brevity.

I have previously argued (See #1 <u>On the Order of Acquisition of Category Labels</u>) that the child's first terms of reference are, in fact, the most frequently occurring names of objects in English. Children will of. n acquire these first terms of reference from the way in which their mothers name objects for them, at least initially. The present study addressed the question of whether or not there is a tendency, in fact, on the part of mothers to supply children with these frequently occurring words. The answer appears to be 'yes', which simply means that the child's first terms of reference are consistent with the kinds of terms a mother transmits to her child in the original naming process.

3. <u>On the Extension of the Child's First Terms of Reference</u>
(J. Anglin and Marvin Cohen)

The vocabulary of a child cannot be taken as a direct measure of his conceptual categories for it cannot be assumed that when he has a word in his vocabulary that it has the same meaning for him as the corresponding term in an adult's vocabulary or that he uses it to refer to the same range of referents as is encompassed by the adult term. One can imagine several possible relationships between the extension of a child's term and of the corresponding adult term, seven of which are illustrated in the form of Venn diagrams in Fig. 1.

Insert Fig. 1 here

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(1) <u>Underextension</u>: The child might use the term to apply to only a subset of the objects included in the corresponding adult concept. For example, the child might include only mammals in his concept of 'animal'. (2) <u>Overextension</u>: The child might use the term to apply to a broader range of referents than the adult does. For example, he may initially apply the term 'dog' to all quadrupeds. (3) <u>Overlap</u>: The child might use the term to apply to some of the same objects that an adult does, not apply it to some objects covered by the adult term, and apply it to some objects not encompassed by the adult term. For example, the child might apply the term 'flower' to most flowers but not to roses and daisies and, in addition, might apply the term to other kinds of plants. (4) <u>Non-overlap</u>: The child might use the term to apply to a completely different range of referents from the range of referents covered by the adult term. This particular relationship would seem to be unlikely but would prevail, for example, if the child used the term 'dog' to apply only to cats. (5)The child might not use the word to apply to any referent. This is the case for terms which have not yet entered the child's

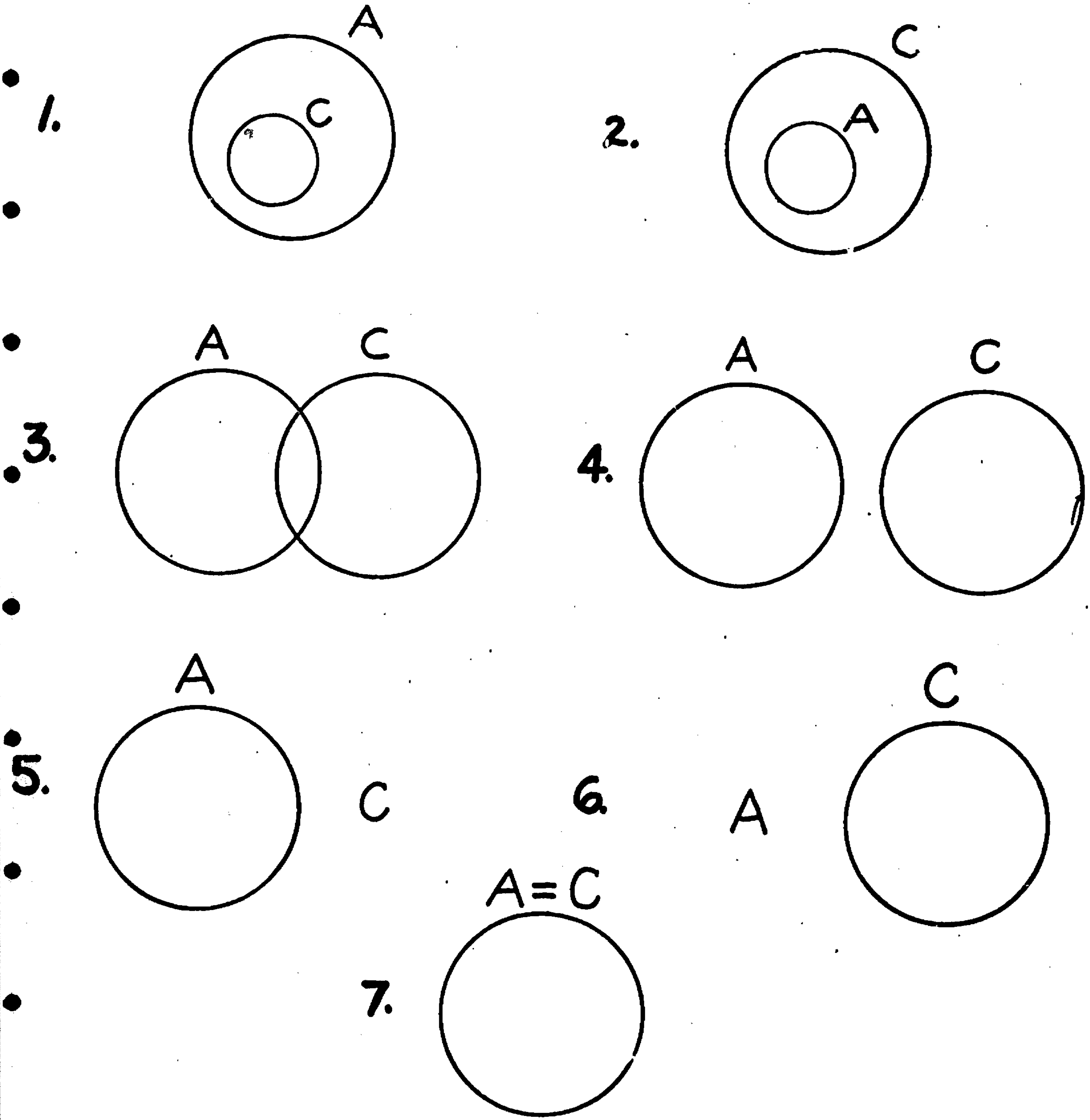

Fig. 1

Venn diagrams illustrating possible relationships between the extension of a child's word and of the corresponding adult term. (See explanation of diagrams, next page.)

Fig. 1

1. Underextension: $C \subset A$: The child uses the term to apply to only a subset of the objects included in the adult concept.

2. Overextension: $A \subset C$: The child uses the term to apply to a broader range of referents than the adult does.

3. Overlap: $A \not\subset C$; $C \not\subset A$; $A \cap C > 0$. The child uses the term to apply to some of the same objects as an adult does but overextends the term to some objects and does not apply the term to some objects covered by the adult term.

4. Non-overlap: $A \cap C = 0$ where $A > 0; C > 0$. The child uses the term to apply to a completely different range of referents from the range of referents covered by the adult term.

5. $A > 0$; $C = 0$: The child does not use the word to refer to any referent.

6. $C > 0$; $A = 0$: The child uses the word to refer to a range of referents whereas the adult does not.

7. Concordance: $A = C$. Adult and child use the term to apply to exactly the same range of referents.

vocabulary. For example, he may never use the term 'philodendron' to refer to anything. (6) The child might use a word which does not exist in the adult's vocabulary to apply to some range of referents. For example, the child might invent a word such as 'psee' to apply to flowers, trees and other forms of vegetation, or 'dee-dee' to apply to cars, trucks and other vehicles. (7) Concordance: The child might use the term to apply to exactly the same range of referents as is encompassed by the adult term. For example, the child might use the term 'person' to apply to exactly the same set of featherless bipeds as the adult does. This state of concordance presumably represents the end state toward which development progresses.

The psychological literature on the subject for the most part has characterized the relationship as one of overextension -- the child is portrayed as using a term of reference to apply to a broader range of objects than the adult does (see for example Leopold, 1939, 1948; Luria and Yudovich, 1959; Chamberlain and Chamberlain, 1904; Brown, 1958b; E. Clark, 1973). The corresponding developmental process is therefore viewed as differentiation -- the child who begins with overly general categories gradually narrows these down until they focus on the same range of referents as are encompassed by the adult terms.

Many of the protagonists of this point of view offer as the primary source of evidence for their hypothesis (i.e., that the child's early concepts are overly general) the results of diary studies in which the words used by the child are recorded along with the contexts in which they are used (see for example Leopold, 1939, 1948; Moore, 1896; Stern, 1924; Chamberlain and Chamberlain, 1904). Eve Clark (1973) has recently written a valuable review of the diary literature (although I disagree with her theoretical position). The point often stressed by these writers is that the child often overextends a term to objects which are not included in the adult category. For example, children have been observed to use the term 'papa' to apply to men other than their fathers (Moore, 1896), the term 'bird' to apply to cows, dogs, cats and other animals (Moore, 1896), the term 'fly' to apply to specks of dirt, dust, small insects, toes, bread crumbs and a toad (Moore, 1896), the term'bottle' to apply to various glass containers (Leopold, 1939), the term 'train' to apply to an airplane, a wheelbarrow and a streetcar (Leopold, 1939), the term 'mama' to apply to many different women (Leopold, 1948), the term 'dog' to apply to various animals (Stern, 1924), the term 'goose' to apply to a wren, a sparrow, an ostrich and a camel (Stern, 1924), the term 'carrot' to apply to a carrot, a turnip, a plum and a watermelon (Luria and Yudovich, 1959) and so on. Eve Clark has argued that overextension is language independent and universal. Furthermore, she argues that the determinant of overextensions is perceptual similarity between the object overgeneralized to and the instances of the class denoted by the term which is overgeneralized. "The majority of overextensions seem to be based on the perceived similarities among objects or events included referentially in a single category. The principle characteristics can be classified into several categories such as 'movement', 'shape', 'size', 'sound', 'taste' and 'texture'."(Clark, 1973). According to Eve Clark, the child narrows down the meaning of an originally overextended term as he adds new features to the word as new words are introduced to take over sub-areas of the semantic domain.

Undoubtedly there are instances of overgeneralization in the child's early use of words. However, the evidence from diaries is systematically biased to show overextension only and, because of the way it is collected and interpreted, cannot reveal underextension if it occurs. Consider the way these data are collected in terms of a specific example:

Referent	Name	Error
collie	'dog'	No error
cat	'dog'	Overextension
poodle	---	---(Not recorded)

If in the presence of a collie the child uses the word 'dog', he is using the term as an adult would and is therefore considered to be correct. Now suppose that in the presence of a cat the child says 'dog'. This is counted as an overextension error because the child is referring to an object by means of a term that is more restricted in adult use. (Notice that if the word 'cat' is in the child's vocabulary, then this could be considered to be an example of under-extension of the word 'cat' although it is never recorded as such.) Now suppose the same child sees a poodle but does not realize that this particular creature is an instance of the word 'dog' and therefore does not use the term. This sort of occurrence is not recorded since the child has not spoken. In other words the child either uses a word appropriately or he does not. Whenever he uses the word appropriately his response is counted as correct. Whenever he does not use the word appropriately his response is counted as incorrect and an instance of overextension. In this way diary studies are systematically biased to show overextension and to suggest differentiation (narrowing down categories) as the developmental process. They cannot show underextension and therefore they cannot reveal the process of generalization (filling out categories) if it occurs in the development of verbal concepts. It is possible, therefore, that overgeneralization is like the tip of an iceberg, the most visible but neither the only nor necessarily the most prevalent component of the child's referential problems.

A similar criticism can be levied at an influential experiment in "perceptual learning" by Eleanor and James Gibson (1955). They first presented a nonsense scribble to subjects of different ages whose task it then was to identify that nonsense scribble in a pack of 34 cards made up of 17 similar, 12 different and 4 identical cards. The Gibsons tested three groups of subjects in their task: adults, older children (8 1/2 to 11 years) and younger children (6 to 8 years). The only data that they report in this study are responses to the 17 different but perceptually similar items. They found that the number of times a subject identified these 17 items as the critical figure decreased with age. That is to say, young children said that these 17 different items were the critical figure more often than did adults. Thus the Gibsons argued that "perceptual learning" was a matter of increasing differentiation.

Again, however, since each of the 17 instances was different from the critical figure, there was no opportunity to show undergeneralization or overdiscrimination errors. That is, a subject either said that one of the 17 figures was the critical figure or he said it was not. If he said it was not then he was scored as correct. If he said it was then he was scored as incorrect and this was counted as an error of overgeneralization or lack or differentiation. There was no opportunity to show the opposite kind of error, undergeneralization or overdiscimination.

Saltz and Sigel (1967), partially in response to the study by the Gibsons, did a nice experiment along the same lines in which they provided an equal opportunity for both overgeneralization and overdiscrimination errors. Subjects of different ages were shown several sets of pictures of boys with 4 pictures in each set. The subject was shown the first picture in a set and was told that the next 3 pictures might or might not be of the same boy. The subject's task was to say whether or not each of the 3 pictures was of the same boy. In the various sets, either 0, 1, 2 or 3 of the pictures were of the same boy whose picture was used as a standard. Thus in this study there was the possibility of both overgeneralization and undergeneralization. Overgeneralization occurred when the subject said that a picture of a different boy was the same boy; overdiscrimination occurred when the subject said that a picture of the same boy was a different boy. In fact, subjects made both kinds of errors, the number of errors decreasing with age. Moreover, young children made more overdiscrimination errors than overgeneralization errors, whereas adults made more overgeneralization errors.

These studies, while relevant to our problem methodologically, are not concerned with quite the same kind of developmental process that is the topic of this inquiry. They deal with the development of what might be called identity categories -- the ability to recognize a given object as being the same at different times. Our concern is rather with the development of equivalence categories ---- the ability to group discriminably different objects under the same category label. In the experiment reported below, in a fashion analogous to the approach taken by Saltz and Sigel (1967), we have tried to improve upon diary studies by allowing the possibility of both overdiscrimination errors and overgeneralization errors, of both overextension and underextension in the child's first terms of reference.

Method

There were three groups of subjects with 18 subjects in each group. The youngest group consisted of children between 2 1/2 and 4 years of age; the next oldest group consisted of children between 4 and 6 years of age; the oldest group consisted of undergraduates from Harvard and Radcliffe. Every subject was shown a total of 120 pictures and was asked one question for each picture. The verbal concepts that were tested were as follows:

Hierarchy 1	Hierarchy 2	Hierarchy 3
animal	food	plant
dog	fruit	flower
collie	apple	tulip

We chose concepts at different levels of generality because we suspected that perhaps the tendency to make underextension errors (in particular) might vary with the generality of the concept in question. Specifically, it seemed quite possible that children would make more undergeneralization errors for rather general concepts such as 'animal', 'food' and 'plant' since these concepts include a broad and varied set of instances.

There were several pictures representing instances of each of these nine concepts as well as several pictures of inanimate objects. A given subject was shown 10 instances of a concrete concept in one hierarchy and 10 non-instances; he was shown 20 instances of an intermediate concept from a different hierarchy and 20 non-instances; finally he was shown 30 instances of the general concept in the remaining hierarchy as well as 30 non-instances. Each time the subject was shown an instance or a non-instance of a given concept he was asked whether it was an instance of the concept being tested. For example, one child was shown 10 pictures of collies and was asked "Is this a collie?" and also 10 non-collies (3 other dogs, 3 other animals and 4 inanimate objects) for which he was also asked "Is this a collie?" The same child was also shown 20 pictures of fruits (10 apples and 10 other fruits) as well as 20 non-fruits (10 other foods and 10 inanimate objects) for which the question was asked "Is this a fruit?" Finally, he was shown 30 pictures of plants (10 tulips, 10 other flowers, 10 other plants) and also 30 pictures of inanimate objects for which the question was asked "Is this a plant?" The design was such that within each age group six subjects were tested on each of the nine concepts.

The 120 pictures were presented one at a time in a different random order for each subject. An underextension error occurs when the subject is shown an instance of a concept, e.g., a dog, and when asked "Is this a dog?" responds "No". An overextension error occurs when he is shown a non-instance of a concept, e.g., a non-dog, and when asked "Is this a dog?" responds "Yes". Since there was an equal number of instances and non-instances of each concept, there was, in theory at least, an equal opportunity for both overextension and underextension errors.

Results and Discussion

Subject by Subject Breakdown of Extension Errors:

There was ample evidence in the responses of the young children of both overextension errors and underextension errors. Tables 1 to 9 show a

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Insert Tables 1 to 9 here

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subject by subject breakdown of both kinds of errors for each child for each of the nine concepts investigated in this experiment. An underextension error is a "No" response to an instance and is represented in the upper part of each table. An overextension error is a "Yes" response to a non-instance and is represented in the lower part of each table. Tables 1 to 9 also show the number of times, if any, that a given subject gave a "Don't Know" response.

Animal:

Table 1 shows the number of both kinds of errors made by each child for the concept 'animal'. One child (S7) appeared to have no notion of what the word 'animal' means and said "No" in response to the question "Is this an animal?" for every picture regardless of whether or not it was of an animal. The other 11 children did seem to have some conception of what an animal is, for they identified some animals as animals and virtually never identified an inanimate object as an animal. However, none of these 11 children identified all of the pictures of animals as animals whereas, as we shall see, every adult who was tested on the concept 'animal' identified each and every picture of an animal as an instance. One child (S1) correctly identified every picture of an animal as an animal except for the picture of a woman, saying "That's not an animal, that's a person." This child's pattern of responses was closest to the adult pattern for this particular concept. As we shall see in a picture by picture

Tables 1-9. Number of underextension and overextension errors for each child for the nine concepts tested in the extension experiment. An underextension error is a "No" response to an instance and is represented in the upper part of each table. An overextension error is a "Yes" response to a non-instance and is represented in the lower part of each table.

(#) = number of "Don't Know" responses

Tables 1, 2, 3

1. ANIMAL HIERARCHY

Is this an animal?

	Ages 2½-4 years						Ages 4½-6 years						TOTAL	
	S1	S2	S3	S7	S8	S9	S19	S21	S22	S23	S24	S25	#	%
1. 10 collies	0	0	1	10	7	2	10	0	0	0	0	0	30/120	25 %
2. 10 dogs	0	0	1	10	1	0	10	0	0	0	0	0	22/120	18.4 %
3. 10 animals	1	2	1	10	3	3	3	2	2	2	2	4 (1)	35/120	29.2 %
TOTAL	1/30	2/30	3/30	30/30	11/30	5/30	23/30	2/30	2/30	2/30	2/30	4/30	87/360	24.2 %
4. 30 objects	0	0	0	0	0	0	0	0	0	0	0	0	0/360	0 %
TOTAL	0/30	0/30	0/30	0/30	0/30	0/30	0/30	0/30	0/30	0/30	0/30	0/30	0/360	0 %

Is this a dog?

	Ages 2½-4 years						Ages 4½-6 years						TOTAL	
	S4	S5	S6	S10	S11	S12	S20	S34	S35	S26	S27	S36	#	%
1. 10 collies	2	0	0	0	0	0	1	0	1	0	0	1	5/120	4.2 %
2. 10 dogs	0	0	0	0	0	4	0	0	0	0	0	0	4/120	3.3 %
TOTAL	2/20	0/20	0/20	0/20	0/20	4/20	1/20	0/20	1/20	0/20	0/20	1/20	9/240	3.8 %
3. 10 animals	0	0	0	6	2	0	0	0	0	0	0	0	8/120	6.7 %
4. 10 objects	0	0	0	0	0	0	0	0	0	0	0	0	0/120	0 %
TOTAL	0/20	0/20	0/20	6/20	2/20	0/20	0/20	0/20	0/20	0/20	0/20	0/20	8/240	3.3 %

Is this a collie?

	Ages 2½-4 years						Ages 4½-6 years						TOTAL	
	S13	S14	S15	S16	S17	S18	S28	S24	S30	S31	S32	S33	#	%
. 10 collies	10	10	0	0	8	0	10	0	10	10	0 (3)	5	63/120	52.5 %
TOTAL	10/10	10/10	0/10	0/10	8/10	0/10	10/10	0/10	10/10	10/10	0/10	5/10	63/120	52.5 %
. 3 dogs	0	1	3	2	1	3	0	3	0	0 (1)	0	3	16/36	44.4 %
. 3 animals	0	0	3	0	0	0	0	0	0	0	0	2	5/36	13.9 %
. objects	0	0	2	0	0	0	0	0	0	0	0	0	2/48	4.2 %
TOTAL	0/10	1/10	8/10	2/10	1/10	3/10	0/10	3/10	0/10	0/10	0/10	5/10	23/120	19.2 %

XI. PLANT HIERARCHY

Is this a plant?

	Ages 2½-4 years						Ages 4½-6 years						TOTAL	
	S4	S5	S6	S13	S14	S15	S20	S34	S35	S28	S29	S30	#	%
1. 10 tulips	0	1	1	6	0	0	1	0	0	0	10	1	20/120	16.7%
2. 10 flowers	0	0	1	10	2	0	0	0	1	1	10	0	25/120	20.9%
3. 10 plants	3	0	2	6	4	0	2	2	2	0	4	0	25/120	20.9%
TOTAL	3/30	1/30	4/30	22/30	6/30	0/30	3/30	2/30	3/30	1/30	24/30	1/30	70/360	19.4%
4. 30 objects	0	0	0	0	0	4	1	0	1	1	0	0	7/360	1.9%
TOTAL	0/30	0/30	0/30	0/30	0/30	4/30	1/30	0/30	1/30	1/30	0/30	0/30	7/360	1.9%

Is this a flower?

	Ages 2½-4 years						Ages 4½-6 years						TOTAL	
	S1	S2	S3	S16	S17	S18	S19	S21	S22	S31	S32	S33	#	%
10 tulips	0	0	0	0	0	0	0	0	1	2	0	0	3/120	2.5%
10 flowers	0	0	2	1	2	0	0	0	0	1	0	0(1)	6/120	5.0%
TOTAL	0/20	0/20	2/20	1/20	2/20	0/20	0/20	0/20	1/20	3/20	0/20	0/20	9/240	3.8%
10 plants	3(1)	9	0	2	0	3	7	5	7	6(1)	1(1)	2(1)	45/120	37.5%
10 objects	0	0	0	0	0	0	0	0	0	0	0	0	0/120	0.0%
TOTAL	3/20	9/20	0/20	2/20	0/20	3/20	7/20	5/20	7/20	6/20	1/20	2/20	45/240	18.8%

Is this a tulip?

	Ages 2½-4 years						Ages 4½-6 years						TOTAL	
	S7	S8	S9	S10	S11	S12	S23	S24	S25	S26	S27	S36	#	%
10 tulips	0	9	9(1)	7(1)	0	9	2(1)	4(1)	4(2)	3	0	8	55/120	45.8%
TOTAL	0/10	9/10	9/10	7/10	0/10	9/10	2/10	4/10	4/10	3/10	0/10	8/10	55/120	45.8%
3 flowers	3	0	0	1	3	1	1	0	0	0	2	0	11/36	30.6%
3 plants	1	0	0(1)	1	3	2	2	0	0	0	2	0	11/36	30.6%
4 objects	0	0	0	1	3	0	0	0	0	0	0	0	4/48	8.4%
TOTAL	4/10	0/10	0/10	3/10	9/10	3/10	3/10	0/10	0/10	0/10	4/10	0/10	26/120	21.8%

Is this a food?

	Ages 2½-4 years						Ages 4½-6 years						TOTAL	
	S10	S11	S12	S16	S17	S18	S26	S27	S36	S31	S32	S33	#	%
1. 10 apples	7	1	10	3	10	0	8	0	0	1	0	1	41/120	34.2%
2. 10 fruits	3	0	9	0	9	1	7	0	0	3	0	0	32/120	26.7%
3. 10 foods	2	0	10	2	9	0	5	0	1	2	0(1)	1(1)	32/120	26.7%
TOTAL	12/30	1/30	29/30	5/30	28/30	1/30	20/30	0/30	1/30	6/30	0/30	2/30	105/360	29.2%
4. 30 objects	10	1	0	0	0	0	0	1	0	0	0	0	12/360	3.3
TOTAL	10/30	1/30	0/30	0/30	0/30	0/30	0/30	1/30	0/30	0/30	0/30	0/30	12/360	3.3

Is this a fruit?

	Ages 2½-4 years						Ages 4½-6 years						TOTAL	
	S7	S8	S9	S13	S14	S15	S23	S24	S25	S28	S29	S30	#	%
1. 10 apples	8	10	8	6	1	7	0	0	0	0	0	1	41/120	34.2%
2. 10 fruits	8	9	8	6	2	1	3(1)	1	4(1)	0	5	1	48/120	40%
TOTAL	16/20	19/20	16/20	12/20	3/20	8/20	3/20	1/20	4/20	0/20	5/20	2/20	89/240	37.1%
3. 10 foods	0(1)	0	0	0	7	1	0(1)	3	0(1)	7(1)	2	2(1)	22/120	18%
4. 10 objects	0	0	0	0	0	1	0	0	0	0	0	0	1/120	0.8%
TOTAL	0/20	0/20	0/20	0/20	7/20	2/20	0/20	3/20	0/20	7/20	2/20	2/20	23/240	9.6%

Is this an apple?

	Ages 2½-4 years						Ages 4½-6 years						TOTAL	
	S1	S2	S3	S4	S5	S6	S19	S21	S22	S20	S34	S35	#	%
1. 10 apples	1	0	0	0	0	0	0	0	0	1	1	0	3/120	2.5%
TOTAL	1/10	0/10	0/10	0/10	0/10	0/10	0/10	0/10	0/10	1/10	1/10	0/10	3/120	2.5%
2. 3 fruits	1(1)	1	0	2	2	1	1	1	0	1	1	2	13/36	36.1%
3. 3 foods	1	0	0	0	0	0	0	0	0	0	0	0	1/36	2.8%
4. 4 objects	0(1)	0	0	0	0	0	0	0	0	0	0	0	0/48	0%
TOTAL	2/10	1/10	0/10	2/10	2/10	1/10	1/10	1/10	0/10	1/10	1/10	2/10	14/120	11.7%

analysis for each concept, no child was willing to classify the picture of a woman as an instance of the concept 'animal'. Many children (Ss 2, 21, 22, 23, 24) identified all of the pictures of animals as animals with the exception of two instances, the woman and one other, which was usually either the preying mantis or the caterpillar. One child (S19), for each of the pictures of a dog, when asked "Is this an animal?" said "No, it's a dog not an animal", implying apparently that for him the two classes were mutually exclusive. This behavior which we have come to call the "dominant name response" was also notable in another child (S8) who insisted that 8 of the dogs were not animals ("They are dogs"); this subject did not treat every picture of a dog this way, but rather classified 12 of them correctly as animals. For most of the subjects, however, dogs were definitely animals but usually some other instances were not. One child (S25) included all of the dogs as animals but not 4 of the non-canine animals.

Thus it can be seen from Table 1 that children are somewhat variable with respect to the instances they include in the concept 'animal'. All of them undergeneralize to some extent, but many of them only for a couple of the instances used in this experiment. Other children exclude more animals from their concept of animal which often seems intuitively to be in the case of two kinds of instances: (1) atypical or noncentral (cf., Heider, 1973, 1973) instances of animals and (2) very familiar animals for which they have a preferred dominant name (e.g., "dog").

Dog:

Table 2 shows the results for the 12 children for the concept 'dog'. Children are very good at identifying instances of this concept and at excluding non-instances. 'Dog' is a concept which is often used as an illustration of overextension in the diary literature, but in this experiment these children by and large appear to have basically the same extension of the concept as adults. There were two children (out of 12) who overgeneralized the word 'dog' to other kinds of animals (<u>S</u>s 10 and 11), but there were also children who undergeneralized the concept, not counting a few dogs as 'dogs' while correctly identifying the others (e.g., <u>S</u>s 4 and 12). Most subjects neither overgeneralized nor undergeneralized this particular concept, however.

<u>Collie</u>:

Table 3 shows the results for each child for the concept 'collie'. Many children seemed to have no idea of what a collie is, responding "No" to both instances and non-instances (e.g., <u>S</u>s 13, 14, 28, 30, 31) or "Yes" to both instances and non-instances (e.g., <u>S</u>15). Other children seemed to know that a collie is some kind of dog, but not exactly which dogs are collies. Thus some children said that all or most of the pictures of dogs were 'collies' (<u>S</u>s 16, 18, 29) while one child identified two out of the ten collies and one other dog as 'collies'. The reader may wonder whether or not during the course of the experiment a child might learn what 'collie' means and might show improvement in identifying the instances of collies as collies after a number of collies had been presented. Subjects were given no feedback as to the correctness of their responses during the experiment but still it might seem possible that seeing a number of collies to which the question was "Is this a collie?" might encourage them to adopt a correct or partially correct hypothesis concerning the concept during the course of the experiment. To check on this possibility we examined each subject to see whether or not there was a tendency to improve at identifying collies over trials. It turned out that for this concept only one child (<u>S</u>32) apparently improved. In general for this and for the other concepts which we tested in this study there was very little improvement at identifying instances as the experiment progressed: usually, subjects either had a concept at the beginning of the experiment or not at all.

Plant:

Table 4 shows the pattern of responses for each child for the concept 'plant'. All children except one (S15) make some underextension errors when asked to identify pictures of plants. The one subject who made no underextension errors overgeneralized the term 'plant' to 4 out of 30 inanimate objects. For the other children, however, overextension of the concept was very rare to the 30 inanimate objects which were used as non-instances, while underextension was the rule. Two children (Ss 13 and 29) did not include most of the flowers and various other plants in their concept 'plant'. The other children made fewer underextension errors (from one to six) with the most common mistakes being for the two trees (a sycamore tree and a traveler's tree). Children were often observed to say for a picture of a tree, "That's not a plant, that's a tree", again suggesting the role played by what we have been calling a dominant name.

Flower:

Table 5 shows each child's pattern of responses for the concept 'flower'. Underextension errors for the concept 'flower' are relatively infrequent, although they do occur. On the other hand, overextension errors of the concept 'flower' to other kinds of plants are quite common. Ten of the 12 children made some overextension errors to other plants with a third of the children (Ss 2, 19, 22, 31) overgeneralizing 'flower' to more than half of the plants. In this study as well as others (see, for example, #1 On the Order of Acquisition of Category Labels) we have found the child's tendency to overextend the concept'flower' (to other plants) to be more prevalent than for any other concept we have investigated. Conversely, as we have seen, children will also usually undergeneralize their concept of 'plant'. For adults 'plant' is clearly superordinate to the term 'flower', whereas children lack this appreciation of the hierarchical relation between these two concepts. For them it often appears that 'plant' and 'flower' reside at roughly the same level of generality.

Tulip:

Table 6 shows the pattern of errors for each child for the concept 'tulip'. As was the case for the concept 'collie', some children seemed to have no notion of what a 'tulip' is, since they responded "No" indiscriminately to both instances and non-instances (Ss 8, 9, 10, 12, 36) or "Yes" to both instances and non-instances (S11). Other children seemed to realize that tulips are flowers, but they were not sure which ones were tulips. Two of these children (Ss 7 and 27) identified each instance of a tulip as a 'tulip', but overgeneralized the term 'tulip' to other kinds of flowers and plants. Other children (Ss 24, 25, 26) did not overgeneralize the term 'tulip' to non-instances, but rather undergeneralized the term so that only some instances of tulips were identified as 'tulips'. Finally, one subject (S23) both undergeneralized and overgeneralized the term.

Food:

Table 7 shows the pattern of errors for each child for the concept 'food'. One child (S10) overgeneralized the term 'food' to ten inanimate objects. This was the only child who demonstrated a tendency to overgeneralize the term 'food' to the non-instances of 'food' in this study. On the other hand, most subjects including this one tended to undergeneralize the term 'food', not including some of the instances as examples of 'food'. Two subjects (Ss 12 and 17) gave the response "No" to almost every instance of food when asked "Is this food?", usually identifying the single food with a more particular name -- e.g., "That's not a food; it's an apple", etc. Since these two subjects gave the response "No" indiscriminately to both instances and non-instances of 'food' it cannot be assumed that they have the word in their vocabulary at all. The other children, however, indicated that they had some notion of what 'food' means since they did correctly identify some instances as 'food' and rarely overextended the term to non-instances. For example, S26 correctly responded "No" to all non-instances, and "Yes" to ten instances, but was incorrect in responding "No" to 20 instances. Similarly, Ss 16 and 31 made no overextension errors but made five and six (out of 30 possible) underextension errors respectively.

It should be noted that these and other subjects who made underextension errors did not necessarily treat the same kind of food uniformly in their responses. For example, S16 identified seven out of ten apples as 'food' but excluded three apples from the food category. Two of these underextension errors were associated with dominant name responses ("No, it's an apple") whereas one was associated only with the response "No". Similarly, S26 identified two out of ten apples as 'food' but excluded the other eight apples from the food category. This particular child simply said "Yes" to two of the apples and "No" to the other eight with no overt dominant name coming into play in his responses, although it is quite possible that the negative responses were mediated by covert dominant naming. This inconsistency on the part of an individual subject in classifying apples as foods is puzzling and suggests that the child does not always use a single fixed criterion for classification, but rather vascillates from instance to instance between different, probably vaguely formulated, criteria. (For example, in response to the question "Is this a food?" the child might be thinking "Yes, because I can eat it", but later "No, it's an apple", and might respond inconsistently according to the two different criteria .)

This behavior also raises the question of how consistent an individual child would be in his extension errors if he were tested on the same instance at different times. Although we did not include a test for consistency in this particular experiment, later studies have shown that when a child makes either an overextension error or an underextension error on a given instance he will usually, though not always, make the same mistake again. In one study, Judy Ungerer found that [illegible] of the times that a child makes an underextension error he will persist in his error if tested on it again immediately and 81% of the time if he is tested on it sometime later. In another study Elizabeth Smith and I found that overall 92% of the time a child will persist in his overextension error when he is tested again on the same instance some time after his initial mistake.

Fruit:

Table 8 shows the pattern of errors for each child for the concept 'fruit'. Ignoring Ss 7, 8, and 9 who make so many errors that it cannot be assumed that they have any idea of the concept 'fruit', it can be seen that some subjects (Ss 14, 28) tend to overgeneralize the concept 'fruit' to other kinds of food whereas other subjects tend to undergeneralize the concept'fruit' (Ss 13, 15, 23, 25, 29), although many of these subjects do make both overextension and under-extension errors. Again, some of the younger subjects (e.g., Ss 13, 15) are inconsistent in the way they respond to the pictures of apples when asked "Is this a fruit?", sometimes saying "Yes" and sometimes saying "No". When these children said "No" they usually gave the dominant name reaction -- e.g., "No, (it's an) apple."

Apple:

Table 9 shows the subject by subject breakdown of errors for the concept 'apple'. Children are very good at identifying instances and rejecting non-instances of this concept. They make virtually no underextension errors, although they make some overextension errors, usually to a picture of a tomato or a pome-granate.

Tables 10 to 18 show a subject by subject breakdown of the errors made

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Insert Tables 10 to 18 here

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by the adults tested in the extension experiment. These tables are provided for

Tables 10-18. Number of underextension and overextension errors for each adult for the nine concepts tested in the extension experiment. An underextension error is a "No" response to an instance and is represented in the upper part of each table. An overextension error is a "Yes" response to a non-instance and is represented in the lower part of each table.

Tables 10, 11, 12

I. ANIMAL Hierarchy

Is this an animal?

	Adults						TOTAL	
	S1	S2	S3	S7	S8	S9	#	%
10 collies	0	0	0	0	0	0	0/60	0
10 dogs	0	0	0	0	0	0	0/60	0
10 animals	0	0	0	0	0	0	0/60	0
TOTAL	0/30	0/30	0/30	0/30	0/30	0/30	0/180	0
30 objects	0	0	0	0	0	0	0/180	0
TOTAL	0/30	0/30	0/30	0/30	0/30	0/30	0/180	0

Is this a dog?

	Adults						TOTAL	
	S4	S5	S6	S10	S11	S12	#	%
10 collies	0	0	0	0	0	0	0/60	0
10 dogs	0	0	0	0	0	0	0/60	0
TOTAL	0/20	0/20	0/20	0/20	0/20	0/20	0/120	0
10 animals	0	0	0	0	0	0	0/60	0
10 objects	0	0	0	0	0	0	0/60	0
TOTAL	0/20	0/20	0/20	0/20	0/20	0/20	0/120	0

Is this a collie?

	Adults						TOTAL	
	S13	S14	S15	S16	S17	S18	#	%
10 collies	1	1	1	1	0	1	5/60	8.3
TOTAL	1/10	1/10	1/10	1/10	0/10	1/10	5/60	8.3
3 dogs	1	0	1	0	0	0	2/18	11.1
3 animals	0	0	0	0	0	0	0/18	0
4 objects	0	0	0	0	0	0	0/24	0
TOTAL	1/10	0/10	1/10	0/10	0/10	0/10	2/60	3.3

II. PLANT Hierarchy

Is this a plant?

Adults

	S4	S5	S6	S13	S14	S15	TOTAL #	%
1. 10 tulips	0	0	0	0	0	0	0/60	0
2. 10 flowers	0	0	0	0	0	0	0/60	0
3. 10 plants	1	0	0	0	0	0	1/60	1.7
TOTAL	1/30	0/30	0/30	0/30	0/30	0/30	1/180	0.6
4. 30 objects	0	0	0	0	0	1	1/180	0.6
TOTAL	0/30	0/30	0/30	0/30	0/30	1/30	1/180	0.6

Is this a flower?

Adults

	S1	S2	S3	S16	S17	S18	TOTAL #	%
1. 10 tulips	0	0	0	0	0	0	0/60	0
2. 10 flowers	0	0	1	0	0	0	1/60	1.7
TOTAL	0/20	0/20	1/20	0/20	0/20	0/20	1/120	0.8
3. 10 plants	1	1	0	1	0	0	3/60	5.0
4. 10 objects	0	0	0	0	0	0	0/60	0
TOTAL	1/20	1/20	0/20	1/20	0/20	0/20	3/120	2.5

Is this a tulip?

Adults

	S7	S8	S9	S10	S11	S12	TOTAL #	%
1. 10 tulips	4	6	4	4	4	2	24/60	40
TOTAL	4/10	6/10	4/10	4/10	4/10	2/10	24/60	40
3 flowers	1	0	1	0	1	1	4/18	22.2
3 plants	0	0	0	0	0	0	0/18	0
4 objects	0	0	0	0	0	0	0/24	0
TOTAL	1/10	0/10	1/10	0/10	1/10	1/10	4/60	6.

III. FOOD Hierarchy

Is this a food?

	Adults						TOTAL	
	S10	S11	S12	S16	S17	S18	#	%
apples	0	0	0	0	0	0	0/60	0
10 fruits	0	0	0	0	0	1	1/60	1.7
10 foods	1	0	1	1	0	0	3/60	5.0
TOTAL	1/30	0/30	1/30	1/30	0/30	1/30	4/180	2.2
30 objects	0	0	1	0	0	0	1/180	0.6
TOTAL	0/30	0/30	1/30	0/30	0/30	0/30	1/180	0.6

Is this a fruit?

	Adults						TOTAL	
	S7	S8	S9	S13	S14	S15	#	%
10 apples	0	0	0	0	0	0	0/60	0
10 fruits	0	1	1	2	2	0	6/60	10.0
TOTAL	0/20	1/20	1/20	2/20	2/20	0/20	6/120	5.0
10 foods	0	0	0	0	0	0	0/60	0
10 objects	0	0	0	0	0	0	0/60	0
TOTAL	0/20	0/20	0/20	0/20	0/20	0/20	0/120	0

Is this an apple?

	Adults						TOTAL	
	S1	S2	S3	S4	S5	S6	#	%
10 apples	1	1	0	0	0	0	2/60	3.3
TOTAL	1/10	1/10	0/10	0/10	0/10	0/10	2/60	3.3
3 fruits	0	0	0	0	0	0	0/18	0
3 foods	0	0	0	0	0	0	0/18	0
objects	0	0	0	0	0	0	0/24	0
TOTAL	0/10	0/10	0/10	0/10	0/10	0/10	0/60	0

comparison with Tables 1 to 9 for children. Again, an underextension error is a "No" response to an instance and is represented in the upper part of each table. An overextension error is a "Yes" response to a non-instance and is represented in the lower part of each table. These tables reveal that, unlike children, adults make very few extension errors of either kind except for the concept 'tulip' for which they tend to make a fairly large number of underextension errors. We were curious about why adult subjects had trouble with the pictures of tulips. It seemed possible that either there was something wrong with our pictures of tulips (e.g., perhaps they were visually ambiguous) or that the average adult cannot identify all instances of tulips as 'tulips'. We therefore decided to test some experts on the pictures of tulips, specifically, four florists in the Cambridge area. Each of the florists was shown the ten tulips and the ten other kinds of flowers in a random order. For each picture he was asked, "Is this a tulip?". Three of the four florists made no errors (overextension or underextension) in the task while the fourth expressed uncertainty ("I don't know") for two of the tulips. In their spontaneous explanations of their responses, they mentioned criteria such as leaf structure, the stamen, petal number and shape, etc. Their decisions were based on extensive knowledge of plant families and the distinctive characteristics of the botanical classification "tulip", including unusual and extinct varieties, regardless of whether or not they had ever actually seen each particular kind of tulip. Our typical adult, however, judged pictures pretty much by the shape and general "looks" of the flower in comparison to their central notion of what a tulip looks like, and did not know the range well enough to include "peripheral" instances. At any rate, apart from the case of tulips, adults do on the whole correctly identify the instances of the concepts tested in this study as instances and reject the non-instances.

Picture by Picture Breakdown of Underextension Errors:

Tables 19 to 27 show the number of underextension errors ("No" responses

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Insert Tables 19 to 27 here

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to instances) made by children for each instance for each of the nine concepts tested in the extension experiment. The purpose of this analysis was to see if certain instances of a given concept were more likely to produce underextension errors than others and if we could formulate hypotheses concerning the determinants of underextension errors which we could then subject to further tests. In the present discussion I would like to focus on the most general concepts in each of the three hierarchies tested: 'animal', 'plant' and 'food'.

Consider first the concept 'animal'. One of the instances of the concept 'animal' produced an underextension error in every child -- the picture of the woman. (See a Xerox of the picture on the next page.) In this study and in others

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Insert picture of the woman here

(see, for example, #1 On the Order of Acquisition of Category Labels) we have found that preschool children almost invariably fail to classify people as 'animals'. No other instance produces nearly such a high frequency of underextension errors, but some do produce more errors than others. For example, the picture of a preying mantis and the picture of a caterpillar produce more underextension errors than the other stimuli. (See Xeroxes of these pictures on the next two pages.) Why should children be less likely to classify these insects as animals

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Insert pictures of preying mantis and caterpillar here

Tables 19-27. Number of underextension errors ("No" responses to instances) made by children for each instance for each of the nine concepts tested in the extension experiment.

(#)= number of "Don't Know" responses

ANIMAL
Hierarchy

Is this an animal?

collies	collie	collie	collie	collie	collie	collie	collie	collie	collie	collie	TOTAL
	2/12	3/12	3/12	3/12	3/12	3/12	4/12	3/12	3/12	3/12	30/120
r dogs	pointer	water spaniel	bulldog	cocker spaniel	lhasa apso	poodle	fox terrier	afghan	mongrel	golden moray	TOTAL
	2/12	2/12	2/12	2/12	2/12	2/12	2/12	2/12	3/12	3/12	22/120
other animals	fish	person	cater-pillar	hedge-hog	praying mantis	crab	duck	tortoise	tree frog	ostrich	TOTAL
	1/12 (1)	12/12	4/12	1/12	5/12	2/12	3/12	1/12	3/12	3/12	35/120

Is this a dog?

collies	collie	collie	collie	collie	collie	collie	collie	collie	collie	collie	TOTAL
	2/12	0/12	0/12	0/12	2/12	0/12	0/12	0/12	0/12	1/12	5/120
other dogs	pointer	water spaniel	bulldog	cocker spaniel	lhasa apso	poodle	fox terrier	afghan	mongrel	golden moray	TOTAL
	0/12	0/12	1/12	1/12	0/12	1/12	0/12	1/12	0/12	0/12	4/120

Is this a collie?

collies	collie	collie	collie	collie	collie	collie	collie	collie	collie	collie	TOTAL
	7/12 (1)	7/12 (1)	5/12	6/12	7/12	7/12 (1)	6/12	6/12	5/12	7/12	63/120

PLANT
Hierarchy

Is this a plant?

1. tulips	tulip	tulip	tulip	tulip	tulip	tulip	tulip	tulip	tulip	tulip	TOTAL
	2/12	1/12	4/12	2/12	3/12	1/12	2/12	2/12	1/12	2/12	20/120
other flowers	rose	dahlia	geranium	calendula	verbena	mum	lily	hibiscus	aster	gardenia	TOTAL
	3/12	2/12	2/12	3/12	2/12	2/12	3/12	3/12	3/12	2/12	25/120
3. other plants	sage	sycamore tree	geranium	asparagus fern	elephant's ear	cactus	lavender	coconut	traveler's tree	philodendron	TOTAL
	0/12	8/12	1/12	4/12	0/12	3/12	1/12	2/12	6/12	0/12	25/120

Is this a flower?

1. tulips	tulip	tulip	tulip	tulip	tulip	tulip	tulip	tulip	tulip	tulip	TOTAL
	0/12	1/12	1/12	1/12	0/12	0/12	0/12	0/12	0/12	0/12	3/120
2. other flowers	rose	dahlia	geranium	calendula	verbena	mum	lily	hibiscus	aster	gardenia	TOTAL
	2/12	0/12	0/12	1/12 (1)	2/12	0/12	1/12	0/12	0/12	0/12	6/120

Is this a tulip?

1. tulips	tulip	tulip	tulip	tulip	tulip	tulip	tulip	tulip	tulip	tulip	TOTAL
	4/12 (2)	4/12 (1)	3/12 (1)	5/12	7/12	6/12	8/12	8/12	6/12 (1)	4/12 (1)	55/120

OOD
erarchy

Is this a food?

apples	apple	apple	apple	apple	apple	apple	apple	apple	apple	apple	TOTAL
	4/12	5/12	5/12	4/12	4/12	4/12	3/12	4/12	3/12	5/12	41/120
fruits	grapefruit	orange	pear	persimmon	raspberries	lemon	cantaloupe	pomegranate	banana	tomato	TOTAL
	3/12	3/12	2/12	3/12	5/12	4/12	4/12	3/12	3/12	2/12	32/120
other foods	dog biscuit	lettuce	egg	caviar	swiss cheese	potato	cookie	garlic	corn	rye bread	TOTAL
	3/12	5/12	2/12	3/12 (2)	2/12	3/12	5/12	4/12	3/12	2/12	32/120

Is this a fruit?

apples	apple	apple	apple	apple	apple	apple	apple	apple	apple	apple	TOTAL
	3/12	6/12	4/12	4/12	5/12	3/12	3/12	4/12	5/12	4/12	41/120
other fruits	grapefruit	orange	pear	persimmon	raspberries	lemon	cantaloupe	pomegranate	banana	tomato	TOTAL
	4/12 (2)	6/12	4/12	6/12	6/12	6/12	4/12	2/12	4/12	6/12	48/120

Is this an apple?

apples	apple	apple	apple	apple	apple	apple	apple	apple	apple	apple	TOTAL
	0/12	2/12	0/12	0/12	1/12	0/12	0/12	0/12	0/12	0/12	3/120

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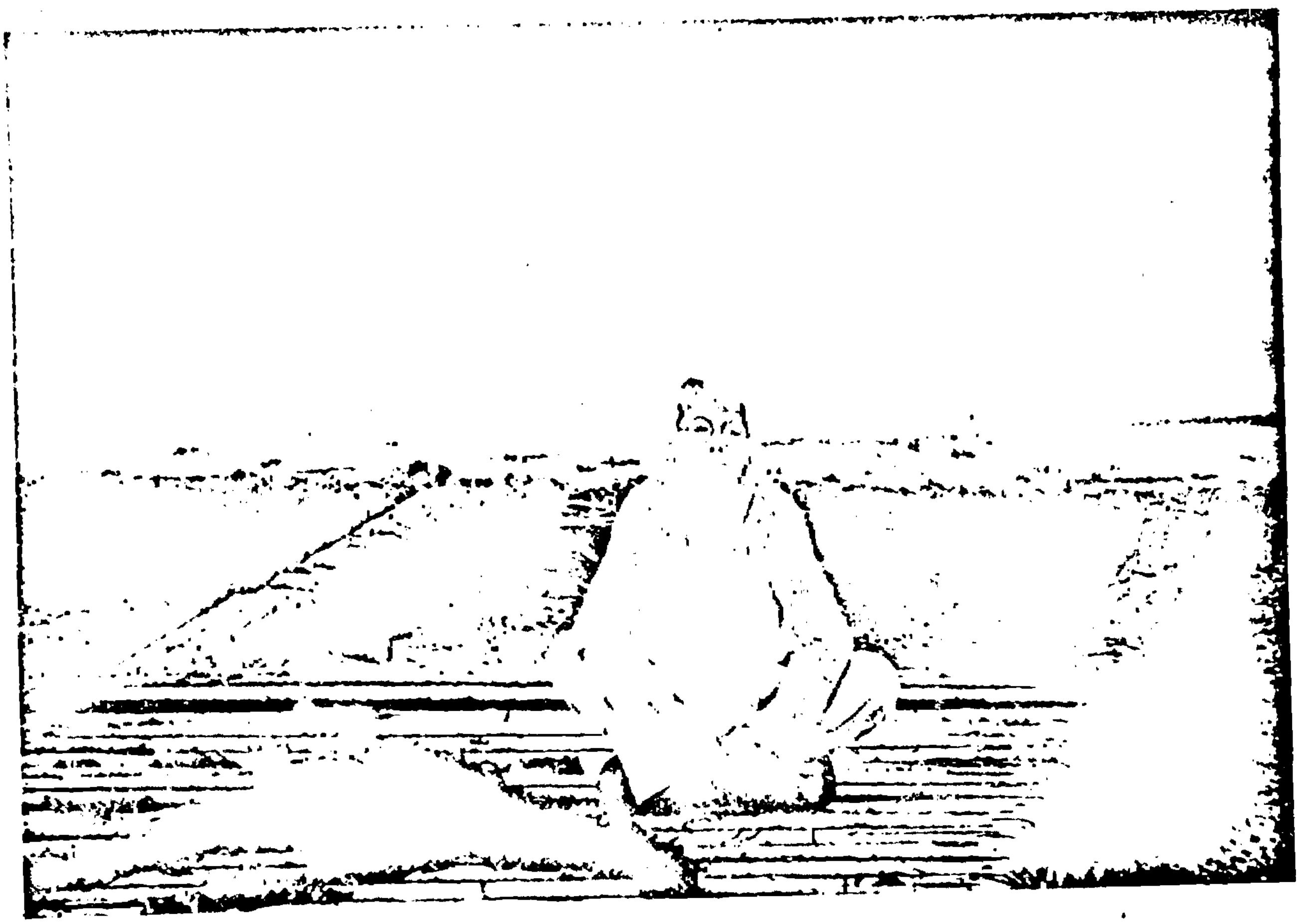
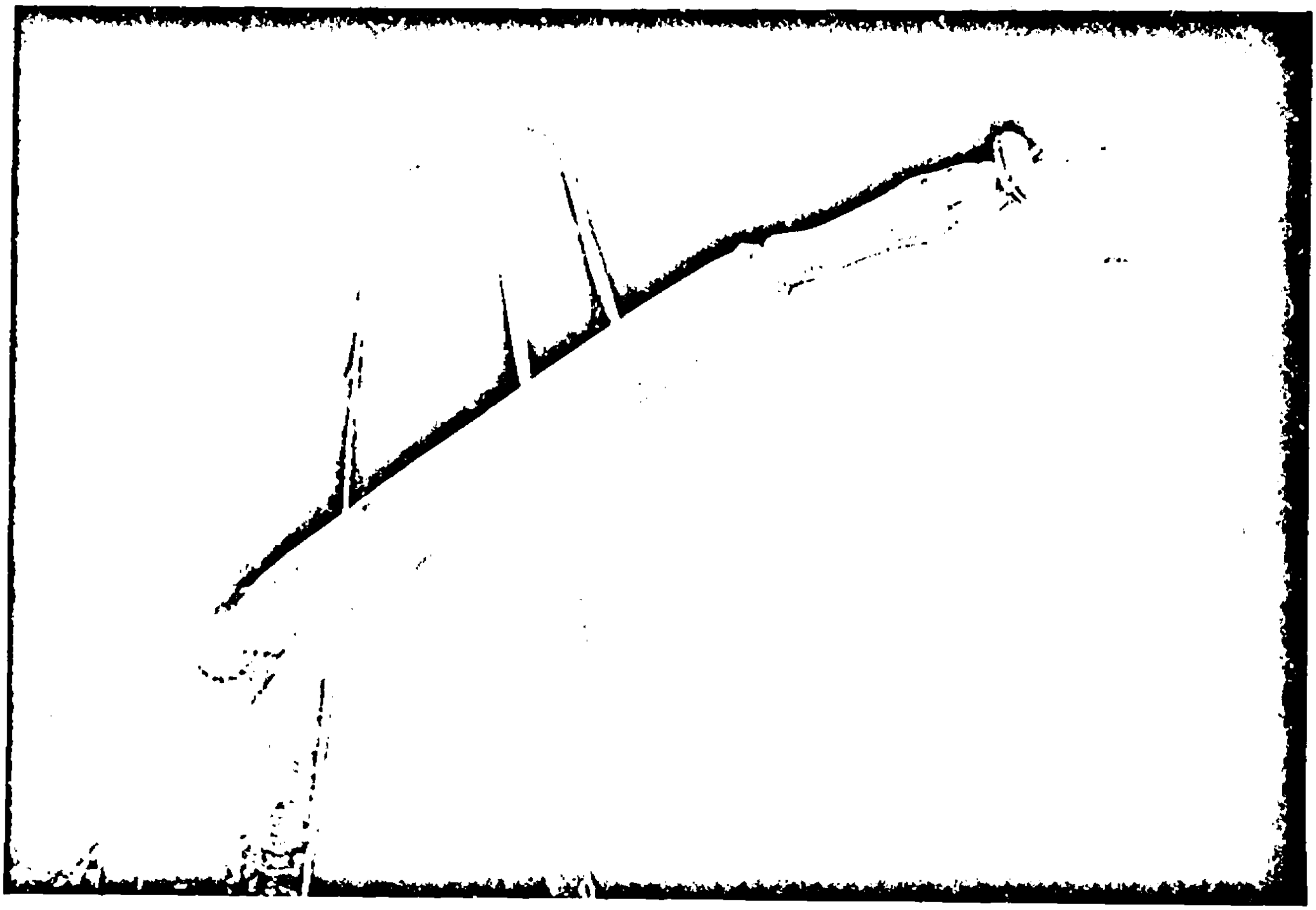


Woman



Preying Mantis

Caterpillar

than a dog or a hedgehog, for example? On the assumption that typical animals are four-legged furry mammals, insects would seem to be rather atypical instances of the animal category. That is to say, although we have not scaled these instances for their degree of centrality (cf., Heider, 1973, 1973) to the concept 'animal', it is safe to assume that adults would rate these insects as being less central to the concept than dogs or hedgehogs. Of course, this is not the only possible explanation. Preying mantises and caterpillars are probably less familiar to the child than are dogs and cats, and so the child's general lack of experience with such creatures may be related to his ability to classify such instances as animals. Other considerations make lack of familiarity seem less likely to be an important determinant of underextension errors in children, however. For example, only one child (out of 12) makes an underextension error to a picture of a hedgehog. A hedgehog is presumably not a very familiar kind of animal in the child's world, but it is a four-legged furry mammal and, therefore, presumably central to the concept 'animal'. Indeed, familiar stimuli it could be argued may be associated with more underextension errors than unfamiliar stimuli of equal centrality. For as we have seen, the young child will sometimes exclude a familiar instance from a general category when he has another name for that instance ("That's a dog, not an animal.") Table 19 shows that children make fewer underextension errors to the presumably less familiar hedgehog than to the more familiar dogs and, as we saw previously, a failure to classify a dog as an animal is often associated with the use of a dominant name (e.g., 'dog'). At any rate in a later study (see #4 The Determinants of Underextension Errors) we have tried to tease apart the roles played by lack of centrality and lack of familiarity in determining underextension errors.

Now consider Table 22 which shows for each picture the number of underextension errors made by the children for the concept 'plant'. The stimuli which produce the greatest number of underextension errors in this case are the two trees, the sycamore tree (8 out of 12 errors) and the traveler's tree (6 out of 12 errors). A Xerox of the picture of the sycamore tree is shown on the next page. Although

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Insert picture of sycamore tree here

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trees are plants, intuitively they do not seem to be typical or central instances of the concept 'plant' and this lack of centrality again may be the determinant of the large number of underextension errors made to this stimulus. Another factor which may also be operative in producing these errors, at least in some children, is their use of a dominant name ("That's a tree, not a plant.")

Now consider the underextension errors made to the various instances of the concept 'food' which are shown in Table 25. Each of the food stimuli produced between two and five underextension errors. With this small a range it is difficult to establish with confidence that some of these stimuli produce more errors than others, let alone to discern the determinants of underextension errors. However, here are some speculations on the subject.

The apples in general produce a relatively large number of errors which may be related to the fact that apples are not central to the concept 'food' (they are not "meat, bread and potatoes") and/or to the fact that in the presence of an apple children often give the dominant name reaction ("That's an apple, not a food.") Among the foods which are not fruits children do best on the pictures of bread, cheese and an egg and worst on the pictures of a cookie, caviar and lettuce. Xeroxes of the pictures of the cookie, the caviar and the lettuce are shown on the next three pages. These instances are probably less typical or

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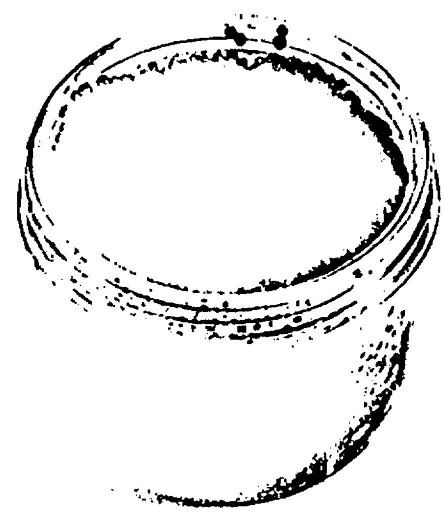
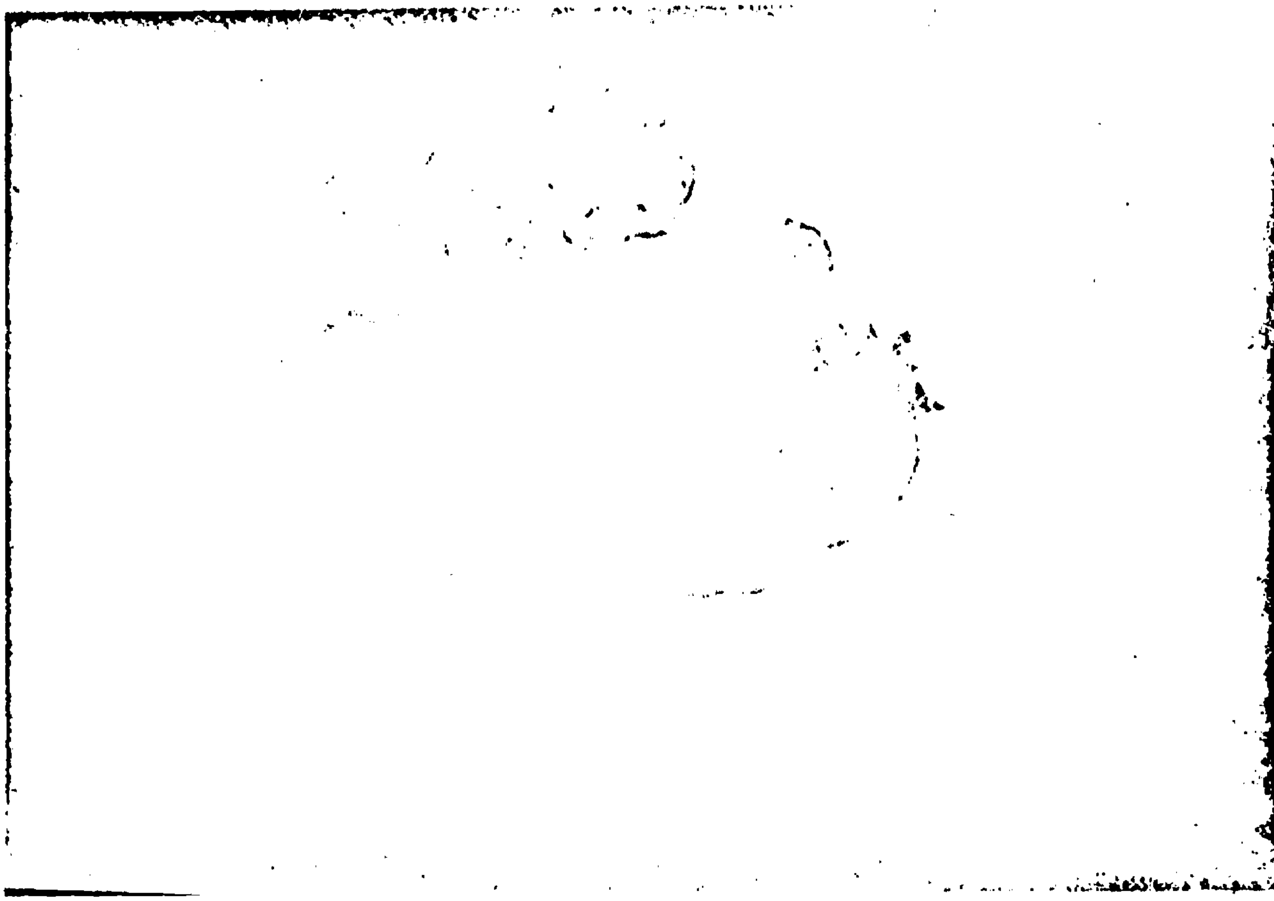
Insert pictures of cookie, caviar and lettuce here

Sycamore Tree

Cookie



Caviar



Lettuce

less central to the concept 'food' than are the bread, cheese and egg. Caviar, of course, is probably quite unfamiliar to most preschool children, but cookies and lettuce are probably fairly familiar. Again, therefore, it would appear that instances which are not typical or central to the concept 'food' are the ones most likely to be excluded from the concept by children and, again, the role played by familiarity is unclear. This analysis is of course ad hoc, speculative and intuitive, but it has provided some hypotheses about the determinants of underextension errors which we have tested more objectively in a later study (see #4 The Determinants of Underextension Errors).

Picture by Picture Breakdown of Overextension Errors:

Tables 28 to 36 present the number of overextension errors ("Yes" responses to non-instances) made by children to each non-instance for each of the nine

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Insert Tables 28 to 36 here

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concepts tested in the extension experiment. No non-instance produces overextension errors in all children and most non-instances produce very few overextension errors. Nonetheless, some non-instances do produce more overextension errors than do others.

Although the task of discerning what relation the non-instances for which there was a relatively high degree of overextension bear to the concepts being tested is complex and difficult, most overextension errors seem consistent with the hypothesis that they are often a result of a perceptual similarity between the object depicted in the picture and some idealized visual representation of the concept or some visual memory of a particular instance of the concept. Intuitively this is borne out by the fact that far more overextension errors are made by children to pictures of other animals vs. inanimate objects when

Tables 28-36. Number of overextension errors ("Yes" responses to non-instances) made by children for each non-instance for each of the nine concepts tested in the extension experiment.

(#)= number of "Don't Know" responses

Hierarchy

Is this an animal?

30 objects

lawn-mower	tele-phone	table	one-way sign	ring	ruler	tugboat	record	soap	tele-vision	belt	razor	tooth-brush	pail	teapot
0/12	0/12	0/12	0/12	0/12	0/12	0/12	0/12	0/12	0/12	0/12	0/12	0/12	0/12	0/12
eraser	camera	candle	radio	beer can	mug	bell	pan	iron	car	chain	screw-driver	bowl	sandal	hammer
0/12 (1)	0/12	0/12	0/12	0/12	0/12	0/12	0/12	0/12	0/12	0/12	0/12	0/12	0/12	0/12

	#	%
TOTAL	0/360	0.0

Is this a dog?

10 animals

fish	person	cater-pillar	hedge-hog	praying mantis	crab	duck	tortoise	tree frog	ostrich		#	%
1/12	1/12	0/12	2/12	1/12	2/12	0/12	0/12	0/12	1/12	TOTAL	8/120	6.7

10 objects

dime	clock	tennis ball	football	key	vase	purse	scissors	anchor	pencil		#	%
0/12	0/12	0/12	0/12	0/12	0/12	0/12	0/12	0/12	0/12	TOTAL	0/120	0.0

	#	%
TOTAL	8/240	3.3

Is this a collie?

3 dogs

afghan	mongrel	golden morray			#	%
5/12 (1)	6/12	5/12		TOTAL	16/36	44.4

3 animals

tor-toise	tree frog	ostrich			#	%
2/12	1/12	2/12		TOTAL	5/36	13.9

4 objects

shoe	book	anvil	ship		#	%
1/12	0/12	1/12	0/12	TOTAL	2/48	4.2

	#	%
TOTAL	23/120	19.2

Hierarchy

Is this a plant?

30 objects

lawn-mower	telephone	table	one-way sign	ring	ruler	football	record	soap	television	belt	razor	toothbrush	pail	teapot
0/12	0/12	0/12	0/12	0/12	0/12	0/12	0/12	1/12	1/12	1/12	0/12	1/12	0/12	0/12

eraser	camera	candle	radio	beer can	mug	bell	pan	iron	car	chain	screwdriver	bowl	sandal	hammer
0/12	0/12	0/12	0/12	0/12	0/12	2/12	1/12	0/12	0/12	0/12	0/12	0/12	0/12	0/12

	#	%
TOTAL	7/360	1.9

Is this a flower?

10 plants

sage	sycamore tree	geranium	asparagus fern	elephant's ear	cactus	lavender	coconut	traveler's tree	philodendron		#	%
5/12	0/12	7/12	2/12	5/12	1/12 (2)	6/12	9/12	3/12 (2)	7/12	TOTAL	45/120	37.5

10 objects

dime	clock	tennis ball	football	key	vase	purse	scissors	anchor	pencil		#	%
0/12	0/12	0/12	0/12	0/12	0/12	0/12	0/12	0/12	0/12	TOTAL	0/120	0.0

	#	%
TOTAL	45/240	18.8

Is this a tulip?

3 flowers

hibiscus	aster	gardenia			#	%
5/12	3/12	3/12		TOTAL	11/36	30.6

3 plants

coconut	traveler's tree	philodendron			#	%
5/12	4/12	2/12		TOTAL	11/36	30.6

4 objects

shoe	book	anvil	ship		#	%
2/12	1/12	0/12	1/12	TOTAL	4/48	8.3

	#	%
TOTAL	26/120	21.7

Hierarchy

Is this a food?

30 objects

lawn-mower	telephone	table	one-way sign	ring	ruler	tugboat	record	soap	television	belt	razor	toothbrush	pail	teapot
0/12	0/12	1/12	0/12	1/12	0/12	0/12	0/12	0/12	0/12	0/12	1/12	0/12	0/12	1/12
eraser	**camera**	**candle**	**radio**	**beer can**	**mug**	**bell**	**pan**	**iron**	**car**	**chain**	**screwdriver**	**bowl**	**sandal**	**hammer**
1/12	0/12	1/12	0/12	2/12	0/12	1/12	0/12	1/12	0/12	1/12	0/12	1/12	0/12	0/12

	#	%
TOTAL	12/360	3.3

Is this a fruit?

													#	%
10 foods	dog biscuit	lettuce	egg	caviar	Swiss cheese	potato	cookie	garlic	corn	rye bread				
	3/12[1]	4/12[1]	3/12[1]	0/12[1]	3/12	2/12	0/12	3/12[1]	3/12	1/12		TOTAL	22/120	18.3
10 objects	dime	clock	tennis ball	football	key	vase	purse	scissors	anchor	pencil				
	0/12	0/12	0/12	0/12	0/12	1/12	0/12	0/12	0/12	0/12		TOTAL	1/120	0.8

	#	%
TOTAL	23/240	9.6

Is this an apple?

						#	%
3 fruits	pomegranate	banana	tomato				
	5/12[1]	1/12	7/12		TOTAL	13/36	36.1
3 foods	garlic	corn	rye bread				
	0/12	1/12	0/12		TOTAL	1/36	2.8
4 objects	shoe	book	anvil	ship			
	0/12	0/12	0/12[1]	0/12	TOTAL	0/48	0.0

	#	%
TOTAL	14/120	11.7

the concept 'dog' is being tested; to pictures of other dogs vs. other animals vs. inanimate objects when the concept 'collie' is being tested; to pictures of other plants vs. inanimate objects when the concept 'flower' is being tested; to pictures of other flowers vs. other plants vs. inanimate objects when the concept 'tulip' is being tested; to pictures of other foods vs. inanimate objects when 'fruit' is the concept being tested; and to pictures of other fruits vs. other foods vs. inanimate objects when 'apple' is the concept being tested. Occasionally there are overgeneralization errors to pictures of inanimate objects bearing little visual similarity to either an idealized or particular instance of the concepts 'tulip' and 'collie', suggesting to us that in these cases the child does not really know the word at all and is just guessing. With the exception of these few cases, there is a strikingly small number of overextension errors to inanimate objects.

Although perceptual similarity suggests itself as a determinant of overextension errors, examination of the individual pictures raises the possibility that other factors may be playing a role as well. For example, seven out of 12 children, when shown the picture of a tomato (a Xerox of which is shown on the next page) and asked "Is this an apple?", said "Yes". This tomato is clearly perceptually similar to an apple, but it is also functionally similar (you eat

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Insert picture of tomato here

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both apples and tomatoes), and tomatoes may be associated through contiguity with apples (since they are both found in the supermarket, in the refrigerator, or on the dinner table). Thus, functional similarity or association through contiguity may be determinants of overextension errors in this case in addition to or, possibly, rather than perceptual similarity. We were aware of the possible role played by association through contiguity since in another study conducted

Tomato

with great care by Judy Ungerer she found that children, when shown a picture of a vase (a Xerox of which is presented on the next page) and asked "Is this a plant?", would often respond "Yes". This vase does not look especially like a

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Insert picture of vase here

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plant, but such vases often contain plants and, therefore, are contiguous to plants, thus suggesting that association through contiguity may play a role in producing overextension errors at least in some cases. Functional similarity seems less likely to be a factor since we have not come across cases where objects which are used for the same purpose as instances of the concept being tested produce a great number of overextension errors unless those objects are perceptually similar to or likely to be associated through contiguity with instances of the concept in question. For example, a banana serves the same function as an apple (both dessert foods), but a picture of a banana produced only one overextension error (out of 12 possible) to the concept 'apple'. A Xerox of the picture of a banana is shown on the next page. Actually, this

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Insert picture of banana here

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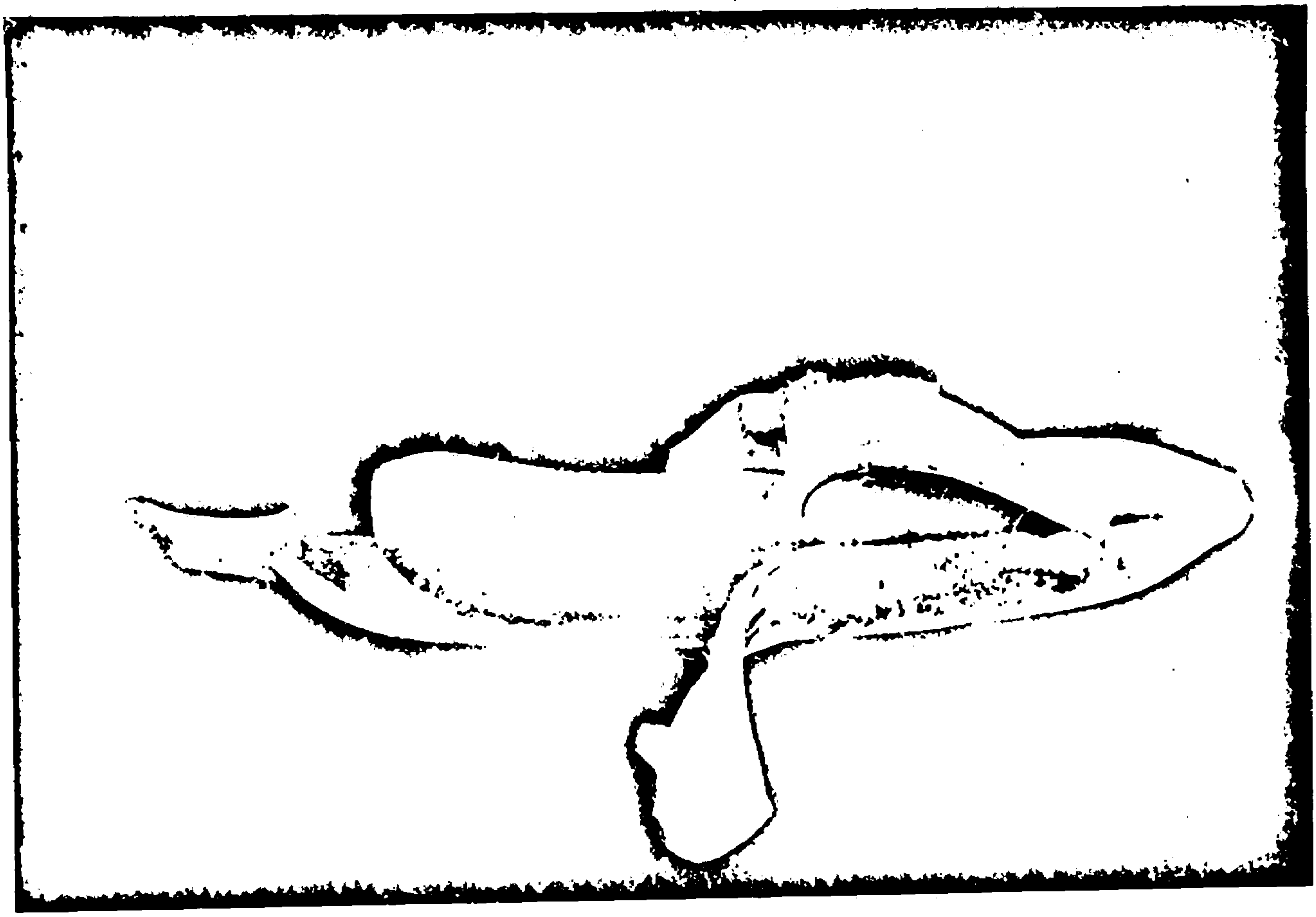
example would make it seem that the case of the child's overextending the term'apple' to a picture of a tomato were the result of perceptual similarity rather than association through contiguity, since bananas are just as likely, if not more so, to be experienced contiguously with apples as are tomatoes.

In this and other studies (see, for example, <u>#1 On the Order of Acquisition of Category Labels</u>) we have found the child's tendency to overgeneralize the concept 'flower' to other kinds of plants to be more prevalent than for any other concept we have tested. For example, five out of 12 children said that a picture of an elephant's ear was a 'flower'; nine out of 12 children said that a picture

Vase



Banana

of a coconut was a 'flower', and seven out of 12 children said that a picture of a philodendron was a 'flower'. Xeroxes of these pictures are shown on the

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Insert three pictures of plants here

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next three pages. Again it is not clear whether perceptual similarity or association through contiguity is the chief determinant of these overextension errors. Functional similarity seems less likely to be a factor since neither plants nor flowers serve important functions in the child's life.

Thus an examination of the pictures which produced the greatest number of overextension errors suggests that three factors may play a role in determining overextension errors. In decreasing order of the likelihood of their importance these are: (1) perceptual similarity -- the non-instance is perceptually similar to an instance of the concept; (2) association through contiguity -- the non-instance has been seen by the child in the presence of an instance of the concept; and (3) functional similarity -- the non-instance serves the same function as an instance of the concept. In this study it is often difficult to discern exactly which of these three factors is crucial since the non-instances which produce overextension errors are often both perceptually similar <u>and</u> contiguous to an instance of the concept or perceptually similar, contiguous <u>and</u> functionally similar to an instance of the concept. In another study (see #5 <u>The Determinants of Overextension Errors</u>) we have tried to disentangle the role played by each of these factors in determining overextension errors.

<u>Ratio of Underextension to Overextension Errors:</u>

As we have seen in this experiment children make both underextension and overextension errors. A question of mild interest is: Which kind of error do children make most often? This question is answered by Fig. 2 which shows the

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Insert Fig. 2 here

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Elephant's Ear

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p105

Coconut

Philodendron

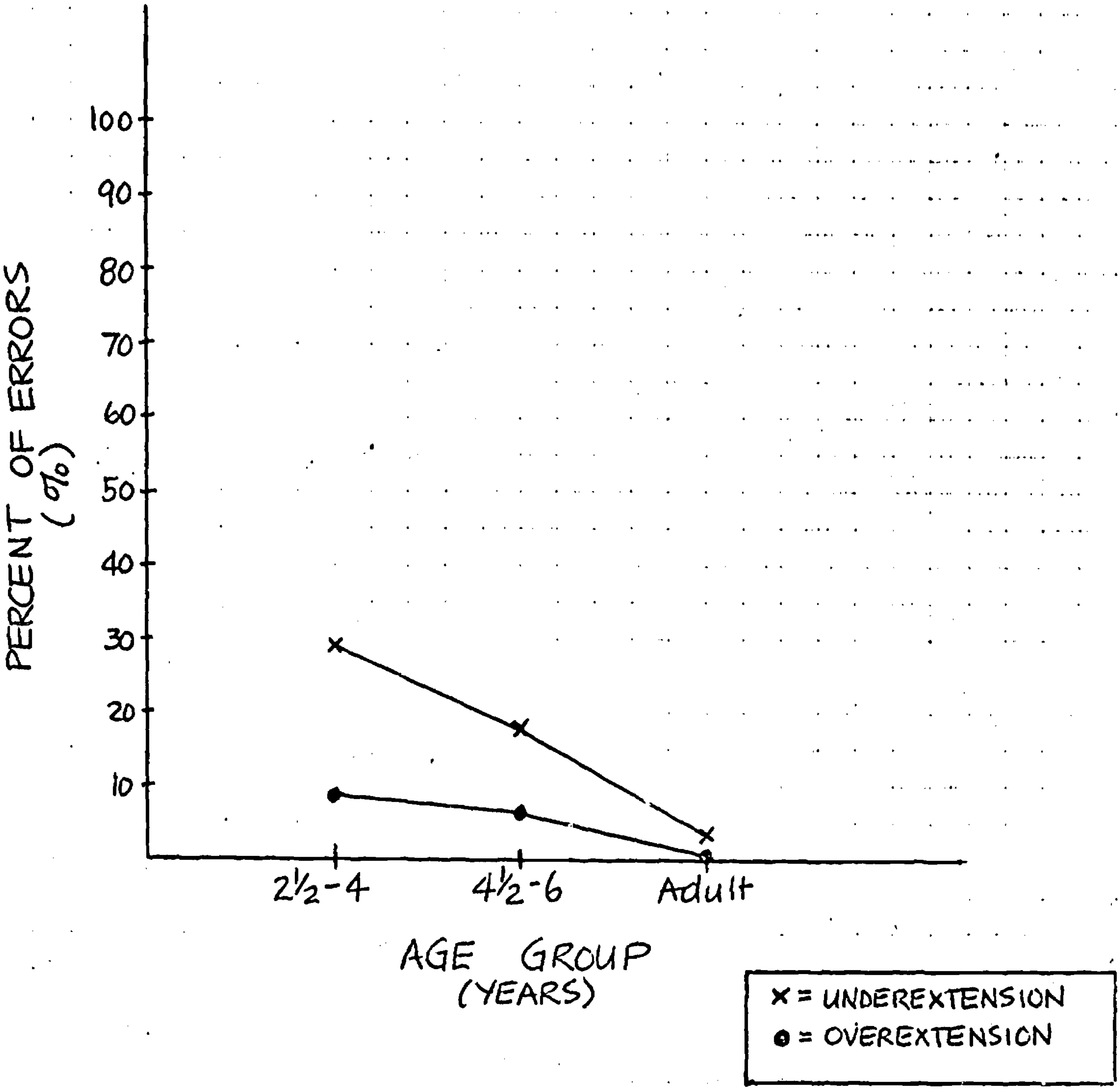

Fig. 2

Graph showing (1) % of possible underextension errors made as a function of age
(2) % of possible overextension errors made as a function of age

Method 1: all subjects

percentage of possible underextension errors and the percentage of possible overextension errors made by each of the three age groups tested in this study. The number of both kinds of errors is shown in Fig. 2 to decrease systematically with age. For both of the youngest age groups (as well as for the adults) the number of underextension errors is greater than the number of overextension errors. Specifically, the 2 1/2 to 4 year old group makes 28.9% of the possible underextension errors and only 8.4% of the possible overextension errors. The 4 1/2 to 6 year old group makes 16.5% of the possible underextension errors and only 6.2% of the possible overextension errors. Fig. 2 was calculated using all subjects with "No's" to instances being counted as underextension errors, and "Yes's" to non-instances being counted as overextension errors. It might be objected that it is not fair to count all subjects on all concepts since some subjects might not have a given term in their vocabulary and their responses might be simply guesses. Children rarely say they don't know when asked if a given stimulus is an instance of a given concept, even though their pattern of responses might indicate that they have no idea of what the concept means. If children were biased to give more "No" responses than "Yes" responses to such stimuli, then this would inflate the number of underextension errors relative to the number of overextension errors. For this reason we performed the analysis again, but this time only included subjects whose overall pattern of responses indicated that they had some notion of the concept for which they were being tested. Our criteria for including a subject's performance on a given concept in this analysis were fairly stringent: (1) the subject had to identify more than 20% of the instances as instances, and (2) the ratio of the number of "Yes's" to instances over the number of "Yes's" to non-instances had to be equal to or greater than 2. The results are shown in Fig. 3 which again shows

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Insert Fig. 3 here

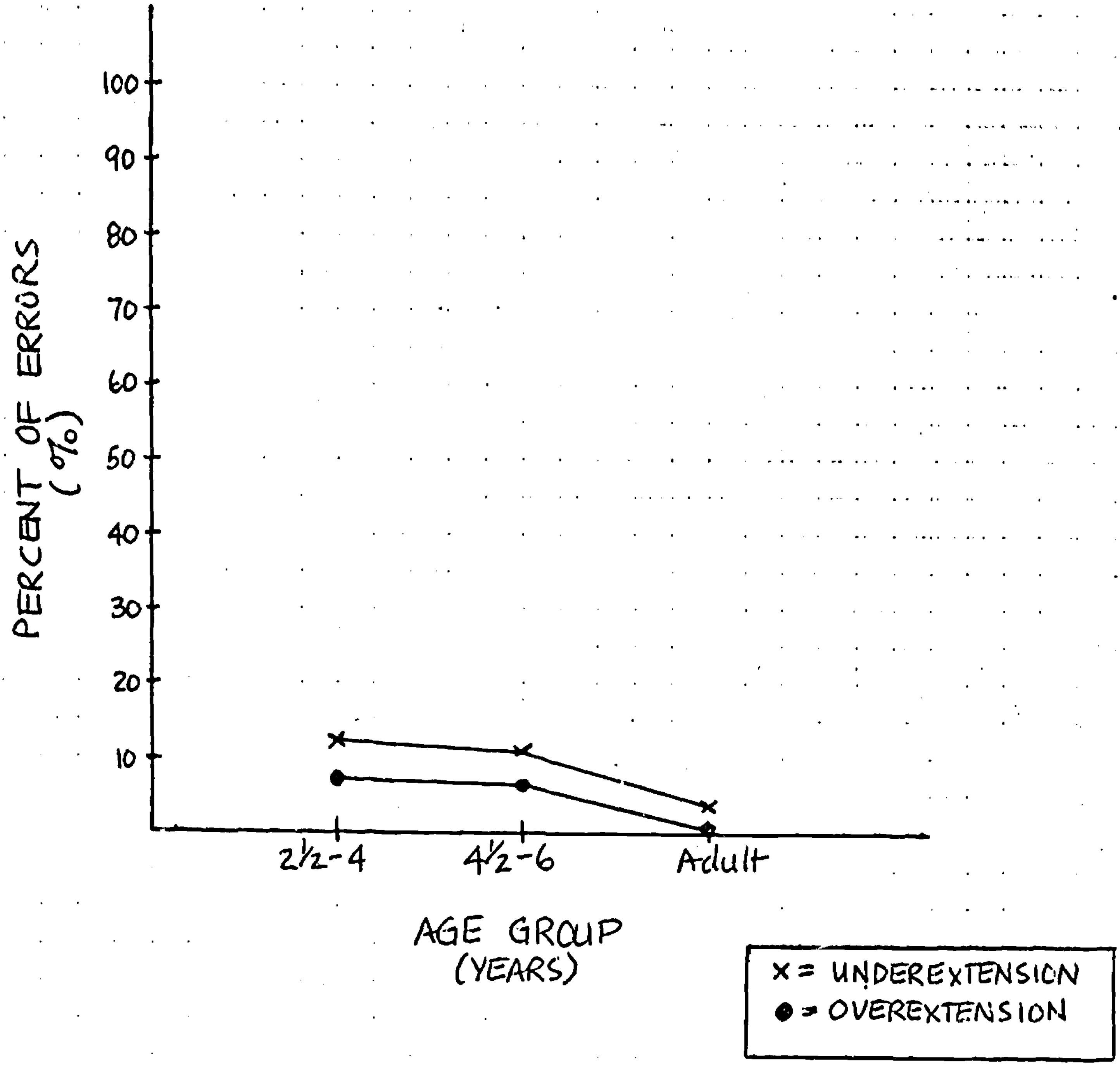

Fig. 3

Graph showing (1) %of possible underextension errors made as a function of age
(2) % of possible overextension errors made as a function of age

Method 2: subjects deleted who do not meet criterion for having a word in their vocabulary.

the percentage of possible underextension errors and the percentage of possible overextension errors made by each age group, but this time the calculations are based only on subjects who met the aforementioned criteria for having the word in their vocabulary. Fig 3 shows that when the analysis is done in this way the percentages of both kinds of errors made by the children drops considerably, but still there is a decreasing tendency to make either kind of error with increasing age and still the number of underextension errors is greater for both groups of children than the corresponding number of overextension errors.

The question of which kind of errors are made most often by children in this study is only mildly interesting because there is no guarantee that another study which employed different instances and non-instances would also show a greater number of underextension errors. It would be unwise to extrapolate from the findings of the present study to the conclusion that children more frequently undergeneralize than overgeneralize their first terms of reference, although it is certainly possible. The point is that by judicious choice of concepts, of instances and of non-instances a clever experimenter could conduct a similar study which would show a preponderance of either kind of error.

In this particular study we did try to allow for the possibility of both kinds of errors not only by including an equal number of instances and non-instances of each concept but also by choosing instances which we thought might promote underextension errors and by choosing non-instances which we thought might promote overextension errors. Specifically, in the case of the instances of a concept we attempted to cover a broad range of the denotative possibilities of the various concepts, including both typical and familiar instances (e.g., dog, bread) and unfamiliar and atypical instances (e.g., preying mantis, caviar). In the case of non-instances we included a relatively large number of cases which, based on our understanding of previous reports of overextension in the child's first terms of reference, would be most likely to produce overextension errors (and indeed they did). For example, when the child was tested for 'collie', three out of ten non-instances were other dogs, and three were other animals; when he was tested for 'dog', ten out of 20 non-instances were other animals, etc. Thus this study allowed for both kinds of errors and, indeed, both kinds of errors were made. It is notable that in this particular study children make more underextension errors, especially in view of the fact that the literature on the subject has so often stressed only overextension in the child's first terms of reference. However, I do not want to argue that underextension is necessarily more prevalent than overextension in the child's first terms of reference on the basis of this study. My position is rather that both kinds of errors do occur and whether you will observe more of one than the other depends upon the concepts being tested and the nature of the instances and the non-instances.

A more interesting question than "Which kind of errors do children make most?" is "How does the ratio of one type of error to the other change with increasing age?" The literature which emphasizes overgeneralization in the child is usually concerned with children between the ages of one and three years. The children in our study were between 2 1/2 and 4 years and 4 1/2 and 6 years. Is it possible that younger children are more likely to make relatively more overextension errors compared to underextension errors? The answer to this question is given by Figs. 4 and 5 which show the ratio of underextension errors to overextension errors for each of the age groups. Fig 4 is based on all subjects

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Insert Figs. 4 and 5 here

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with a "No" to an instance counting as an underextension error and a "Yes" to a non-instance counting as an overextension error. Fig.4 shows that, if anything, the 2 1/2 to 4 year old group makes proportionately more underextension errors

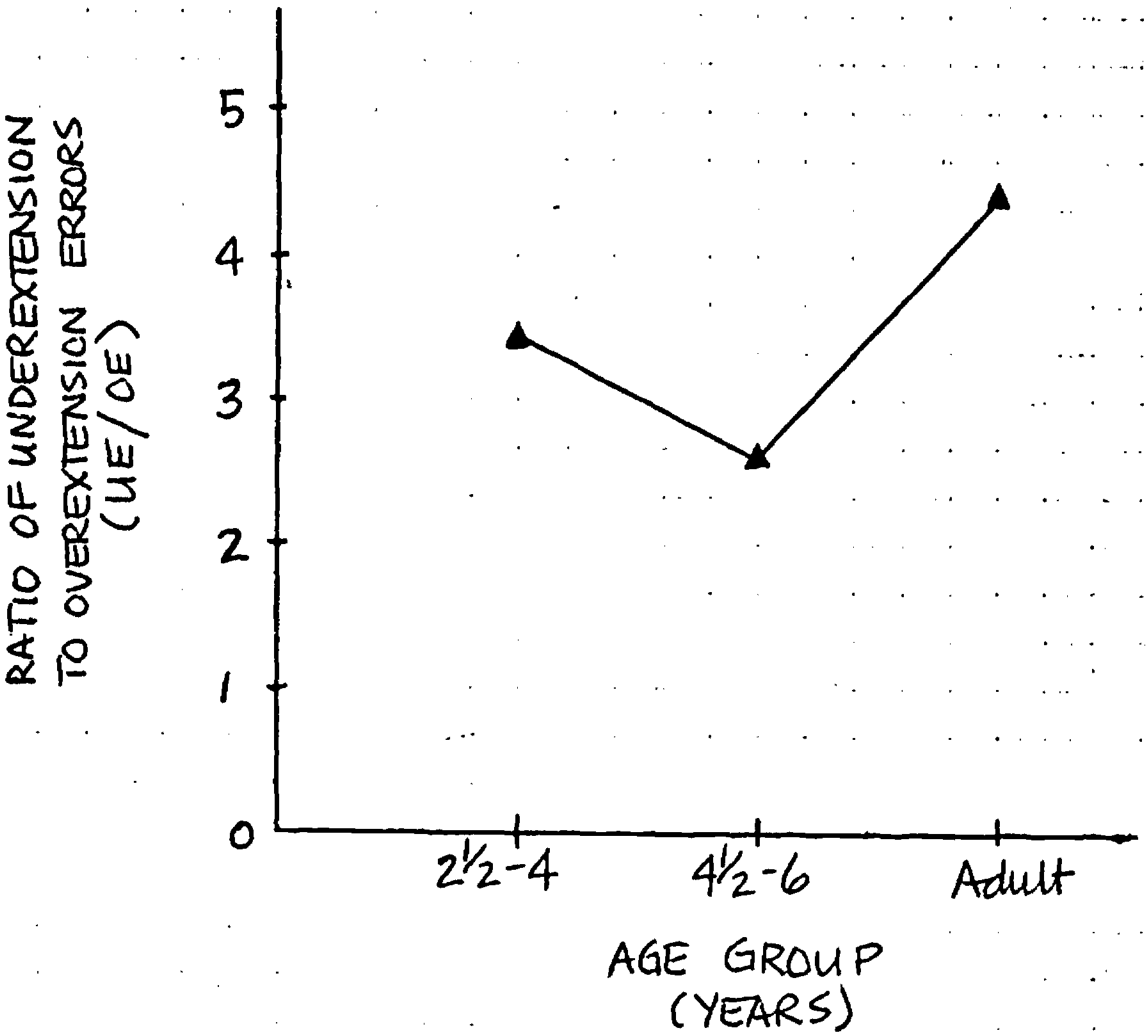


Fig. 4

Graph showing ratio of underextension errors to overextension errors made as a function of age.

<u>Method 1</u>: all subjects

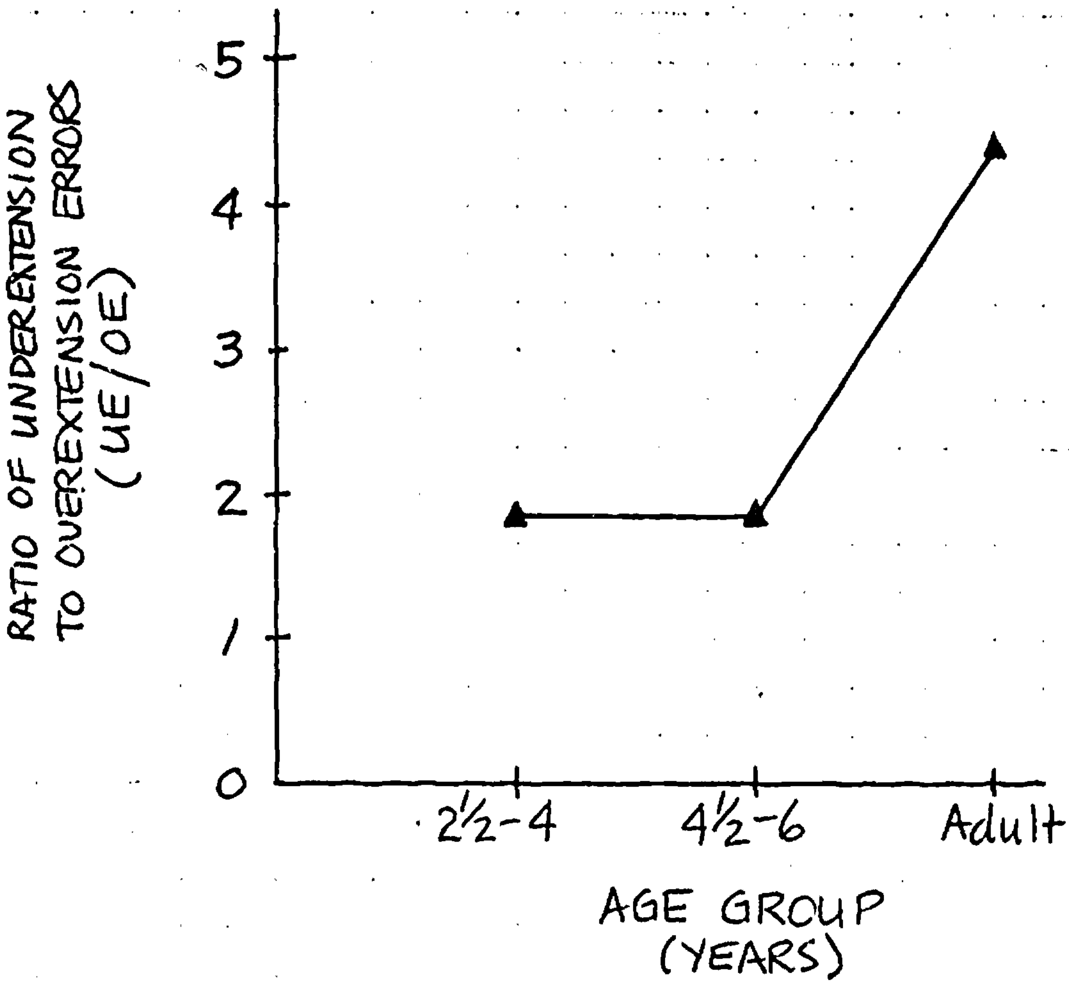


Fig. 5

Graph showing ratio of underextension errors to overextension errors made as a function of age.

Method 2: subjects deleted who do not meet criterion for having a word in their vocabulary.

than overextension errors compared to the 4 1/2 to 6 year old group. Again it might be objected that we should not include subjects who have not demonstrated that they have the word in their vocabulary. So in Fig. 5 we again calculated the ratio of underextension errors to overextension errors, but this time we deleted those subjects who did not meet the previously used criteria for having the word in their vocabulary. When the analysis is done in this way it can be seen in Fig. 5 that the ratio of underextension to overextension errors is 1.8 for both the 2 1/2 to 4 year olds <u>and</u> the 4 1/2 to 6 year olds. The implication of this analysis is that, although younger children make more errors of both kinds than do older children, they do not necessarily make proportionately more overgeneralization errors than do older children.

<u>Relation of Underextension Errors to Level in Hierarchy</u>:

When we were planning this experiment we decided to test children for concepts at different levels of generality. At the back of our minds was the hypothesis that the more general a concept the more likely it would be that children would make more underextension errors. We reasoned that the more specific a concept, the more perceptually homogeneous the instances of that concept would be and, therefore, that if a child could correctly classify one instance of a specific concept he would probably be able to correctly classify other instances since they would be perceptually similar. The more general a concept, the more perceptually diverse the instances of that concept would be, and, therefore, we thought that the child's ability to correctly classify one instance of a more general concept would be no guarantee that he would be able to correctly classify another perceptually dissimilar instance.

However, this hypothesis in retrospect appears to have been somewhat simplistic, for there appear to be cases where a child will not recognize an instance as belonging to a more specific category, although he does recognize it as belonging to a more general category. For example, there were several pictures of tulips which children said were not 'tulips' while other children correctly identified these tulips as being 'flowers'. In some cases for which a child said that a picture of a tulip was not a 'tulip' it appears that he did not have the word in his vocabulary at all and that he was simply guessing, which resulted in negative responses to positive instances. However, in other cases some children seemed to know that only flowers were tulips (they never said that non-flowers were tulips), but still said that several instances of tulips were not 'tulips'. Even adults make several underextension errors on the concept 'tulip' whereas they rarely make underextension errors on the concept 'flower'. In a recent issue of Better Homes and Gardens, photographs of several different kinds of chrysanthemums were shown and I was struck by the variety of types of chrysanthemums that do exist, many of which I did not recognize as chrysanthemums although I did recognize them all as being flowers. These examples illustrate that our initial hypothesis that the more general a concept, the greater the likelihood of underextension errors is not correct in all cases. [1]

What our data on underextension errors do suggest is that, in terms of vocabulary development, there is neither a concrete to abstract progression nor an abstract to concrete progression, but most often the child is best at identifying instances of some intermediate term within a hierarchy of names and does not do so well at more specific and more general names. For the particular hierarchies of concepts that we used in this experiment children do better on 'dog' than on 'collie' or 'animal'; better on 'flower' than on 'tulip' or 'plant'; and better on 'apple' than on 'fruit' or 'food'. Such a description seems appropriate when only pictures which were tested at each level in a hierarchy are considered. For example, for the ten pictures of collies children gave the greatest percentage of "Yes" responses when asked "Is this a dog?", next greatest

[1] I am grateful to R. J. Herrnstein for first pointing out to me the problem with this hypothesis.

when asked "Is this an animal?" and least when asked "Is this a collie?" For the ten pictures of tulips children did best when asked "Is this a flower?", next best when asked "Is this a plant?" and worst when asked "Is this a tulip?" For the ten pictures of apples children do best when asked "Is this an apple?" and equally badly when asked "Is this a fruit?" and "Is this a food?" On the assumption that the ability of children to recognize instances as belonging to various categories is a measure of the order of acquisition of category labels these results constitute a replication of the basic findings in our previously reported study The Order of Acquisition of Category Labels.

Conclusions

Diary studies are systematically biased to show only overextension in the child's first terms of reference. When an experiment is done which permits the possibility of both overextension and underextension errors it is seen that children do in fact make both kinds of errors. Generalization (filling out categories) thus appears to be just as real as differentiation (narrowing down categories) in the early conceptual development of the child.

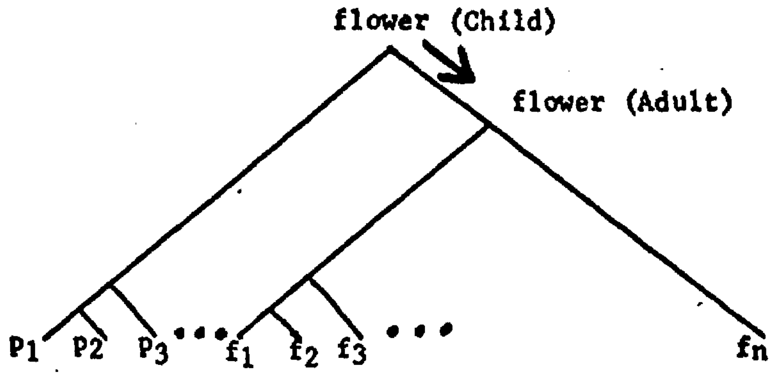
Whether a child will make overextension errors or underextension errors appears to depend upon at least the following three factors: (1) the particular child in question; (2) the concept being investigated; (3) the nature of the instances and non-instances being tested. With respect to the child in question, some children will overextend certain terms whereas others will underextend those same terms while still others will neither overextend nor underextend them.

The answer to the question of whether a child's concept is more or less general than the corresponding adult concept also depends upon the particular concept in question. For example, the preschool child's concept of 'flower' often extends beyond the adult's concept of 'flower' since the child often includes several other kinds of plants (non-flowers) in the category "flower". On the other hand, the child's concept of 'plant' is often less general than the adult's concept of 'plant' since the child will often not include certain kinds of plants (such as trees and sometimes flowers) in the category 'plant'. Thus the concept 'flower' usually becomes more restricted in development whereas the concept 'plant' usually becomes more general. The developmental changes in the extension of the concepts 'flower' and 'plant' are depicted schematically in Fig. 6.

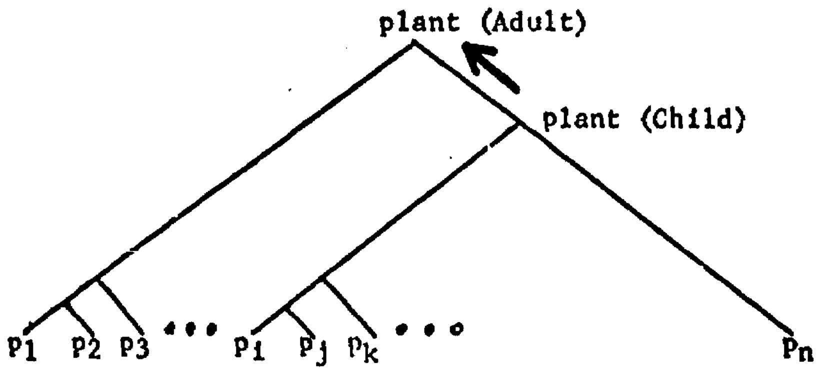
Insert Fig. 6 here

Finally, certain kinds of instances appear to be more likely to produce underextension errors in children than other kinds of instances, and certain kinds of non-instances appear to be more likely to produce overextension errors than other kinds of non-instances. Atypical or peripheral instances (cf., Heider, 1973, 1973) of a given concept seem more likely to produce underextension errors than typical or central instances. The familiarity of the instance may also play a role. At least in some cases young children will exclude a familiar instance from a general category because they have another name for that instance ("That's a dog, not an animal") and because they sometimes do not seem to realize that a single object can belong to more than one category or, to put it another way, that a given object has several equally valid names. Three attributes of non-instances may be important in enticing the child to make overextension errors. In decreasing order of the likelihood of their importance these are : (1) perceptual similarity -- the non-instance is perceptually similar to an instance of the concept; (2) association through contiguity -- the non-instance has been seen in the presence of an instance of the concept; and (3) functional similarity -- the non-instance serves the same function for the child as an instance of the concept.

Schematic representation of developmental changes in the extension of the concepts "flower" and "plant". The figure illustrates that whether a child's concept is more or less general than the adult's concept depends upon the particular concept in question. The child's concept of "flower" often extends beyond the corresponding adult concept whereas the child's concept of "plant" is usually more restricted than an adult's.



The arrow indicates the direction of developmental change.



The arrow indicates the direction of developmental change.

In the present study it was often difficult to isolate the roles played by peripherality and familiarity in producing underextension errors and to isolate the roles played by perceptual similarity, association through contiguity and functional similarity in producing overextension errors. In the two experiments to be presented next we have tried to tease apart the contributions of these various factors in bringing about the child's early referential problems.

4. The Determinants of Underextension Errors (J. Anglin and Elizabeth Smith)

In a previous study (See #3 On the Extension of the Child's First Terms of Reference) it was shown that children sometimes do not include instances in concepts which adults do include. For example, when shown a picture of a preying mantis and asked "Is this an animal?", many children said "No" whereas adults invariably said "Yes". Or, when shown a picture of a sycamore tree and asked "Is this a plant?", many children said "No", often adding "It's a tree, not a plant", whereas adults invariably said "Yes". The question of real interest concerning the underextension errors of the child is: Why do they make them for certain instances and not for others? An intuitive and ad hoc analysis of the stimuli suggested that at least two factors may play a role in enticing a child to make such errors. First it seemed that children would often make errors for instances which intuitively do not seem to be "typical" instances or good examples of the concept being tested. Thus, for example, although adults will agree that a preying mantis is an 'animal' they will often point out that it is not as good an example of an 'animal' as a dog or horse or some other four-legged furry mammal. Eleanor Heider (1973, 1973) has recently made much of the notion that some instances are better examples of concepts than others. She, like several others recently including Susan Carey (1973) and J. Fodor (1972), has argued that the traditional notion of a concept as being comprised of a bundle of criterial attributes or features is incorrect and that most natural categories do not have well-defined boundaries. Rather she argues that a given concept has "internal structure" by which she means that a given category is composed of a core meaning which consists of the clearest cases or best examples of the category, surrounded by other category members of decreasing similarity to that core. Thus, instances of a concept vary along a dimension which she calls 'centrality', with the best instances being very central and the worst instances being very peripheral. She has found that adult subjects find it a meaningful task to rate instances according to their degree of centrality to a given concept and that they tend to agree in their judgements of centrality. So, for example, for the concept 'fruit' 'apple' is rated by adult subjects as being a good exemplar of the category whereas 'fig' or 'olive' are rated as being poor exemplars. 'Robin' is rated as a good exemplar of 'bird' whereas 'chicken' or 'ostrich' are rated as poor exemplars.

One might speculate, as Heider in fact has, that children's concepts often start out being comprised of the central or prototypical instances of the corresponding adult concept and that it is only with development that the more peripheral instances of the adult concept come to be included in the child's. While this hypothesis both overstates its case and does not account for all of the child's underextension errors, it does make intuitive sense out of many of the underextension errors which do occur. For example, although we did not have adults rate the pictures in the preceding experiment along the dimension of centrality, it is safe to assume that the picture of a preying mantis would be rated as less central to the concept 'animal' than, for example, a picture of a dog. Also we have had adults rate various kinds of trees for their degree of centrality to the concept 'plant' and in general trees are rated as being rather peripheral. Thus again it would be fairly safe to assume that the picture of the sycamore tree which produced many underextension errors in children is probably a peripheral instance of the concept 'plant'. Children do not always make underextension errors to the picture of the preying mantis or to the picture of the sycamore tree or to other pictures which one might guess would be rated as peripheral (which is why I said the hypothesis probably overstates its case), but most of the instances of concepts which produced a relatively large number of underextension errors do seem to be atypical, peripheral or 'poor' examples of the concepts in question. There was one notable exception to this general rule, however. Adults generally rate pictures of human beings as being quite central to the concept 'animal', but as we saw previously preschool children invariably choose not to classify a picture of a woman as an 'animal'. Thus adult judgements of centrality will not always provide a predictor of the tendency of the child to exclude an instance from a category, but then again they may very often be predictive.

Eleanor Heider (1973) conducted an experiment which in fact did suggest that when a child fails to include an instance in a concept it is often in the case of peripheral instances. She presented words to children and to adults in either true sentences or false sentences and the subject's task was to push a button indicating whether the sentence was true or false. True sentences were of the form "A robin is a bird", "A duck is a bird", "A carrot is a vegetable", etc. The nouns in the subjects of these sentences were of two types: they were either central or peripheral instances (according to adult ratings) of the categories in the predicates of the sentences. She found, among other things, that neither adults nor children made many errors on the central instances but that children made many errors (about 25%) on the peripheral instances whereas adults did not. This suggests that children tend to exclude instances from categories when they are peripheral exemplars of those categories. The children in Heider's study were 9 to 11 years old, much older than the age group with which we have been concerned in this series of studies. In the study to be presented we have attempted to see whether two to six year olds will also make underextension errors for instances which have been rated as peripheral by adults more often than for instances which have been rated as central. We have used pictures rather than words, but the basic idea is the same.

In addition to the central-peripheral factor, we also wanted to investigate the role played by another attribute of instances which can be rated by adults: the familiarity of the instance. According to one hypothesis the child would make relatively more underextension errors to unfamiliar than to familiar instances since his lack of experience with such instances might go hand in hand with a lack of knowledge of the categories to which those instances belong. It seemed possible, for example, that children failed to classify a preying mantis as an 'animal' because they knew nothing of preying mantises, including that they are animals. The problem here is that a preying mantis is both a peripheral and unfamiliar instance of the concept 'animal' and it is unclear which of these two factors is the important one in determining underextension errors to it. Would the child also make underextension errors to a wombat, or an aardvark, or an anteater, which are presumably unfamiliar to him but which, because they are four-legged furry mammals are also central to the concept 'animal'?

Another line of argument suggests that familiar rather than unfamiliar stimuli will sometimes encourage underextension errors, for we noted in the preceding study that the child will sometimes fail to include a familiar kind of object in a general category quite possibly because he has a more specific name for the object and because he does not realize that a given object can belong to two different categories or be named in two equally valid, different ways. Thus, in the case of the picture of the sycamore tree when asked "Is this a plant?", children were often observed to say something like "No,it's a tree, not a plant." In the case of a picture of a dog when asked "Is this an animal?", children occasionally said "No, it's a dog, not an animal." Inhelder and Piaget (1964) have made similar kinds of observations. For example, they showed a child a group of eight flowers, four of which were primroses. They then asked the child if he would have more if he took all of the primroses or all of the flowers. The child said he would have the same in either case, suggesting that he did not realize that the object which is called 'primrose' is also called 'flower'.

Such examples illustrate that children sometimes have not mastered the structure of class hierarchy and have trouble interpreting any given object as an instance of more than one conceptual category. According to this view, when the child says of a sycamore tree "It's a tree, not a plant", his labelling the object with the dominant name 'tree' dissuades him from categorizing it as a 'plant' at the same time. Presumably such interference will be more likely to occur for familiar objects since he may often have access to names for familiar objects but not for unfamiliar objects.

In the study to be presented we have attempted to discern the contributions of the central-peripheral factor and the familiar-unfamiliar factor in determining underextension errors. In an effort to disentangle the roles played by these factors we have examined the extent to which children make underextension errors for four different kinds of instances: central-familiar, central-unfamiliar, peripheral-familiar and peripheral-unfamiliar.

Method

Our goal was to investigate the tendency of children to exclude four kinds of instances of concepts from those concepts. Specifically the kinds of instances we wanted to investigate were : (1) central and familiar; (2) central and unfamiliar; (3) peripheral and familiar, and (4) peripheral and unfamiliar. We did not want to rely on our own intuitions of the degree of centrality or familiarity of the instances since our intuitions might be idiosyncratic or biased for one reason or another. We therefore decided to obtain judgements from several adults of the centrality and familiarity of several instances to several concepts so that we might choose from these instances ones which adults in general tend to rate as being central and familiar, central and unfamiliar, peripheral and familiar and peripheral and unfamiliar.

We began by taking photographs of several different instances of several different categories. Specifically we collected a pool of about 300 pictures of instances which fell into eight different categories :dogs, toys, foods, plants, birds, animals, clothing and vegetables. We then chose from these 300 pictures a total of 188, with 23 or 24 pictures in each category which we thought were visually clear and which intuitively seemed to cover a fair range of the centrality-peripherality and the familiarity-unfamiliarity dimensions. We then asked ten adults to rate these pictures according to their degree of centrality to the categories to which they belonged and according to their degree of familiarity. The adult judges, seven females and three males, were all over 18 years of age, were from the Cambridge area and were either students at Harvard or otherwise employed. Adult judges were told that they would be asked questions about pictures of instances of the eight categories: 'animal', 'plant', 'food', 'dog', 'toy', 'bird','vegetable' and 'clothing'. Specifically they were told that they would be given a pack of 23 or 24 pictures for each of these categories and would be asked to rate each picture for its degree of centrality to the category to which it belonged and also for its degree of familiarity. We spent a few minutes explaining to subjects what we meant by centrality and what we meant by familiarity. Specifically, for the 'centrality-peripherality' dimension we told them: "This dimension refers to how 'close' or 'distant' the object pictured is to the most typical instance (or instances) of the concept. In your judgements, first think of the most typical instance (or instances) that you can (the "doggiest" dog, the most "clotheslike" article of clothing, etc.). Then as you look through the pictures, rate each one according to its nearness to (centrality) or distance from (peripherality) this typical instance. Some cases are better cases of a concept than others and those which you feel are good instances should be rated as central whereas those which you feel are poor instances should be rated as peripheral." After some discussion subjects seemed to understand what we meant by centrality and the seven-point scale along which they were to rate the stimuli (which I will describe more fully shortly). We then told them that it was possible that for some of the pictures they might feel that the objects depicted were not instances of the concepts under study at all and, if so, they were not to rate the stimulus for its degree of centrality to the category in question but rather should mark the space provided on the rating sheet with an "X". We later rejected any of the pictures which were judged not to be instances from the set we finally chose to use with children since we wanted to be sure that when a child made an underextension error it was a genuine one and that adults would not make the same mistake.

We then told them that for each picture they would also be asked to rate it along a familiarity-unfamiliarity dimension. Specifically, we told them: "For this dimension rate each picture according to how familiar or unfamiliar the kind of object pictured is. In this rating, try to be as little idiosyncratic and as much intuitively average as you can. In other words, rate each object pictured by thinking how familiar that kind of object is 'in general' or among the other possible objects in this category. Perhaps you have seen an armadillo frequently, but on the whole an armadillo is less familiar, less well-known, or less frequently seen than, say, a dog." Subjects seemed to have little problem with the idea of familiarity.

They were then shown a seven-point scale along which they were to rate the pictures for both centrality and familiarity. Each of the numbers on the scale was described verbally. Subjects were to choose a 1 is they thought the stimulus was 'extremely' peripheral or unfamiliar, a 2 if they thought it was 'very' peripheral or unfamiliar, a 3 if they thought it was 'quite' peripheral or unfamiliar, a 4 if they thought it was 'moderately' central or familiar, a 5 if they thought it was 'quite' central or familiar, a 6 if they thought it was 'very' central or familiar and a 7 if they thought it was 'extremely' central or familiar. The seven-point scale was placed at the top of each individual rating sheet so the judges could refer to it as they rated the pictures. Subjects were asked to go through all the pictures in a pack and rate them along one dimension. Then they were asked to go through the pictures in that pack again and rate them along the other dimension. Half of the subjects rated the pictures for centrality first and familiarity second; the other half of the subjects rated them for familiarity first and centrality second. The rating process took from 45 to 60 minutes for each subject. All subjects seemed to understand the task although many of them had questions about its purpose which were answered at the end of the session.

The adult centrality ratings for each stimulus were then averaged as were the adult familiarity ratings. On the basis of these average ratings we chose 12 pictures for each of four categories to be used in an experiment with children. The four categories were 'animal', 'clothing', 'food' and 'bird'. The 12 pictures for each category were chosen such that three of them had been rated by adults as being central and familiar, three of them as central and unfamiliar, three of them as peripheral and familiar and three of them as peripheral and unfamiliar. The numerical criteria we were forced to use in light of the averaged adult ratings were as follows: (1) Instances which were rated as greater than 4.5 along the centrality dimension were used as central instances; instances which were rated as less than 4.5 along the centrality dimension were used as peripheral instances. (2) Instances which were rated as greater than 5.0 on the familiarity dimension were used as familiar instances; instances which were rated as less than 5.0 on the familiarity dimension were used as unfamiliar instances. The instances used in each category and the average adult judgements of centrality and familiarity for each instance are shown in Table 1. Consider, for example, the first column of Table 1 which

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Insert Table 1 here

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shows the 12 pictures which were used as instances of the concept 'animal'. The three central pictures are of a cow, horse and cat. Adult judges had rated these as being both central to the concept'animal' and familiar. The three central unfamiliar instances were pictures of a wombat, an aardvark and an anteater. Adults had rated these pictures as being central to the concept

... and familiarity ratings for 48 stimuli used in the underextension study.

PERIPHERAL OR UNFAMILIAR	1	2	3	4	5	6	7	CENTRAL OR FAMILIAR
	extremely	very	quite	MODERATE	quite	very	extremely	

CONCEPT	ANIMAL		CLOTHING			FOOD			BIRD		
STIM	Average Centrality Rating	Average Familiarity Rating	STIM	Average Centrality Rating	Average Familiarity Rating	STIM	Average Centrality Rating	Average Familiarity Rating	STIM	Average Centrality Rating	Average Familiarity Rating
cow	7.0	7.0	shirt	6.8	7.0	bread	6.8	6.9	prothonotary warbler	6.5	5.5
horse	6.9	6.7	pants	6.6	6.8	egg	6.8	7.0	English tree sparrow	6.6	6.6
cat	7.0	7.0	dress	6.6	6.3	chicken	7.0	6.8	bluejay	6.2	6.0
wombat	5.9	2.9	kimono	4.9	3.2	beef kidney	4.8	2.9	vulture	5.7	4.7
aardvark	5.6	3.0	coptic tunic	5.1	3.1	cod fish	5.8	4.4	Eastern Green Heron	5.8	4.2
anteater	5.5	3.4	1587 suit	5.2	3.5	tongue	5.9	3.6	hummingbird	5.7	4.5
ant	2.7	6.2	high heel	4.2	6.5	ketchup	3.0	6.9	hen	3.8	6.4
butterfly	3.1	6.2	scarf	3.8	6.3	coffee	2.7	6.8	duck	4.3	6.7
starfish	2.8	5.8	skates	3.4	6.3	lollipop	3.0	6.3	penguin	3.9	6.8
crustacean	1.4	1.2	lace collar	2.2	2.2	coffee beans	2.6	4.1	kiwi	3.1	2.9
hydra	1.6	1.3	1715 wood shoe	2.4	2.3	mint leaves	1.8	2.7	American Egret	3.7	4.2
[illegible]tipede	2.0	3.1	venetian hat	2.5	2.9	morel mushroom	2.2	2.1	baby Brown Pelican	3.3	3.1

'animal' but unfamiliar. The three peripheral familiar instances were pictures of an ant, a butterfly and a starfish. Adults had rated these pictures as being peripheral examples of the concept 'animal' but familiar. Finally the three peripheral unfamiliar instances were pictures of a crustacean, a hydra and a centipede. Adults had rated these pictures as being both peripheral to the concept 'animal' and unfamiliar. Xeroxes of the actual pictures of instances used in the experiment with children are shown in the following pages. In addition to the 12 instances of each concept were also included six

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Insert 48 pictures here

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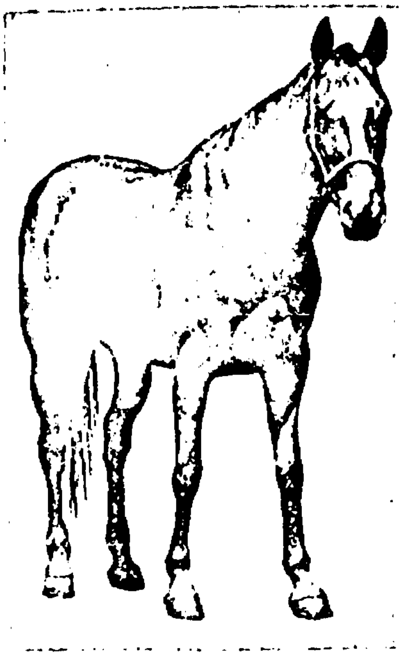
non-instances (which are not presented) for each concept in our study with children. Thus each child was shown a total of 72 pictures with 12 instances and six non-instances of the four concepts 'animal', 'clothing', 'food' and 'bird'.

Subjects were 20 children between two and six years of age from the Living and Learning School in Woburn, Massachusetts. All children were from middle class families living in the area. Children were taken from the classroom situation and came quite voluntarily to the "surprise room", a private staff room where there was a table, chairs and the material for the session. Children were seated to the left of the experimenter who began by asking them for such vital statistics as their names, ages and how much television they watched. (All children watched some T.V. and had seen Sesame Street in particular.) Then when the child seemed comfortable E turned on the tape recorder and began a session. First the child was asked to define, describe

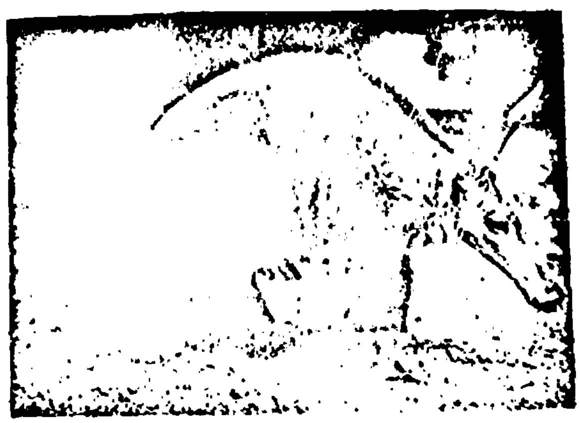
Cow



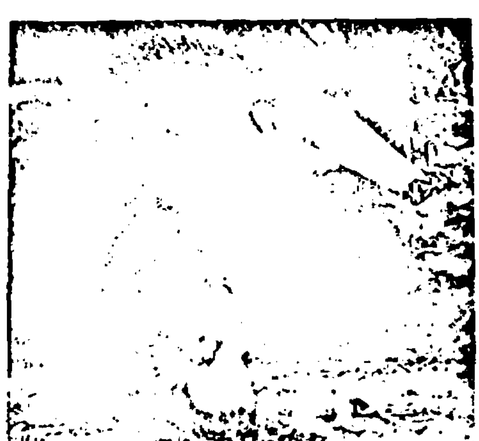
Horse

Cat

Wombat



Aardvark



Anteater

Ant

Butterfly

Starfish

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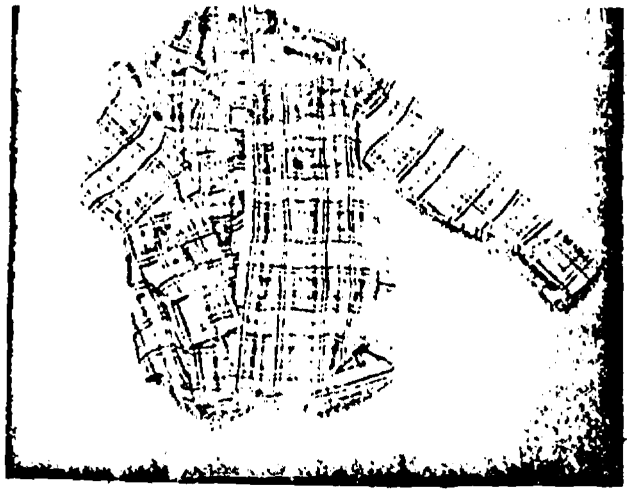
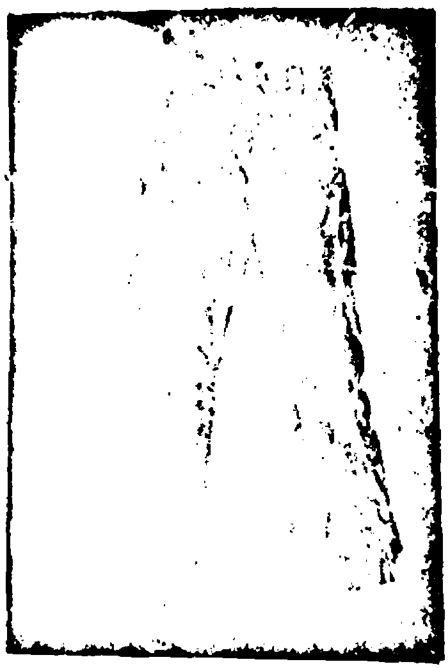
Crustacean

Hydra

Centipede

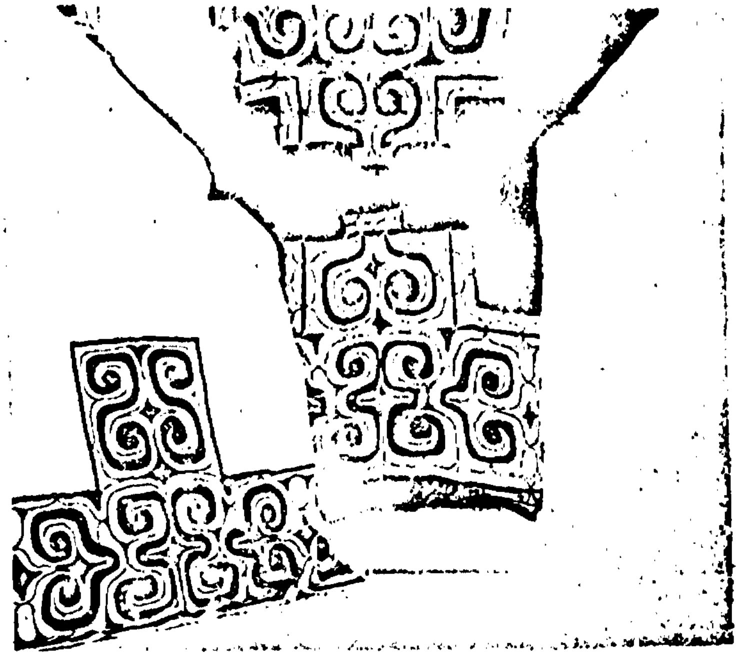


Shirt



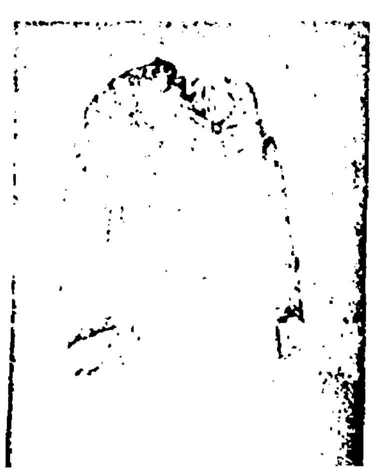
Pants

Dress

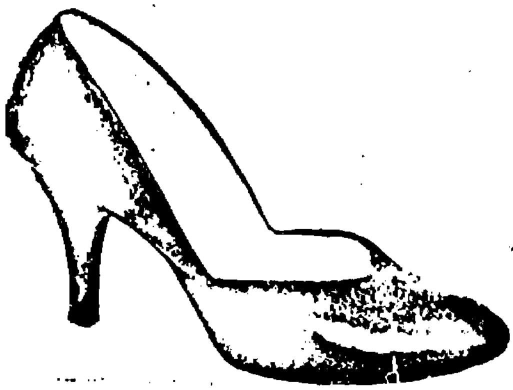


Kimono

Coptic Tunic

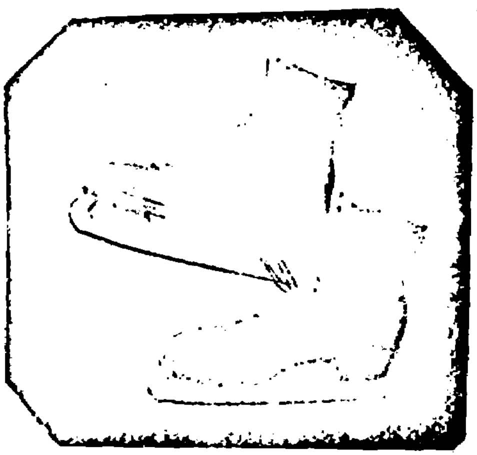


1587 Suit

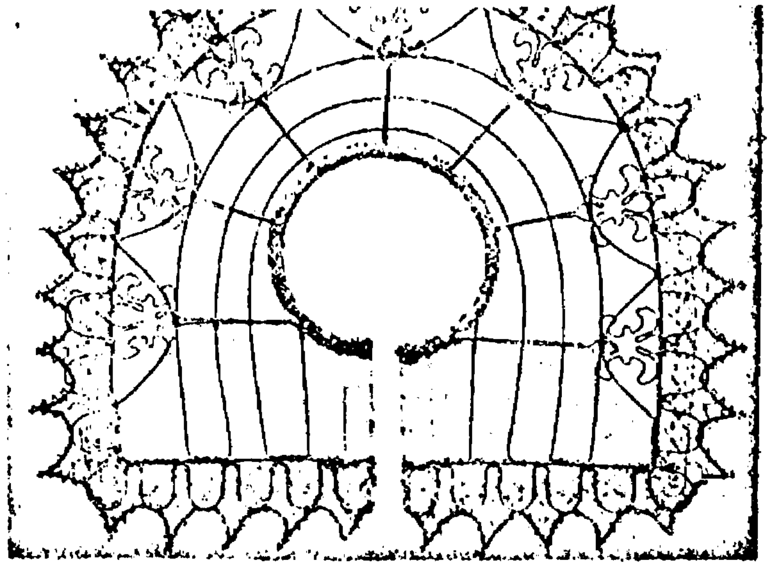


High Heel

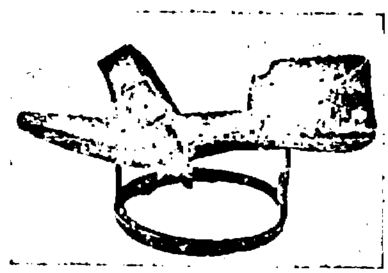
Scarf



Skates



Lace Collar



1715 Wood Shoe

Venetian Hat

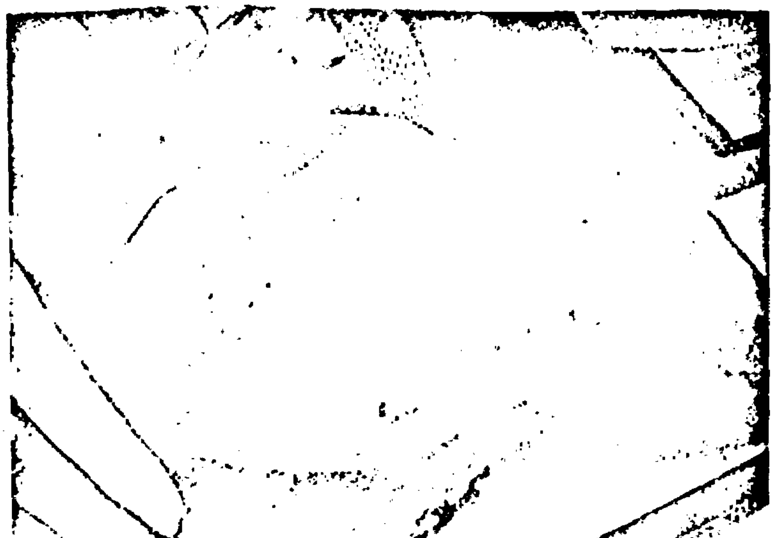
Bread

Egg

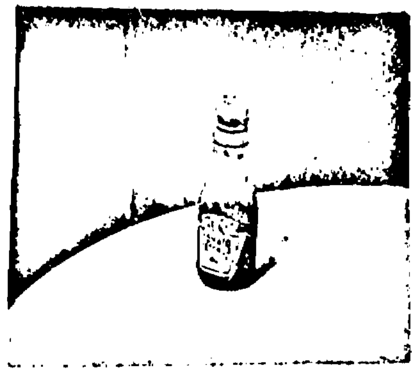
Chicken

Kidney

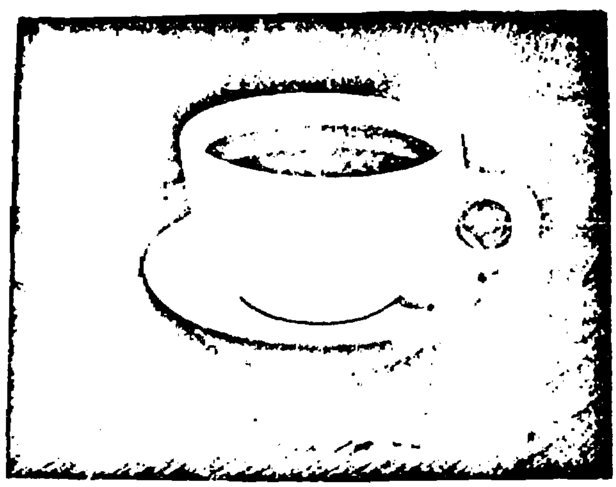
Cod Fish



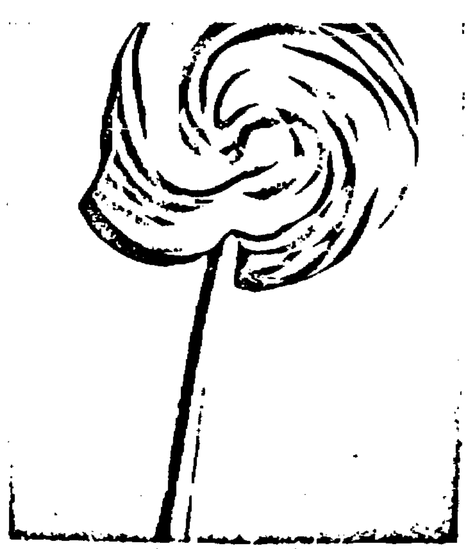
Tongue



Ketchup



Coffee



Lollipop

Coffee Beans

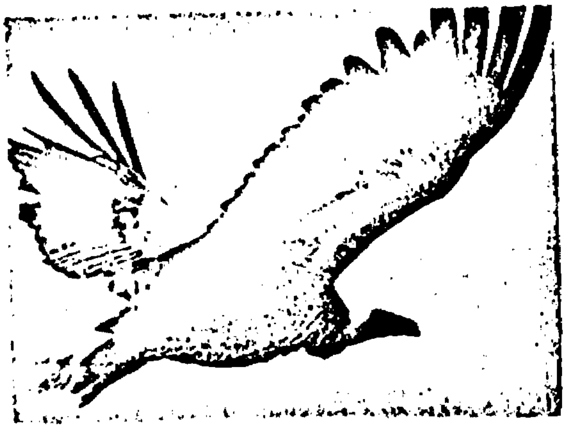
Mint Leaves

Morel Mushrooms

Prothonotary Warbler

English Tree Sparrow

Bluejay



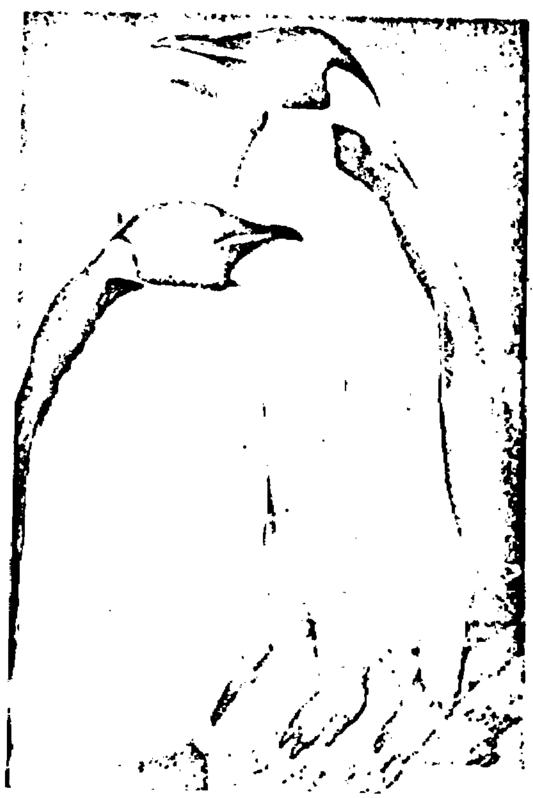
Vulture

Eastern Green Heron

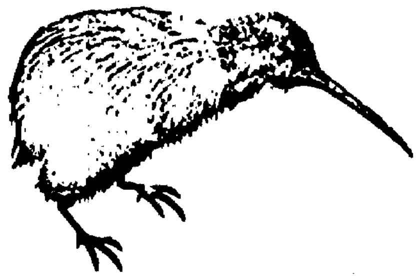
Hummingbird

Hen

Duck

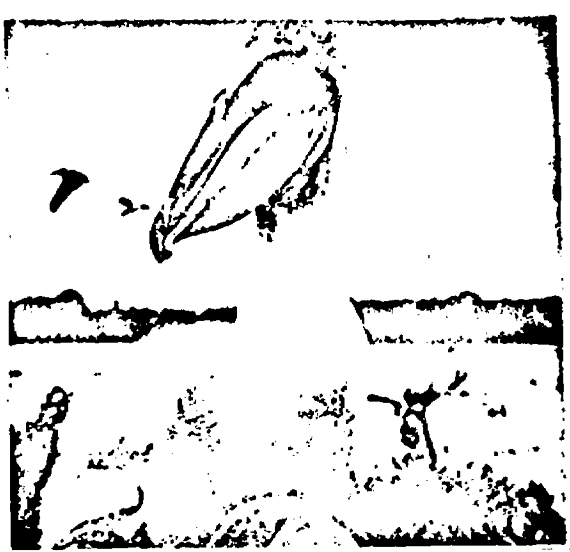


Penguin



Kiwi

American Egret



Pelican

and give examples of each of the four test categories. As it turned out they could all give some example or definition of the categories which indicated that they had at least some notion of them. Then E explained that they would be shown pictures and asked a question for each picture and that they would be asked to answer "Yes" or "No" to the question. Also they were encouraged at the outset to name any picture they were shown for which they might know a name. Then E showed each picture one at a time to the child and asked, "Is this an animal?" or "Is this clothing (clothes)?" or "Is this food?" or "Is this a bird?" depending upon which picture was being presented. If the child answered "Yes", that answer was recorded, the picture was placed apart for later probing and E moved on to the next picture. If the child answered "Yes, it's an X", that entire answer was recorded, and E moved on to the next picture. If the child answered "No, it's an X", that entire response was recorded and E moved on to the next picture. If the child answered simply "No", E probed the child immediately inquiring "What is it?", recorded the entire response and moved on to the next picture. After testing the child on each of the 72 pictures, E again presented to the child all those pictures for which he had responded simply "Yes" and asked of each "What is this?", recording the child's name for the picture. Thus for each instance our results included for each child not only a "Yes" or a "No" to the question "Is this a ______?" but also the label with which each child chose to name each picture. We wanted to obtain specific identifications of the stimuli from the children in order to understand the nature of any underextension errors that might occur. Specifically, if the child made an underextension error to a stimulus but identified it correctly then this would be evidence that his underextension error was not due to the perceptual ambiguity of the picture but rather was conceptual in origin. On the other hand if the child misidentified the stimulus with a name that was not an instance of the category being investigated then this might mean that his error was due to the perceptual ambiguity of the picture.

Oftentimes a picture would require considerable discussion to insure that the child definitely meant "Yes" or "No" and knew, or at least thought he knew, what the object depicted was. Sessions lasted for about half an hour. The occasional child sometimes grew restless but all finished the task with complete and serious responses. Many of the children seemed to enjoy the task and would ask if they could "do it again". Children were given lollipops as a modest reward for their services at the end of the session.

Results

Fig. 1 shows the total number of underextension errors (out of 48 possible)

Insert Fig. 1 here

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made for each individual child as a function of age. Fig. 1 reveals that children make a substantial number of such errors in this study with three quarters of the children making more than ten (out of 48 possible) errors. Fig. 1 also reveals that there is an inverse relation between the number of underextension errors made and the age of the child, although this relation is far from monotonic.

For which of the instances did children make the greatest number of underextension errors? Table 2 shows the total number of errors made for

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Insert Table 2 here

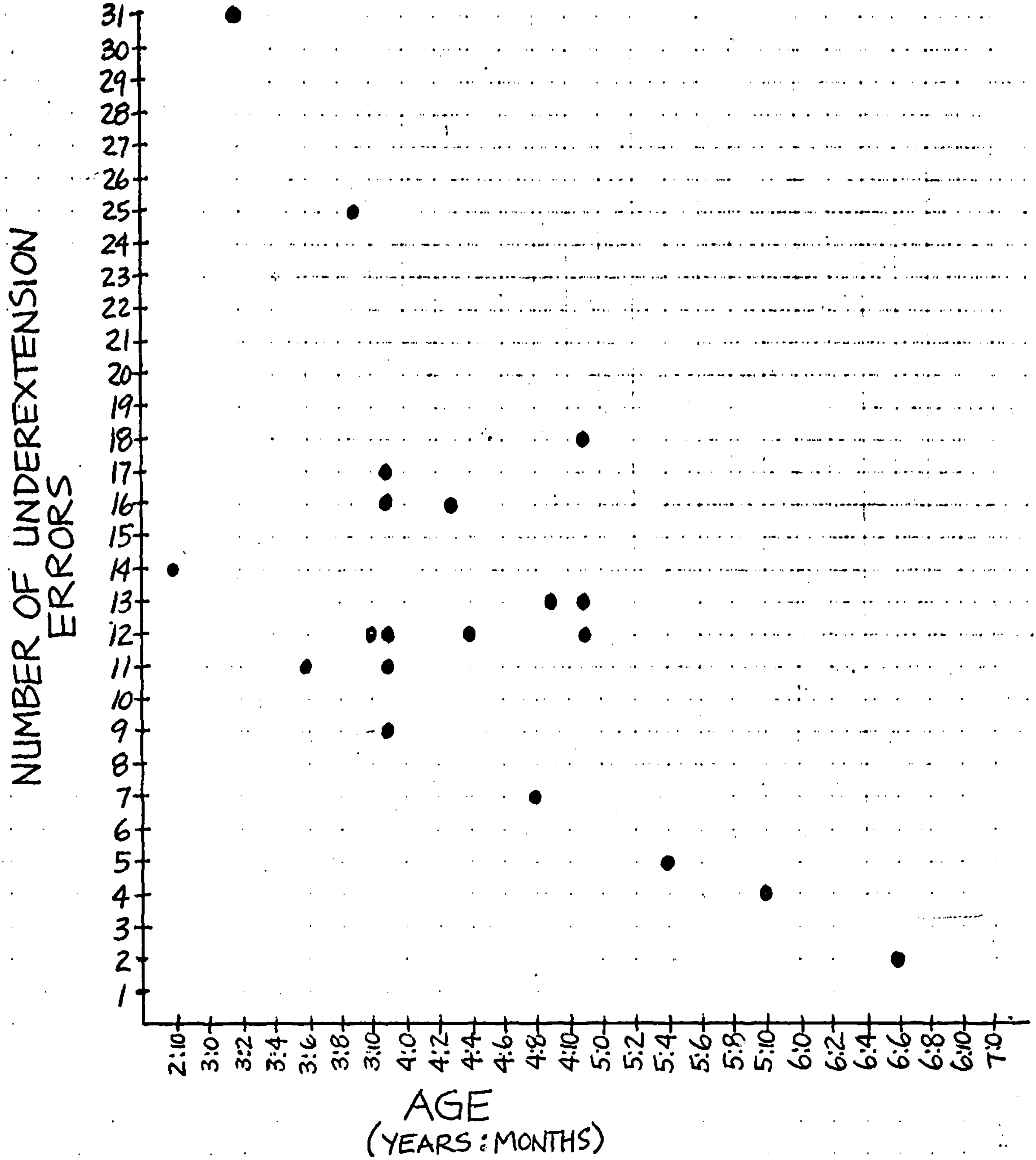

Fig. 1

Total number of underextension errors as a function of age.

Table 2

Total number of errors made for each kind of stimulus used in underextension study.

	CENTRAL	PERIPHERAL
FAMILIAR	17	132
UNFAMILIAR	19	92

each of the four kinds of instances being studied in this experiment: central and familiar, central and unfamiliar, peripheral and familiar and peripheral and unfamiliar. As Table 2 shows central instances, regardless of whether they are familiar or unfamiliar, produce very few errors (17 and 19) compared to peripheral instances (132 and 92). Both kinds of peripheral instances produce many errors with familiar peripheral instances actually producing substantially more errors (132) than unfamiliar peripheral instances (92).

While Table 2 gives the overall pattern of underextension errors made by children in this study, it will require a more detailed examination of the responses produced by children for each of the individual instances of each of the concepts in order to understand and interpret that pattern. Table 3

Insert Table 3 here

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presents the total number of underextension errors ("No" responses to instances) and the total number of correct responses ("Yes" responses to instances) made by the 20 children to each of the 48 instances used in this study. Recall that in addition to obtaining a "Yes" or "No" to the question "Is this a _____?" children were also encouraged to give a name for the object depicted in each picture as well if they did not do so spontaneously. A breakdown of the naming of pictures in cases where the child made underextension errors is presented in Table 4. A breakdown of the naming of pictures in cases where the child did not make underextension errors is presented in Table 5. In Tables 4 and 5

Insert Tables 4 and 5 here

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responses for 48 instances in
the underextension study.

CONCEPT ANIMAL STIM	TOTAL YES	TOTAL NO	CLOTHING STIM	TOTAL YES	TOTAL NO	FOOD STIM	TOTAL YES	TOTAL NO	BIRD STIM	TOTAL YES	TOTAL NO
cow	19	1	shirt	17	3	bread	19	1	prothonotary warbler	20	0
horse	19	1	pants	17	3	egg	20	0	English tree sparrow	20	0
cat	17	3	dress	16	4	chicken	19	1	bluejay	20	0
wombat	20	0	kimono	15	5	beef kidney	19	1	vulture	20	0
aardvark	20	0	coptic tunic	16	4	cod fish	20	0	Eastern Green Heron	19	1
anteater	19	1	1587 suit	16	4	tongue	18	2	hummingbird	19	1
ant	13	7	high heel	5	15	ketchup	7	13	hen	8	12
butterfly	12	8	scarf	10	10	coffee	4	16	duck	12	8
starfish	10	10	skates	5	15	lollipop	14	6	penguin	8	12
crustacean	15	5	lace collar	4	16	coffee beans	15	5	kiwi	19	1
hydra	15	5	1715 wood shoe	6	14	mint leaves	8	12	American Egret	18	2
centipede	15	5	Venetian hat	4	16	morel mushroom	13	7	baby Brown Pelican	16	4

Table 4

Breakdown of naming of pictures in cases where child made under-extension errors.
(Continued next page.)

CATEGORY	STIMULUS	COND	# NO	CC	RC	UC	DK
ANIMAL	A1 cow	C-F	1			1	
	A2 horse		1	1			
	A3 cat		3	3			
	A4 wombat	C-UN	0				
	A5 aardvark		0				
	A6 anteater		1		1		
	A7 ant	P-F	7	5	2		
	A8 butterfly		8	7	1		
	A9 starfish		10	8		1	1
	A10 crustacean	P-UN	5			2	3
	A11 hydra		5		3	1	1
	A12 centipede		5		5		
		TOTAL	46	24	12	5	5
CATEGORY	STIMULUS	COND	# NO	CC	RC	UC	DK
CLOTHING	C1 shirt	C-F	3	2	1		
	C2 pants		3	3			
	C3 dress		4	4			
	C4 kimono	C-UN	5		1	4	
	C5 coptic tunic		4		4		
	C6 1597 suit		4		4		
	C7 highheel	P-F	15	15			
	C8 scarf		10	7		1	2
	C9 skates		15	11	4		
	C10 lace collar	P-UN	16			10	6
	C11 1715 wood shoe		14	13		1	
	C12 Venetian boot		16	3		12	1
		TOTAL	109	58	14	28	9

Table 4 (continued)

CATEGORY	STIMULUS	COND	# NO	CC	RC	UC	DK
FOOD	F1 bread	C-F	1	1			
	F2 egg		0				
	F3 chicken		1			1	
	F4 beef kidney	C-UN	1		1		
	F5 cod fish		0				
	F6 tongue		2			2	
	F7 ketchup	P-F	13	12	1		
	F8 coffee		16	16			
	F9 lollipop		6	5			1
	F10 coffee beans	P-UN	5		5		
	F11 mint leaves		12	10		1	1
	F12 morel mushroom		7	2	1	3	1
		TOTAL	64	46	8	7	3
CATEGORY	STIMULUS	COND	# NO	CC	RC	UC	DK
BIRD	B1 prothonotary warbler	C-F	0				
	B2 English tree sparrow		0				
	B3 bluejay		0				
	B4 vulture	C-UN	0				
	B5 eastern green heron		1				1
	B6 hummingbird		1			1	
	B7 hen	P-F	12	7	3		2
	B8 duck		8	8			
	B9 penguin		12	9	3		
	B10 kiwi	P-UN	1			1	
	B11 American Egret		2		2		
	B12 baby Brown Pelican		4		2	1	1
		TOTAL	41	24	10	3	4

Table 5

Breakdown of naming of pictures in cases where child did <u>not</u> make underextension errors.
(Continued next page.)

CATEGORY	STIMULUS	COND	# YES	CC	RC	UC	DK
ANIMAL	A1 cow	C-F	19	14	3		2
	A2 horse		19	18	1		
	A3 cat		17	17			
	A4 Wombat	C-UN	20		17		3
	A5 aardvark		20	1	12		7
	A6 anteater		19	3	10		6
	A7 ant	P-F	13	11	1		1
	A8 butterfly		12	12			
	A9 starfish		10	8	2		
	A10 crustacean	P-UN	15		10		5
	A11 hydra		15		7		8
	A12 Centipede		15		13		2
		TOTAL	194	84	76		34
CATEGORY	**STIMULUS**	**COND**	**# YES**	**CC**	**RC**	**UC**	**DK**
CLOTHING	C1 shirt	C-F	17	12	3		2
	C2 pants		17	16			1
	C3 dress		16	15			1
	C4 Kimono	C-UN	15		10		5
	C5 coptic tunic		16		14		2
	C6 1557 suit		16		14		2
	C7 high heel	P-F	5	5			
	C8 scarf		10	7	1		2
	C9 skates		5	3	2		
	C10 lace collar	P-UN	4		1	2	1
	C11 1715 wood shoe		6	6			
	C12 Venetian hat		4	3			1
		TOTAL	131	67	45	2	17

Table 5 (continued)

TEGORY	STIMULUS	COND	# YES	CC	RC	UC	DK
FOOD	F1 bread	C-F	19	19			
	F2 egg		20	19	1		
	F3 chicken		19	15	2		2
	F4 beef kidney	C-UN	19	1	12		6
	F5 cod fish		20	7	10		3
	F6 tongue		18		15		3
	F7 ketchup	P-F	7	7			
	F8 coffee		4	4			
	F9 lollipop		14	14			
	F10 coffee buns	P-UN	15	1	12		2
	F11 mint leaves		8	4	4		
	F12 morel mushroom		13	2	6	1	4
		TOTAL	176	93	62	1	20
ATEGORY	STIMULUS	COND	# YES	CC	RC	UC	DK
BIRD	B1 prothonotary warbler	C-F	20	20			
	B2 English tree sparrow		20	20			
	B3 bluejay		20	20			
	B4 vulture	C-UN	20	20			
	B5 Eastern Green Heron		19	19			
	B6 Hummingbird		19	19			
	B7 hen	P-F	8	4	3	1	
	B8 duck		12	11			1
	B9 penguin		8	5	1		2
	B10 kiwi	P-UN	19	19			
	B11 American Egret		18	15	3		
	B12 baby Brown Pelican		16	10	4	1	1
		TOTAL	199	182	11	2	4

each of the names provided by children for the pictures were assigned to one of four categories : (1) CC- Correct Classification: If the child named the object depicted correctly his name was counted as a correct classification (e.g., "cow" to a picture of a cow, "horse" to a picture of a horse). (2) RC - Related Classification: If the child named the object depicted incorrectly but with a name that is an instance of the category being tested his name was scored as a related classification. For example, if the subject called a picture of a cow a "horse" it was scored as a related classification since "horse" is incorrect but at the same time a kind of 'animal'. (3) UC - Unrelated Classification: If the child named the object depicted incorrectly and with a name that is not an instance of the category being tested his name was scored as an unrelated classification. For example, if a subject called the picture of a cow a "tree" it was scored as an unrelated classification since it was both incorrect and not an instance of the concept 'animal'. (4) DK - Don't Know: If the child indicated that he did not know a name for an individual picture this was scored as a "Don't Know" response. Every attempt to name an instance could be classified in one of these four ways. Tables 4 and 5 show for each of the 48 instances the total number of times the names provided by children fell into each of these four categories.

With the aid of Tables 3, 4 and 5 I would like to consider the responses of the children to each instance in turn in an attempt to discern the source of their underextension errors where they exist. This discussion will be relatively free of theoretical interpretation. After I have examined each of the instances in turn I will try to interpret the results in a more theoretical discussion.

A. Animals: Central and Familiar

(1) Cow: 1 No [UC]; 19 Yes [14 CC, 3 RC, 2 DK]
(C=7.0; F=7.0)

The picture of a cow received 19 "Yes" responses and 1 "No" response to the question "Is this an animal?" Fourteen of the 20 children correctly identified this instance as a 'cow' and also correctly classified it as an 'animal'. Thus the availability of a more specific name was not enough to cause children to exclude this instance from the animal category. The one child who did not classify it as an animal identified it as 'food' and so his exclusion was therefore in fact consistent with his identification of the stimulus.

(2) Horse: 1 No [CC]; 19 Yes [18 CC, 1 RC]
(C=6.9; F=6.7)

The picture of the horse also received 19 "Yes" responses and 1"No" response to the question "Is this an animal?" The one underextension error was associated with the dominant name reaction "No, horsie." This particular child correctly identified the picture as a horse but in spite of this, or perhaps because of it, did not classify it as an 'animal'. Eighteen of the children correctly identified the picture as a horse but also classified it as an 'animal'. The remaining child mis-identified it as a 'donkey' and classified it as an 'animal'.

(3) Cat: 3 No [3 CC]; 17 Yes [17 CC]
(C=7.0; F=7.0)

All children correctly identified this picture as a 'cat' or 'kitty', etc. Seventeen of these children also correctly classified it as an 'animal'. The three children who made underextension errors to this stimulus gave dominant name reactions such as "No, it's a cat (kitty)."

Animals: Central and Unfamiliar

(4) Wombat: 0 No; 20 Yes [17 RC, 3 DK]
(C=5.9; F=2.9)

No children correctly identified this instance as a wombat. Most of the children guessed that it was a bear, a raccoon, a pig, a rat, etc., but often expressed uncertainty about their guesses. Three of the children simply said that they did not know what it was. Nonetheless all children agreed that it was an 'animal'.

(5) Aardvark: 0 No; 20 Yes [1 CC, 12 RC, 7 DK]
(C=5.6; F=3.0)

Every child also agreed that the picture of an aardvark was an 'animal'. One child could actually name it 'aardvark' since he had seen an aardvark on Sesame Street. The other children either labelled it with the name of some other kind of animal such as 'bear' or 'kangaroo' or 'anteater', etc., or they admitted that they did not know what it was.

(6) Anteater: 1 No [RC]; 19 Yes [3 CC, 10 RC, 6 DK]
(C=5.5; F=3.4)

Nineteen out of 20 children said "Yes" to the question "Is this an animal?" for this stimulus. Only three children could identify it correctly as an anteater. Ten of the children gave it some other animal name and six of the children said they did not know what it was even though they had agreed that it was an animal.

Animals: Peripheral and Familiar

(7) Ant: 7 No [5 CC, 2 RC], 13 Yes [11 CC, 1 RC, 1 DK]
(C=2.7; F=6.2)

Seven out of twenty children said that the picture of the ant was not an 'animal'. Five of these correctly identified it as an 'ant' and two misidentified it as a 'spider'. Since for adults both ants and spiders are animals the "No" responses represent genuine underextension errors and were not due to the visual ambiguity of the picture. Thirteen of the children correctly classified this instance as an 'animal' and usually identified it as an 'ant'. Thus again not all children nor even a majority will fail to classify this instance as an animal even though they can name it more specifically, but a significant minority will.

(8) Butterfly: 8 No [7 CC, 1 RC]; 12 Yes [12 CC]
(C= 3.1; F=6.2)

Eight children said "No" when asked if this instance was an 'animal'. Seven of these children correctly identified it as a 'butterfly' while one child called it a 'fly'. Since butterflies and flies are both animals these mistakes represent genuine underextension errors rather than resulting from perceptual confusion. The other 12 children classified this stimulus as an 'animal' and correctly identified it as a 'butterfly'.

(9) Starfish: 10 No [8 CC, 1 UC, 1 DK]; 10 Yes [8 CC, 2 RC]
(C=2.8; F=5.8)

Ten children said "No" when asked if this instance was an 'animal'. One of these children misidentified the stimulus as a 'flower' and thus his underextension error was in fact consistent with his identification. One child said he did not know what it was. The other eight children, however, correctly identified it as a 'starfish',which means that their failure to classify it as an 'animal' was not the result of perceptual confusion but rather the result of their failure to realize that starfishes are animals. The other ten children said that it was an 'animal' with eight of these correctly identifying it as a 'starfish' and two identifying it as a 'butterfly' and a 'crab'.

Animals: Peripheral and Unfamiliar

(10) Crustacean: 5 No [2 UC, 3 DK]; 15 Yes [10 RC, 5 DK]
(C= 1.4; F=1.2)

Five children said "No" when asked if this stimulus was an 'animal'. Two of these children identified it as a 'tree' and so were consistent in not classifying it as an 'animal'. The other three said they didn't know what it was. Fifteen children said "Yes" it was an 'animal' although none of these children could correctly name it. Five of them said they did not know what it was (although they classified it as an 'animal') and ten labelled it with come other animal name such as 'bug', 'spider','octapus', etc.

(11) Hydra: 5 No [3 RC, 1 UC, 1 DK]; 15 Yes [7 RC, 8 DK]
(C=1.6; F=1.3)

Five children said "No" in response to the question "Is this an animal?" While none of these children could name it correctly, three of them named it with animal names - 'spider', 'octapus', 'octapus'. The fact that they also declined to classify it as an 'animal' suggests that they did not think of spiders or octapuses as 'animals'. Fifteen children did classify it as an 'animal'. Of these eight said they did not know what it was, and seven labelled it with incorrect animal names.

(12) Centipede: 5 No [5 RC]; 15 Yes [13 RC, 2 DK]
(C=2.0; F=3.1)

Five children said "No" when asked if this stimulus was an'animal'. While none of them were able to correctly identify it, all five of them did label it with an animal name - 'caterpillar', 'spider' or 'bug'. Apparently for these children caterpillars, spiders and bugs are not animals. Fifteen children classified this stimulus as an 'animal'with 13 of them labelling it with some incorrect animal name and two of then saying they didn't have a name for it.

B. Clothing: Central and Familiar

(13) Shirt: 3 No [2CC, 1RC]; 17 Yes [12 CC, 3 RC, 2 DK]
(C=6.8; F=7.0)

Three children said "No" when asked of this instance if it was 'clothing'. Two of these children correctly identified the stimulus as a 'shirt' and one of them called it a'dress' and thus their mistakes in not classifying it as 'clothing' were genuine underextension errors. Seventeen of the children did classify it as 'clothing' with 12 of these identifying it as a 'shirt', with three labelling it with the name of some other article of clothing ('coat', 'dress', 'jacket') and with two saying they did not know what to call it.

(14) Pants: 3 No [3 CC]; 17 Yes [16 CC, 1 DK]
(C=6.6; F=6.8)

Three children said "No" when asked if this instances was 'clothing'. Each of these three children identified the stimulus correctly as 'pants' or 'trousers' suggesting that their mistakes were genuine underextension errors. The other seventeen children classified this instance as 'clothing'. Sixteen of these could correctly identify the stimulus as 'pants' or 'trousers' or 'dungarees' while the remaining child said he did not know what it was.

(15) Dress: 4 No [4 CC]; 16 Yes [15 CC, 1 DK]
(C=6.6; F=6.3)

Four children said "No" when asked if this stimulus was 'clothing'. Each of these children identified the stimulus as a 'dress' and so their mistakes were genuine underextension errors. The other 16 children classified it as 'clothing' and all but one of these identified it as a 'dress'.

Clothing: Central and Unfamiliar

(16) Kimono: 5 No [1RC, 4 UC]; 15 Yes [10 RC, 5 DK]
(C=4.9; F=3.2)

Five children said "No" when asked if this stimulus was 'clothing'. Of these four identified it with some non-clothing name such as 'animal' or 'castle'. Thus their mistakes were in fact consistent with their misidentifications. The remaining child called it a 'shirt' but still insisted that it was not 'clothing'. The other fifteen children said "Yes" when asked if it was 'clothing'. These children either misidentified it as a 'dress' or a 'shirt', etc., or said they did not know what it was even though they did classify it as'clothing'.

(17) Coptic Tunic: 4 No [4RC]; 16 Yes [14 RC, 2 DK]
(C=5.1; F=3.1)

Four children said this was not 'clothing' even though they identified it as a 'coat' or a 'dress'. Sixteen children said "Yes" it was 'clothing' although none of then could correctly name it. Fourteen of them gave some incorrect clothing name, while two of them admitted that they did not know what it was, even though they agreed it was 'clothing'.

(18) 1587 Suit: 4 No [4 RC]; 16 Yes [14 RC, 2 DK]
(C=5.2; F=3.5)

Four children declined to classify this stimulus as 'clothing' even though they identified it as a 'coat' or a 'dress'. The other sixteen children agreed that it was'clothing' with fourteen of them identifying it as some such article of clothing as 'pajamas', 'dress', 'jacket', etc. and with two of them saying they did not know what to call it even though they had classified it as 'clothing'.

Clothing: Peripheral and Familiar

(19) High Heel: 15 No [15 CC]; 5 Yes [5 CC]
(C=4.2; F=6.5)

Fifteen children said "No" in response to the question "Is this clothing?".All of these children correctly identified the stimulus as a 'shoe' and so their mistakes were genuine underextension errors. The remaining five children classified this stimulus as 'clothing' and correctly identified it as a 'shoe'.

(20) Scarf: 10 No [7 CC, 1 UC, 2 DK]; 10 Yes [7 CC, 1 RC, 2 DK]
(C=3.8; F=6.3)

Ten children said this was not 'clothing' even though seven of them correctly identified it as a 'handkerchief', 'scarf', etc. The other ten children classified it as 'clothing' with seven of them identifying it correctly.

(21) Skates: 15 No [11 CC, 4 RC]; 5 Yes [3 CC, 2 RC]
(C= 3.4; F=6.3)

Fifteen children said the pair of skates was not 'clothing' although most of them identified them as'skates' with the remaining children identifying them as 'shoes' or 'boots'. Only five children classified them as 'clothing'.

Clothing: Peripheral and Unfamiliar

(22) Lace Collar: 16 No [10 UC, 6 DK]; 4 Yes [1 RC, 2 UC, 1 DK]
(C= 2.2; F=2.2)

Sixteen children chose not to classify this stimulus as 'clothing' Ten of these children identified it with some non-clothing name such as 'picture', 'design', bridge', etc. and so their refusal to classify it as 'clothing' was consistent with their misidentifications. The remaining six children said they did not know a name for it. Only four children classified it as 'clothing'. Curiously, when asked what it was, two of these children identified it with non-clothing names - 'fan' and 'chicken'.

(23) 1715 Wood Shoe: 14 No [13 CC, 1 UC]; 6 Yes [6CC]
(C= 2.4; F=2.3)

Almost all children named this stimulus a 'shoe' but 14 children declined to classify it as 'clothing'. Six children did answer "Yes" to the question "Is this clothing?".

(24) Venetian Hat: 16 No [3 CC, 13 UC]; 4 Yes [3 CC, 1 DK]
(C= 2.5; F=2.9)

Sixteen children said "No" this was not 'clothing'. Of these, however, thirteen misidentified the stimulus with some non-clothing name such as 'hair', 'horse', 'tree', 'grass', etc., so that their underextension errors were actually consistent with their misidentifications. Three of them correctly labelled this stimulus 'hat' suggesting that for them hats are not articles of clothing. Four children classified this stimulus as an article of clothing with three of them correctly identifying it as a 'hat' and one of them saying he did not know a name for it.

C. Food: Central and Familiar

(25) Bread: 1 No [CC]; 19 Yes [19 CC]
(C=6.8; F=6.9)

All children correctly identified this stimulus as 'bread' (one child said 'toast' which we counted as correct) and all but one child classified it as 'food'. The one child who declined to classify it as 'food' gave a dominant name reaction, "No, bread."

(26) Egg: 0 No; 20 Yes [19 CC, 1 RC]
(C=6.8; F=7.0)

All children said "Yes" in response to the question "Is this food?" and all but one child correctly identified it as an 'egg' with the remaining child calling it a 'pancake'.

(27) Chicken: 1 No [1 UC]; 19 Yes [15 CC, 2 RC, 2 DK]
(C=7.0; F= 6.8)

Only one child responded "No" to the question "Is this food?" and he identified it as a 'girl' and so his underextension error was consistent with his odd identification of the stimulus. The rest of the children responded "Yes" with most of them correctly identifying the stimulus as 'chicken' and with two of them calling it 'steak' and 'vegetable' and with two of them saying they did not know a name for it.

Food: Central and Unfamiliar

(28) Beef Kidney: 1 No [RC]; 19 Yes [1 CC, 12 RC, 6 DK]
(C=4.8; F=2.9)

Only one child declined to classify this stimulus as 'food'. This child named the stimulus 'hot dogs' and so his underextension error was inconsistent with his misidentification of the stimulus. Although only one of the remaining 19 children could correctly identify it as 'meat' all of them correctly classified it as 'food'. Many of them identified it with some incorrect food name such as 'peppers', 'bread', 'mushrooms', etc., and many of them admitted that they did not know a name for it even though they agreed that it was 'food'.

(29) Cod Fish: 0 No; 20 Yes [7 CC, 10 RC, 3 DK]
(C=5.8; F=4.4)

All of the children correctly classified this stimulus as 'food' although only seven of them could identify it as 'fish'. Others misidentified it with other food names such as 'chicken' or 'meat' or simply said they could not name it even though they had classified it as 'food'.

(30) Tongue: 2 No [2 UC]; 18 Yes [15 RC, 3 DK]
(C=5.9; F=3.6)

Only two children declined to classify this stimulus as 'food'. These children identified the stimulus as 'animal' and 'turkey'. Although none of the other children was able to correctly identify the stimulus, they all agreed that it was nonetheless 'food'.

Food:Peripheral and Familiar

(31) Ketchup: 13 No [12 CC, 1 RC]; 7 Yes [7 CC]
(C=3.0; F=6.9)

Every child but one (who called it 'coke') correctly identified this stimulus as 'ketchup'. However, thirteen children said "No" in response to the question "Is this food?". All but one of these children recognized what it was but declined to classify it as 'food'.

(32) Coffee: 16 No [16 CC]; 4 Yes [4 CC]
(C=2.7; F=6.8)

All children identified this stimulus as 'coffee' or 'something to drink', etc., but sixteen of them chose not to classify it as 'food'. If the reader does not feel that a cup of coffee is 'food', I must say that I sympathize with him. We included this instance since for some reason all of our ten adult judges rated this stimulus as a food, a peripheral food but nonetheless a food. Perhaps it is best to ignore the data for this particular stimulus since it is not crucial for our overall conclusions.

(33) Lollipop: 6 No [5 CC, 1 DK]; 14 Yes [14 CC]
(C=3.0; f=6.3)

Six children said "No" is response to the question "Is this food?". Five of these correctly identified the stimulus as a 'lollipop' or 'candy' and so their failures to classify it as 'food' represent genuine underextension errors. One child said he did not know what it was. Fourteen of the children correctly identified it as a 'lollipop' or 'candy' and also classified it as 'food'.

Food: Peripheral and Unfamiliar

(34) Coffee Beans: 5 No [5 RC]; 15 Yes [1 CC, 12 RC, 2 DK]
(C=2.6; F=4.1)

Five children said "No" when asked if this stimulus was 'food'. Three of these children identified the coffee beans as 'seeds' so it is unclear whether they were being consistent or inconsistent in their underextension errors since some seeds are edible and others are not. The other two children identified them as 'candy' and so their underextension errors are genuine. The other fifteen children classified this stimulus as 'food' often identifying it with such names as 'seeds', 'peanuts', 'watermelon pits', 'candy', etc. Two children said they did not know what to call them although they classified them as 'food'.

(35) Mint Leaves: 12 No [10 CC, 1 UC, 1 DK]; 8 Yes [4 CC, 4 RC]
(C=1.8; F=2.7)

Twelve children responded "No" when asked if this stimulus was 'food'. Ten of these children identified them as 'leaves', one as 'flowers' and one said he did not know what they were. Eight children responded "Yes" identifying the stimulus as either 'leaves' which they often added were 'food' or as other kinds of food such as 'lettuce', 'mustard greens', chicken', etc.

(36) Morel Mushroom: 7 No [2 CC, 1 RC, 3 UC, 1 DK]; 13 Yes [2 CC, 6 RC, 1 UC, 4 DK]
(C=2.2; F=2.1)

Seven children said "No" in response to the question "Is this food?". Three of these children misidentified the stimulus as a 'tree', a'horse thing' and 'feet' and so their unwillingness to classify this instance as 'food' was consistent with their misidentifications of it. On the other hand two of these children correctly identified it as 'mushrooms' and one of them identified it as 'salad' so their names were in fact inconsistent with their unwillingness to classify it as 'food'. The remaining child said he did not know what it was. The other thirteen children classified this stimulus as 'food' with their identification being two correct, six other food names, one non-food name and four "Don't knows".

D. Birds: Central and Familiar

(37) Prothonotary Warbler: 0 No; 20 Yes [20 CC]
(C=6.5; F=5.5)

(38) English Tree Sparrow: 0 No; 20 Yes [20 CC]
(C=6.6; F=6.6)

(39) Bluejay: 0 No; 20 Yes [20 CC]
(C=6.2; F=6.0)

For each of these stimuli children invariably responded "Yes" to the question "Is this a bird?" and usually identified them as 'bird' or the diminutive 'birdie'.

Birds: Central and Unfamiliar

(40) Vulture: 0 No; 20 Yes [20 CC]
(C=5.7; F=4.7)

(41) Eastern Green Heron: 1 No [1 DK]; 19 Yes [19 CC]
(C=5.8; F=4.2)

(42) Hummingbird: 1 No [1 UC]; 19 Yes [19 CC]
(C=5.7; F=4.5)

Again, apart from one "No" response for the Eastern Green Heron ("Don't Know") and one"No" response for the hummingbird ("kiki; cuckoobird"), children responded "Yes" to the question "Is this a bird?" and usually identified each as a 'bird'.

Birds: Peripheral and Familiar

(43) Hen: 12 No [7 CC, 3 RC, 2 DK]; 8 Yes [4 CC, 3 RC, 1 UC]
(C=3.8; F=6.4)

Twelve children, when asked "Is this a bird?", answered "No" for this stimulus. Seven of these children correctly identified it as a 'hen', a 'chicken', a 'cockledoodledoo', etc., and three identified it as a 'turkey' or a 'rooster'. Thus for these children chickens are apparently not birds. Two of the twelve children who said "No" for this stimulus said they did not know what it was. The other eight children said "Yes" it was a bird, with most of these identifying it as either a 'hen' 'chicken', 'rooster', or 'duck'. One child said it was a 'camel' even though he had correctly classified it as a 'bird'.

(44) Duck: 8 No[8 CC]; 12 Yes [11 CC, 1 DK]
(C=4.3; F=6.7)

Eight children said "No" when asked "Is this a bird?" Each of these eight children correctly identified it as a 'duck'. Thus for these children apparently ducks are not birds. The other twelve said "Yes" it was a'bird'. Eleven of these correctly identified it as a 'duck' while one said he did not know a name for it even though he had classified it as a 'bird'.

(45) Penguins: 12 No [9 CC, 3 RC]; 8 Yes [5 CC, 1 RC, 2 DK]
(C=3.9; F=6.8)

Twelve children said "No" when asked if these were 'birds'. Nine of these correctly identified them as 'penguins' so apparently for them a penguin is not a 'bird'. Three of these children called them 'pigeons' or 'eagles' and so their underextension errors are conceptual rather than perceptual, since both pigeons and eagles are 'birds'. Eight children said "Yes" they were 'birds' with five of them identifying them as 'penguins', one as 'ducks' and two not being able to give them a name.

Birds: Peripheral and Unfamiliar

(46) Kiwi: 1 No [UC]; 19 Yes [19 CC]
(C=3.1; F=2.9)

Only one child said "No" when asked "Is this a bird?" for this stimulus. He identified it as a 'giraffe' and so his underextension error was consistent with his misidentification. All the other children said "Yes" to the question "Is this a bird?" and identified it as a 'bird'.

(47) American Egret: 2 No [2 RC]; 18 Yes [15 CC, 3 RC]
(C=3.7; F=4.2)

Only two children said "No" when asked of this stimulus "Is this a bird?". These children misidentified the stimulus as a 'duck' and an 'eagle'. Since ducks and eagles are actually birds, their errors would appear to be conceptual in origin. The other eighteen children said "Yes" it was a bird with fifteen of these giving a correct identification (usually 'bird') and three identifying it as a 'duck', an 'ostrich' and a 'duck'.

(48) Baby Brown Pelican: 4 No [2 RC, 1 CC, 1 DK]; 16 Yes [10 CC, 4 RC, 1 UC, 1 DK] (C=3.3; F=3.1)

Only four children said "No" when asked if this stimulus was a 'bird'. Two of these children identified it as a 'duck', one as an 'animal' and one said he did not know a name for it. Sixteen children said "Yes" it was a 'bird'. Ten of these identified it correctly usually as a 'bird' or 'birdie', four of them called it a 'duck' or a 'goose', one of them called it a 'comb' and one of them said he did not know a name for it.

Discussion

Of the two dimensions being studied in this experiment it is clearly the central-peripheral dimension which plays the greatest role in bringing about underextension errors. Regardless of whether they were familiar or unfamiliar, every central instance produced fewer underextension errors than any peripheral instance (with the exception of one tie). This is not to say that the child will always fail to include a peripheral instance in a given concept. But when he does make an underextension error the chances are high that it will be for a peripheral instance rather than for a central instance.

Familiarity appears to be less important in influencing the child to make underextension errors. In this study, for central stimuli familiar and unfamiliar instances produced approximately the same number of underextension errors. For peripheral stimuli familiar instances actually produced more underextension errors (about 40%) than unfamiliar stimuli. This may in part be a result of the fact that children more often have specific names for the familiar peripheral instances than for the unfamiliar peripheral instances which they use at times to the exclusion of these instances from more general categories. The availability of a more specific name is only very occasionally enough to dissuade a child from including a central instance in a given concept. However, the availability of a more specific name may often be the additional factor which will dissuade him from including a peripheral instance in that concept.

One of the most interesting aspects of the results just considered is that children consistently classify unfamiliar central instances as instances of the various concepts. Thus every child said that the picture of a wombat and the picture of an aardvark were 'animals' and all but one child said the picture of an anteater was an 'animal'. Some of these children when asked to identify the pictures tentatively guessed that they were pictures of 'bears' or 'kangaroos' or'pigs', etc., but a significant number of them said they did not know what they were, had never seen anything quite like them before, but nonetheless were quite certain that they were 'animals'. This behavior testifies to the inferential or generative nature of the child's concepts, for they will consistently include in categories various kinds of instances which they have never seen before, provided they are central instances.

For the most part the underextension errors made by children in this study appear to have been conceptual mistakes rather than the result of perceptual confusion. There were some cases for which the child apparently did not recognize a given picture, would identify it incorrectly and, consistent with his misidentification, would not include it in a general concept. This happened most often for peripheral unfamiliar instances and the most striking cases were for two of the peripheral unfamiliar instances of 'clothing': the lace collar and the Venetian hat. Children frequently misidentified the lace collar with non-clothing names such as 'picture', 'design', 'bridge', etc. and the Venetian hat with such non-clothing names as 'hair', 'horse', 'tree', 'grass', etc. Their unwillingness to classify these particular stimuli as 'clothing' was therefore consistent with their misidentifications. Thus it is possible that the reason why these children did not include these stimuli as instances of the concept 'clothing' was because of the perceptual ambiguity of the pictures for them. If a child really saw the Venetian hat as a 'horse', then his failure to count it as an instance of 'clothing' results from a a perceptual problem. Conceptually he is being consistent by excluding it

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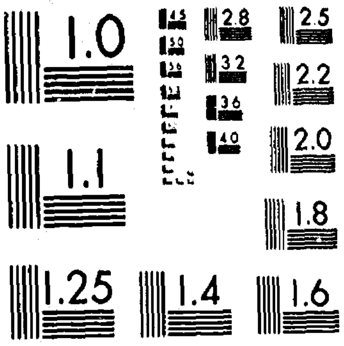

MICROCOPY RESOLUTION TEST CHART
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from the 'clothing' category since horses are not articles of clothing.

The majority of underextension errors were not of this nature, however. Children would correctly identify the pictures of a butterfly as a 'butterfly', of an ant as an 'ant' and of a starfish as a 'starfish', but would not include them in the 'animal' concept; they would correctly identify pictures of a high heel as a 'shoe' or of a scarf as a 'scarf' or of skates as 'skates' but would not include them in the 'clothing' concept; they would correctly idenuify pictures of ketchup as 'ketchup' and of a lollipop as a 'lollipop', but would not include them in the 'food' concept; they would correctly identify pictures of a hen as a 'chicken', of a duck as a 'duck' or of a penguin as a 'penguin', but would not include them in the 'bird' concept. For such cases the child's problem clearly is not due to the perceptual ambiguity of the pictures since he can identify the stimuli correctly. Rather his problem is conceptual in nature. He does not realize that butterflies, ants, and starfish are 'animals', that shoes, scarves and skates are 'clothing', that ketchup and lollipops are 'food' and that chickens, ducks and penguins are'birds'.

Thus this study reveals that children do not always include all the instances which adults do include in a given concept. The child will usually include instances which are rated by adults as being good examples, typical instances or central to the concepts in question regardless of whether those instances are familiar or unfamiliar to him. He will often not include instances which are rated by adults as being poor examples, atypical instances or peripheral to the concepts in question even though he can often identify those instances with a specific name.

5. The Determinants of Overextension Errors (J. Anglin and Elizabeth Smith)

In a previous study (see #3 On the Extension of the Child's First Terms of Reference) it was observed that children would sometimes include objects within concepts which adults would not include. For example, when shown a picture of a tomato and asked "Is this an apple?" many children said "Yes" whereas adults invariably said "No." An examination of the pictures which produced the greatest number of overextension errors suggested that three factors may play a role in enticing the child to make such mistakes. In decreasing order of the likelihood of their importance as determinants of such errors, these were: (1) perceptual similarity--the non-instance is perceptually similar to an instance of the concept; (2) association through contiguity--the non-instance has been seen by the child in the presence of an instance of the concept; and (3) functional similarity--the non-instance serves the same function as an instance of the concept.

In that study it was often difficult to discern which of these three factors were crucial in enticing the child to overextend a given term of reference since the non-instances which did produce the greatest number of overextension errors often appeared to be both perceptually similar and continguous to an instance of the concept or perceptually similar, contiguous and functionally similar to an instance of the concept. For example, the tomato depicted in the picture mentioned above which produced a large number of overextension errors seemed to be perceptually similar to apples ('apple' was the word overgeneralized), but it was also functionally similar (since both tomatoes and apples are edible objects) and either of these factors (or both) might have been crucial in influencing the child to include it in his concept of 'apple.' Moreover, it could be argued that the child may have seen apples and tomatoes in the same place (in the supermarket, in the refrigerator, on the dinner table, etc.) and, therefore, that his overextension errors were the result of association through contiguity.

Certain other considerations suggested that the most powerful of these three determinants of overextension errors was probably perceptual similarity, that the second most powerful was probably association through contiguity and that the weakest was probably functional similarity, if it was operative at all. For example, the children who classified the picture of a tomato as an 'apple' did not classify a picture of a banana as an 'apple.' Bananas are presumably just as functionally similar to apples (both dessert foods) as are tomatoes, and just as likely to be seen in the presence of apples as are tomatoes. Thus, apparently this degree of functional similarity and association through continguity is not sufficient to sway the child to make overextension errors and, therefore, the crucial attribute of the picture of the tomato was probably its perceptual similarity to an apple.

Nonetheless, perceptual similarity does not seem to account for all of the overextension errors that children make. For example, Judy Ungerer observed that children would often say "Yes" when asked if a picture of a vase was a 'plant.' Vases do not look especially like plants, nor do they serve the same function, but plants are often seen in vases, so it seems that this may well be a case of overextension because of association through contiguity. There were no similar cases suggesting that functional similarity alone could produce overextension errors, which is why I argued above that functional similarity is probably the weakest of these three possible determinants of overgeneralization.

These conclusions, however, were very tentative since there were so few cases which would permit the teasing apart of the relative contributions of these three factors in bringing about overextension errors. It was particularly difficult to establish the relative importance of perceptual similarity and association through contiguity, since for many of the stimuli which produced a relatively large number of overextension errors arguments could be made for either factor. In the present study we have investigated the tendency of children to include non-instances in concepts when they are only perceptually similar (and not functionally similar or likely to be associated through contiguity) to instances of those concepts, or when they are only likely to be associated through contiguity with instances of those concepts, or when they are only functionally similar to instances of those concepts. By investigating the tendency of children to include such non-instances in various concepts our eventual hope is to discern the relative contributions of these three factors in causing the child to overgeneralize his first terms of reference.

Method

The approach we took was analogous to the approach we took to attempt to disentangle the factors determining underextension errors (see #4 The Determinants of Underextension Errors). Again, we collected a large pool of about 400 pictures from which we chose 250 which we thought adults might rate as being either perceptually similar to an instance of a concept, or likely to be contiguous with an instance of that concept, or functionally similar to an instance of that concept. We began by taking photographs of objects which we thought were perceptually similar or continguous to instances of the following nine concepts: 'apple,' 'fruit,' 'bread,' 'dog,' 'bird,' 'horse,' 'money,' 'car,' and 'flower.' (We chose these concepts because we had found earlier that most two- to six-year-olds had some notion of their meanings.) We also took photographs of as many objects as we could that we thought were functionally similar to the four concepts 'apple,' 'fruit,' 'car,' and 'money.' We then enlisted the services of ten adults whom we asked to rate the various pictures along three dimensions: perceptual similarity, association through contiguity, and functional similarity. Each adult was asked to rate over 25 pictures for each concept. For five of the concepts ('bread,' 'bird,' 'dog,' 'flower,' and 'horse') each adult was asked to rate the pictures for perceptual similarity and association through contiguity. For the other four concepts ('apple,' 'fruit,' 'car,' and 'money') they were asked to rate the pictures for functional similarity as well as perceptual similarity and association through contiguity. A seven-point scale was used again with a "1" representing extremely perceptually dissimilar or extremely uncontiguous or extremely functionally dissimilar and a "7" representing extremely perceptually similar, extremely contiguous, or extremely functionally similar. Let me illustrate the instructions with reference to the 'car' category. Each adult subject was shown 32 pictures and was asked to "rate each of these pictures according to how perceptually similar the objects in the pictures seem to a 'car.' For example, if the object seems extremely perceptually similar to a car, assign it the number '7'; if it seems moderately perceptually similar, assign it the number '4'; if it seems extremely perceptually dissimilar, assign it the number '1', etc." When the adult judge had completed rating each picture for its degree of perceptual similarity to a 'car,' he was given a new rating sheet and was asked to go through the pictures again and to "rate each of these pictures according to how likely you would be to find the objects in the pictures in the presence of a 'car' ...." Finally, when they were finished rating each picture along this dimension, they were given another rating sheet and were asked to go through the pictures again and to "rate each of these pictures according to how similar in function the objects in the pictures are to a 'car' ...." When a subject had finished rating the pictures for one concept along each dimension, he was asked to rate the pictures for the next concept along each dimension, and so on until he had rated the pictures for each of the nine concepts.

After these judgments had been obtained we averaged the ratings for each dimension for each picture over all ten subjects. Our goals were as follows: (1) to obtain for each of the five categories 'bread,' 'flower,' 'horse,' 'bird,' and 'dog' pictures which were rated by judges as being highly perceptually similar but unlikely to be associated through contiguity (PS stimuli) and pictures which were rated by judges as being highly likely to be associated through contiguity but perceptually dissimilar (C stimuli); (2) to obtain for each of the four categories 'apple,' 'fruit,' 'car,' and 'money' pictures which were rated by judges as being highly perceptually similar but unlikely to be associated through contiguity and functionally dissimilar (PS stimuli), pictures which were rated by judges as being likely to be associated through contiguity but perceptually dissimilar and functionally dissimilar

(C stimuli), and pictures which were rated by judges as being functionally similar but perceptually dissimilar and unlikely to be associated through contiguity (F stimuli). The average adult ratings of the pictures did not allow us to meet these objectives exactly but we came reasonably close. The two major problems were: (1) For the three animal concepts 'horse,' 'bird,' and 'dog' there were almost no PS stimuli. Rather, for these concepts instances which had been rated as being highly perceptually similar (e.g., donkey or mule to 'horse') had also been rated as 'likely to be seen in the presence' of horses. Thus, for these three concepts we used PS + C stimuli (pictures rated as being both perceptually similar and contiguous) and C stimuli. The idea was that by examining the difference between PS + C stimuli and C stimuli we could estimate the contribution of perceptual similarity alone in bringing about overextension errors in children. (2) The second problem was that for three of the concepts 'money,' 'apple,' 'fruit' there were almost no F stimuli. Rather, for these concepts instances which had been rated as high in functional similarity had also been rated as high in association through contiguity or perceptual similarity. For this reason for these three concepts ('money,' 'apple,' 'fruit') we only used PS stimuli and C stimuli. For the 'car' category we did use FS stimuli, however, in addition to C stimuli and PS + FS + C stimuli (i.e., pictures which had been rated as high along all three dimensions).

Insert Table 1 here

Table 1 shows the average adult ratings of "perceptual similarity," "contiguity," and "functional similarity" for the 88 pictures which we chose to use in a test of children's tendency to make overextension

Table 1

Average adult judgements of "perceptual similarity", "contiguity" and "functional similarity" for pictures used in the overextension study.

<u>SCALE used</u>:

	1	2	3	4	5	6	7	
Perceptually Dissimilar Uncontiguous Functionally Dissimilar	extremely	very	quite	mod-erate	quite	very	extremely	Perceptually Similar Contiguous Functionally Similar

<u>NOTE</u>:

TYPE = type of stimulus:

(PS)= perceptually similar
(C)= contiguous
(PS+C)= perceptually similar and contiguous
(FS)= functionally similar
(PS+FS+C)= perceptually similar, functionally similar and contiguous
(N)= neutral

AVERAGE RATINGS

CONCEPT	TYPE	STIMULUS	PERCEPTUAL SIMILARITY	CONTIGUITY	FUNCTIONAL SIMILARITY
READ	PS	1. mattress	5.1	2.2	
		2. cork block	5.0	2.3	
	C	3. lunch bag	1.6	6.3	
		4. black lunch pail	2.6	6.7	
	N	5. wheelbarrow	1.3	1.9	
		6. airforce plane	1.1	1.8	
		7. turtle	1.7	1.8	
		8. tricycle	1.1	1.8	
OWER	PS	9. feather duster	4.9	1.9	
		10. ribbon	4.8	1.9	
	C	11. painted vase	1.8	5.5	
		12. pot with dirt	1.7	6.3	
	N	13. ice box	1.0	1.9	
		14. boat	1.3	1.2	
		15. modern car	1.0	2.6	
		16. coffee jar	1.8	1.8	
ONEY	PS	17. animal medals	6.0	2.4	1.0
		18. buttons	5.5	2.3	1.0
	C	19. plastic black purse	1.0	6.8	1.2
		20. cash register	1.0	7.0	1.4
	N	21. crane	1.0	1.4	1.5
		22. piano	1.0	1.3	1.3
		23. ironing board	1.0	1.4	1.3
		24. sawhorse	1.0	1.1	1.0
PLE	PS	25. balloon	5.7	2.1	1.0
		26. rubber ball	5.5	2.0	1.0
	C	27. knife	1.0	5.4	1.2
		28. basket	1.8	6.3	1.1
	N	29. mailbox	1.2	1.3	1.0
		30. wheelchair	1.0	1.6	1.0
		31. locomotive	1.1	1.4	1.0
		32. typewriter	1.0	1.6	1.0
UIT	PS	33. balloons	5.8	1.5	1.0
		34. mandolin	5.2	1.2	1.0
	C	35. dishware	1.3	5.9	1.4
		36. plate	1.1	5.6	1.4
	N	37. eyeglasses	1.0	1.3	1.3
		38. sandal	1.0	1.8	1.0
		39. doll	1.0	1.9	1.0
		40. chair	1.0	1.3	1.0

AVERAGE RATINGS

ONCEPT	TYPE	STIMULUS	PERCEPTUAL SIMILARITY	CONTIGUITY	FUNCTIONAL SIMILARITY
ORSE	C	41. cowboy	1.2	6.7	
		42. covered wagon	1.5	6.9	
		43. bridle	1.5	6.9	
		44. western saddle	1.6	6.4	
	PS+C	45. donkey	5.4	5.2	
		46. mule	6.6	6.2	
	Z	47. lamppost	1.1	1.5	
		48. ship	1.4	1.7	
		49. spatula	1.0	1.5	
		50. muffin tin	1.0	1.5	
		51. chowmein	1.0	1.4	
		52. grocery	1.0	1.4	
IRD	C	53. birdhouse	1.2	6.2	
		54. birdnest	1.5	6.5	
		55. birdcage	1.1	6.8	
		56. forest	2.2	6.8	
	PS+C	57. butterfly	4.8	5.7	
		58. locust	5.0	5.1	
	Z	59. guitar back	1.4	1.4	
		60. balloon	1.2	1.3	
		61. baby carriage	1.4	2.0	
		62. loafer	1.0	1.6	
		63. shishkebob	1.4	1.3	
		64. grocery	1.1	1.4	
OG	C	65. dog leash	1.3	6.3	
		66. milk bone	1.8	6.9	
		67. dog house	1.5	5.9	
		68. dog dish	1.5	6.9	
	PS+C	69. sheep	4.3	4.8	
		70. wolf	6.2	4.6	
	Z	71. chinese junk	1.3	1.2	
		72. saucepan	1.2	2.6	
		73. pins	1.1	1.9	
		74. skis	1.1	2.3	
		75. coffee pot	1.5	1.9	
		76. suitcase	1.4	2.1	

AVERAGE RATINGS

CONCEPT	TYPE	STIMULUS	PERCEPTUAL SIMILARITY	CONTIGUITY	FUNCTIONAL SIMILARITY	
A.R	FS	77. sled	2.3	2.3	5.5	
		78. ship	2.2	1.5	5.7	
	C	79. meters	1.0	6.9	1.3	
		80. service station	1.0	6.9	1.6	
	PS+FS +C	81. fire engine	5.3	7.0	6.6	
		82. truck	5.3	7.0	6.6	
	N	83. scissors	1.0	1.2	1.0	
		84. pencil sharpener	1.3	1.0	1.0	
		85. rifle	1.1	1.4	1.1	
		86. pail	1.0	1.4	1.3	
		87 handgun	1.1	1.2	1.1	
		88. stove	1.1	1.0	1.0	

errors. Our criteria were that for a stimulus to be counted as PS, C, FS, PS + C, or PS + FS + C it had to have received an average adult rating of greater than 4.8 on the relevant dimension(s) and less than 2.6 on the other dimension(s). We also included "neutral" non-instances (N stimuli) which had been rated as less than 2.6 on all dimensions. As Table 1 shows, for the concept 'bread' the non-instances were two PS stimuli (pictures of a mattress and a cork block), two C stimuli (pictures of a lunch bag and a lunch pail) and four neutral stimuli. For the concept 'flower' there were two PS stimuli (feather duster and ribbon), two C stimuli (a painted vase and a pot with dirt) and four neutral stimuli. For the concept 'money' there were two PS stimuli (animal medals and buttons), two C stimuli (a plastic black purse and a cash register) and four neutral stimuli. For the concept 'apple' there were two PS stimuli (a balloon and a rubber ball), two C stimuli (a knife and a basket), and four neutral stimuli. For the concept 'fruit' there were two PS stimuli (balloons and a mandolin) and two C stimuli (dishware and a plate) and four neutral stimuli. For the concept 'horse' there were four C stimuli (a cowboy, a covered wagon, a bridle, and a western saddle), two PS + C stimuli (a donkey and a mule), and six neutral stimuli. For the concept 'bird' there were four C stimuli (a birdhouse, a birdnest, a birdcage, and a forest), two PS + C stimuli (a butterfly and a locust), and six neutral stimuli. For the concept 'dog' there were four C stimuli (a dog leash, a milk bone, a doghouse, and a dog dish), two PS + C stimuli (a sheep and a wolf), and six neutral stimuli. Finally, for the concept 'car' there were two FS stimuli (a sled and a ship), two C stimuli (meters and a service station), two PS + FS + C stimuli (a fire engine and a truck) and six neutral stimuli.

To give the reader a feeling for what the stimuli looked like Xerox copies (which are unfortunately not that clear) of some of the actual pictures are shown on the next five pages. The first page shows

Insert Pictures here

two PS stimuli (animal medals and buttons) for the concept 'money.' The next page shows two C stimuli (a covered wagon and a saddle) for the concept 'horse.' The next page shows two PS + C stimuli (a donkey and a mule) for the concept 'horse.' The next page shows two FS stimuli (a sled and a ship) for the concept 'car.' Finally, the next page shows two PS + FS + C stimuli (a fire engine and a truck) for the concept 'car.'

Experiment 1 (Pilot Study)

In a pilot study we tested the tendency of nine children to make overextension errors to the 88 pictures described in Table 1. Subjects were between three years, one month and three years, seven months. The pictures were shown to a child one at a time and for each picture the child was asked, "Is this bread?" or "Is this a flower?", etc. depending on which picture was being shown. If the child responded "Yes" to a given picture, he was asked the question again for that picture at the end of the experiment to see if he really meant "Yes" unless he seemed restless, which sometimes was the case. Also, children were encouraged to name and describe the pictures when they made over-extension errors.

Results

Table 2 shows the overextension errors made by each child for each

PS--money

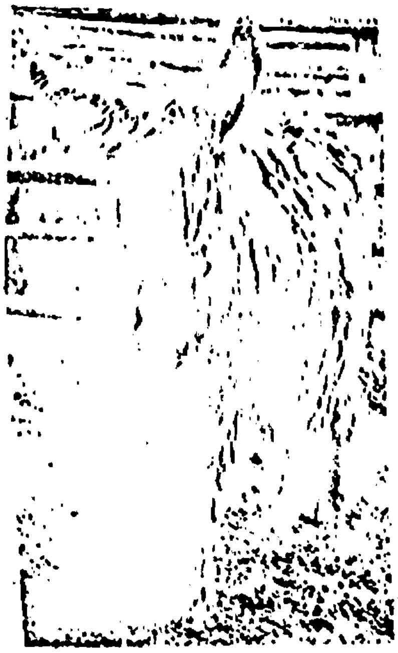
PS--money

BEST COPY AVAILABLE

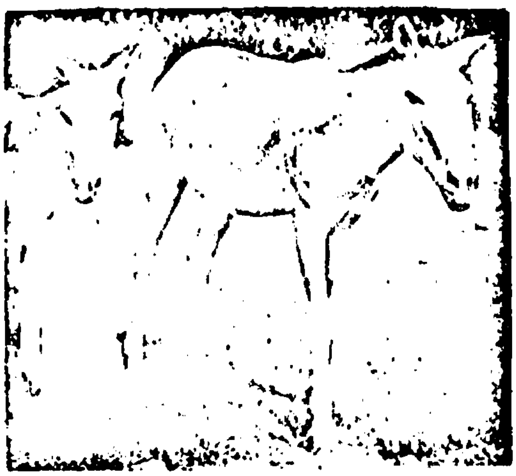
C--horse

C--horse

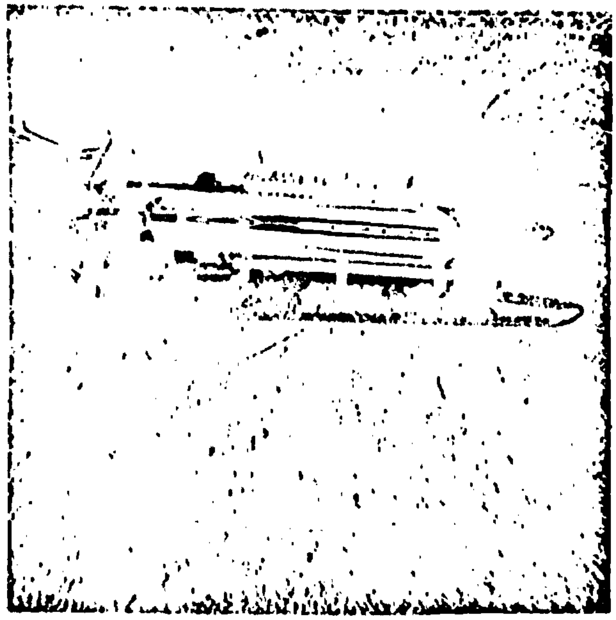
PS + C -- horse

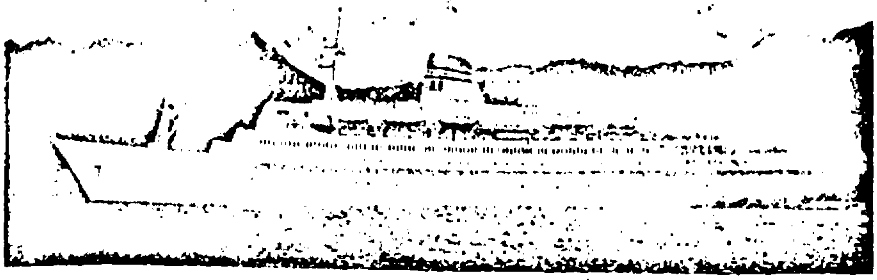


PS + C -- horse



FS--car

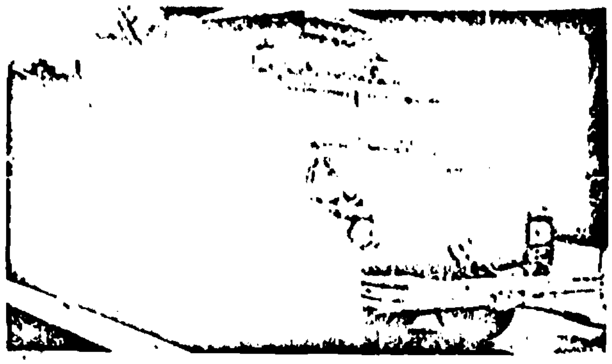




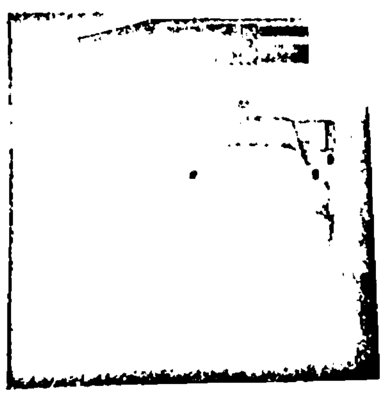
FS--car

BEST COPY AVAILABLE

PS + FS + C--car



PS + FS + C--car



Insert Table 2 here

picture in experiment 1. Overextension errors ("Yes" responses to non-instances) are indicated by large checks (✔). Table 1 also shows the results of the probe test for consistency for each initial over-extension error. A "Yes" response in the probe test is indicated by a small check (✓), and a "No" response in the probe test is indicated by an "R" (meaning "reversal"). Two children (S_2 and S_5) were not probed since they seemed especially restless during the course of the experiment. In Table 1 a zero (0) indicates that a child was not probed.

Table 2 reveals that the children (with the exception of one child on one picture) never answer "Yes" when asked if a neutral stimulus is an instance of a given concept. On the other hand, children do make overextension errors for some of the other kinds of stimuli. There are 36 cases of overextension errors to PS stimuli. Specifically, three children said that a picture of a mattress was 'bread' and five children said that a picture of a cork block was 'bread;' two children said that a picture of a ribbon was a 'flower;' all nine children said that a picture of animal medals was 'money;' and seven of them said that a picture of buttons was 'money;' two children said that a picture of a balloon was an 'apple' and four of them said that a picture of a rubber ball was an 'apple;' two children said that a picture of balloons was 'fruit' and one child said that a picture of a mandolin was 'fruit.'

Although they were not as frequent children also made overextension errors to C stimuli. (There was a total of 36 errors to PS stimuli,

Table 2

Overextension errors made by children in Experiment 1 for each picture. Results of a probe test for consistency are also included.

NOTE:

CONCEPT= concept being asked (e.g., "Is this bread?")
TYPE= type of stimulus presented:

(PS)= perceptually similar
(C) = contiguous
(PS+C)= perceptually similar and contiguous
(FS)= functionally similar
(PS+FS+C)= perceptually similar, functionally similar and contiguous
(N) = neutral

For each subject:

Initial "YES" response is indicated by a large ✓.
Probe response is indicated by a small ✓("YES" response), R (Reversal, or "NO" response), ✓R ("YES" and then "NO" response), or O(child was not probed).

AGE (in years:months) indicated above subject number.

NCEPT	TYPE	STIMULUS	S1 (3:1)	S2 (3:1)	S3 (3:1)	S4 (3:1)	S5 (3:1)	S6 (3:1)	S7 (3:1)	S8 (3:2)	S9 (3:7)
READ	PS	1. mattress				✓ V			✓ R	✓ V	
		2. cork block		✓ O		✓ V	✓ O	✓ R		✓ V	✓ V
	C	3. lunch bag		✓ O		✓ R	✓ O				
		4. black lunchmill									
	N	5. wheelbarrow									
		6. airforce plane									
		7. turtle					✓ O				
		8. tricycle									
OWER	PS	9. feather cluster									
		10. ribbon		✓ O			✓ O				
	C	11. painted vase									
		12. pot with dirt				✓ V	✓ O	✓ V			✓ V
	N	13. ice box									
		14. boat									
		15. modern car									
		16. coffee jar									
ONEY	PS	17. animal medals	✓ V	✓ O	✓ V	✓ V	✓ O	✓ V	✓ V	✓ V	✓ V
		18. buttons	✓ V	✓ O		✓ V	✓ O	✓ V		✓ V	✓ V
	C	19. plastic black purse									
		20. cash register									
	N	21. crane									
		22. piano									
		23. ironing board									
		24. sawhorse									
PPLE	PS	25. balloon				✓ V		✓ V			
		26. rubber ball	✓ R	✓ O		✓ V		✓ V			
	C	27. knife									
		28. basket									
	N	29. mailbox									
		30. wheelchair									
		31. locomotive									
		32. typewriter									
UIT	PS	33. balloons				✓ V		✓ V			
		34. mandolin	✓ V								
	C	35. dishware		✓ O			✓ O		✓ R	✓ R	
		36. plate									
	N	37. eyeglasses									
		38. sandal									
		39. doll									
		40. chair									

Table 2 (cont'd)

NCEPT	TYPE	STIMULUS	3:1 S1	3:1 S2	3:1 S3	3:1 S4	3:1 S5	3:1 S6	3:1 S7	3:2 S8	3:7 S9
ORSE	C	41. cowboy									
		42. covered wagon		✓ o							
		43. bridle									
		44. western saddle		✓ o		✓ v	✓ o				
	PS+C	45. donkey		✓ o	✓ v		✓ o	✓ R	✓ v		
		46. mule	✓ v	✓ o		✓ v	✓ o		✓ v	✓ v	✓ v
	N	47. lamppost									
		48. ship									
		49. spatula									
		50. muffin tin									
		51. chowmein									
		52. grocery									
IRD	C	53. bird house				✓ v	✓ o				
		54. birdnest									
		55. birdcage		✓ o							
		56. forest									
	PS+C	57. butterfly									
		58. locust		✓ o			✓ o		✓ v	✓ v	
	N	59. guitar back									
		60. balloon									
		61. baby carriage									
		62. loafer									
		63. shishkebob									
		64. grocery									
OG	C	65. dogleash									
		66. milk bone				✓ v			✓ R		
		67. dog house									
		68. dogdish									
	PS+C	69. sheep				✓ v	✓ o	✓ v			
		70. wolf	✓ v	✓ o			✓ o	✓ v		✓ v	
	N	71. chinese junk									
		72. saucepan									
		73. pins									
		74. skis									
		75. coffee pot									
		76. suitcase									

Table 2 (cont'd)

CONCEPT	TYPE	STIMULUS	S1 (3:1)	S2 (3:1)	S3 (3:1)	S4 (3:1)	S5 (3:1)	S6 (3:1)	S7 (3:1)	S8 (3:2)	S9 (3:7)
CAR	FS	77. sled									
		78. ship									
	C	79. meters									
		80. service station									
	C + BS+FS	81. fire engine				✓ v	✓ o				
		82. truck					✓ o				
	Z	83. scissors									
		84. pencil sharpener									
		85. rifle									
		86. pail									
		87. handgun									
		88. stove									

20 to C stimuli.) Three children said that a picture of a lunch bag was 'bread;' four children said that a picture of a pot was a 'flower;' four children said that a picture of dishware was 'fruit;' one child said that a picture of a covered wagon was a 'horse,' and three said that a picture of a western saddle was a 'horse;' two children said that a picture of a birdhouse was a 'bird,' and one said that a picture of a bird cage was a 'bird' and, finally, two children said that a picture of a milkbone was a 'dog.' Although children definitely made errors to C stimuli they did not seem to be as stable as the overextension errors to PS stimuli. For one thing, children were more prone to reverse their decision on the probe test for C stimuli than for PS stimuli. Four out of ten children who were probed for their errors on C stimuli changed their minds whereas only three out of 26 children who were probed for their errors on PS stimuli changed theirs. For another thing children would occasionally make comments suggesting that their "Yes" responses to C stimuli were not always responses to the question asked but rather to other questions it suggested to them. For example, when shown a picture of a pot containing dirt and asked, "Is this a flower?" one child said "Yes" but then added, "It's for flowers," suggesting that he did't really think it was a flower. Or when asked of a lunch bag, "Is this bread?" one child said "Yes" but later remarked, "You put bread in it," again suggesting that he didn't really think it was bread and that his affirmative response to our question was more a statement on his part that he saw a connection between the lunch bag and the bread.

Children never made any errors to FS stimuli although we had only included two such stimuli in the experiment because of our difficulties in obtaining them. Children invariably said "No" when asked of a picture of a sled and of a ship if the? were 'cars.' The results for FS stimuli, while only based on two stimuli when combined with other findings, have led us to believe that children will rarely overextend a concept to a noninstance which is functionally similar to an instance of the concept unless that non-instance is also either perceptually similar to, or likely to be associated through contiguity with, an instance of the concept.

The PS + C stimuli tended to produce a fairly high frequency of overextension errors among children (a total of 24). For example, when shown the picture of a donkey and asked, "Is this a horse?" five out of nine children said, "Yes," and when shown a picture of a wolf five of the nine children included it in the 'dog' category. The PS + C stimuli, in general, produce considerably more overextension errors in children than do C stimuli which suggests that for these stimuli perceptual similarity is probably a determinant of many of the child's errors although association through contiguity may also play some role. The responses of children to the PS + C stimuli for the concept 'bird' were very interesting and suggest that linguistic factors may play some role in determining whether or not a child will overextend a given term of reference. Four out of nine children responded "Yes" when asked if a picture of a locust was a bird, and the two children who were probed for their errors persisted in making them. However, none of these children responded "Yes" when asked of the picture of the roughly equally perceptually similar and contiguous butterfly whether it was a 'bird.' Rather they all said, "No" and almost always pointed out that it was a 'butterfly.' This and other similar observations suggest that when a child has a name for an object he will be less likely to include it incorrectly in some other category than when he does not have a name for it.

Finally, there are the two PS + FS + C stimuli for the concept 'car'--the fire engine and the truck. Just one child said that both of these non-instances were 'cars' and one said that the 'fire engine' was a 'car' but not the truck. These few errors that do occur may well be primarily due to the perceptual similarity between the non-instances and cars since neither FS stimuli nor C stimuli for 'car' produce any errors. The fact that there are so few errors suggests that most three-year-old children have a pretty firm grasp on the extension of 'car' which had also been suggested by a previous study (see #1 On the Order of Acquisition of Category Labels).

One further point. The results of the probe tests revealed that children were quite consistent in persisting in their overextension errors to PS, PS + C, and PS + FS + C stimuli (only four reversals out of 43 probes) whereas they were not so consistent in the probe tests for C stimuli (four reversals out of ten probes).

Experiment 2

We thought we should see if we could replicate the basic findings of our pilot study in a full-fledged experiment. The approach we took was basically the same as for experiment 1 except for the following refinements: (1) We decided that for each concept we should add some instances since without instances the correct response to every stimulus is "No." The child may have anticipated in experiment 1 that since he is being asked to identify 'flowers,' 'money,' 'apples,' etc., there would probably be at least some pictures of flowers, of money, and of apples in the set we showed him, and so he may have been more prone to respond "Yes" than if instances had actually been included. We therefore added two photographs of clear instances of each of the concepts we were testing. (2) We did not want to increase by too much the number of pictures in the study since we have found that such studies with more than 100 pictures are a little too long for preschool children. We therefore decided to drop the pictures for the concept 'car' in experiment 2 since these non-instances were yielding very few overextension errors anyway.

Thus, in experiment 2 we used the non-instances for each of the eight categories studied in experiment 1 ('bread,' 'flower,' 'money,' 'apple,' 'fruit,' 'horse,' 'bird,' 'dog') plus two instances for each of these eight concepts. Specifically, instances were pictures of a piece of oatmeal bread and of a piece of rye bread for the concept 'bread,' of a rose and of a daisy for the concept 'flower,' of some coins and of some dollar bills for the concept 'money,' of two different apples for the concept 'apple,' of a pear and of a lemon for the concept 'fruit,' of two horses for the concept 'horse,' of a seagull and a bird resting on a twig for the concept 'bird,' and of a black labrador and of a collie for the concept 'dog.'

The subjects were 20 children between the ages of two years, five months and five years, one month. Just as in experiment 1 each picture was shown one at a time to a child and he was asked, "Is this bread?", "Is this a flower?", etc., depending upon which instance or non-instance had been presented. Again children were probed for any errors that they made and engaged in conversation about the stimuli for which they made errors. Sessions were tape recorded.

Results

Table 3 shows the overextension errors made by each child in

Insert Table 3 here

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experiment 2 for each picture and also the results of the probe tests. The notation in Table 3 is the same as it was for Table 2. At the end of Table 3 the child's performance on instances is also shown. Apart from a very few errors by the youngest subjects it can be seen that children almost invariably recognize the instances as instances of the various concepts being tested.

Children in experiment 2 make not a single overextension error for neutral stimuli but again for the other kinds of stimuli errors are made. Children in this study again fairly often made overextension errors for PS stimuli. A total of 60 overextension errors were made in all to PS stimuli. The PS stimuli which produced errors did so to pretty much the same extent as they had in experiment 1.

In experiment 2, although children also made overextension errors to C stimuli, they were not as frequent as they had been in experiment 1. A total of 19 errors were made to C stimuli by the 20 children in this study compared to the 20 errors made by only nine children in experiment 1. It is possible that the inclusion of instances in this study discouraged overextension errors to contiguous stimuli which would again suggest that errors to C stimuli are not as stable as to PS stimuli. Again children were not as consistent in sticking with their overextension errors to C stimuli in probe tests as they were for PS stimuli. Four times (out of

Table 3

Overextension errors made by children in Experiment 2 for each picture. Results of a probe test for consistency are also included.

NOTE:

CONCEPT= concept being asked (e.g., "Is this bread?)
TYPE= type of stimulus presented:

- (PS)= perceptually similar
- (C)= contiguous
- (PS+C)= perceptually similar and contiguous
- (N)= neutral

For each subject:

Initial "YES" response is indicated by a large ✓.
Probe response is indicated by a small ✓ ("YES" response), R (Reversal, or "NO" response), ✓R ("YES" and then "NO" response), or O (child was not probed).

AGE (in years:months) indicated above subject number.

Table 3

CON-CEPT	Type	STIMULUS	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15	S16	S17	S18	S19	S20
			2:5	2:5	2:8	2:10	3:1	3:1	3:2	3:2	3:2	3:3	3:8	3:8	4:3	4:3	4:3	4:3	4:3	4:3	4:4	5:1
BREAD	PS	1. mattress																			√ v	
		2. cork block							√ v		√ vR	√ v					√ v					
	C	3 lunch bag					√ vR															
		4. black lunch pail																				
	Z	5. wheelbarrow																				
		6. airforce plane																				
		7. turtle																				
		8. tricycle																				
LOWER	PS	9. feather duster																√ v				
		10. ribbon							√ vR			√ v	√ v									
	C	11. painted vase																				
		12. pot with dirt				√ v									√ v				√ vR			
	Z	13. ice box																				
		14. boat																				
		15. modern car																				
		16. coffee jar																				
IONEY	PS	17. animal medals	√ v		√ v	√ v	√ v	√ v	√ v	√ v		√ v		√ v	√ v	√ v	√ v	√ v		√ v	√ v	√ v
		18. buttons			√ v	√ v	√ vR	√ v	√ v	√ v	√ c	√ v			√ v		√ v	√ v	√ v	√ v	√ R	√ v
	C	19. plastic black purse										√ R		√ v	√ R							
		20. cash register			√ o										√ o							
	Z	21. crane																				
		22. piano																				
		23. ironing board																				
		24. sawhorse																				
PPLE	PS	25. balloon	√ v			√ v			√ v			√ R										
		26. rubber ball	√ v			√ v			√ v									√ v				
	C	27. knife																				
		28. basket																				
	Z	29. mailbox																				
		30. wheel chair																				

Table 3 (cont'd)

ON-EPT	TYPE	STIMULUS	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15	S16	S17	S18	S19	S
			2:5	2:5	2:8	2:10	3:1	3:1	3:2	3:2	3:2	3:3	3:8	3:8	4:3	4:3	4:3	4:3	4:3	4:3	4:4	5
RUIT	PS	33 balloons	✓v					✓v	✓v	✓v		✓vR	✓v	✓v	✓vR	✓v		✓v				✓
		34 mandolin	✓v																			
	C	35 dishware	✓v																			
		36. plate																				
	N	37. eyeglasses																				
		38 sandal																				
		39. doll																				
		40. chair																				
ORSE	C	41 cowboy																				
		42. covered wagon	✓v		✓o																	
		43. bridle																				
		44. western saddle	✓v																		✓v	
	PS + C	45. donkey				✓v	✓v	✓v			✓v	✓v										✓
		46. mule	✓v	✓o	✓v		✓v	✓v	✓v	✓v	✓v		✓v	✓v	✓v	✓v	✓v	✓v	✓v	✓v	✓v	✓
	N	47. lamppost																				
		48 ship																				
		49 spatula																				
		50. muffin tin																				
		51. chow mein																				
		52 grocery																				
IRD	C	53. birdhouse	✓v																		✓R	
		54 bird nest	✓v									✓R										
		55. bird cage																				
		56 forest																				
	PS + C	57. butterfly						✓v														
		58 locust						✓v							✓vR							
	N	59. guitar back																				
		60 balloon																				
		61. baby carriage																				
		62 loafer																				
		[illegible]																				

Table 3 (cont'd)

CONCEPT	TYPE	STIMULUS	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15	S16	S17	S18	S19
			2:5	2:5	2:8	2:10	3:1	3:1	3:2	3:2	3:2	3:3	3:8	3:8	4:3	4:3	4:3	4:3	4:3	4:3	4:4
DOG	C	65 dog leash																			
		66 dog house	✓v																		
		67 milk bone																			
		68 dog dish																			
	PSt C	69 sheep				✓v			✓v			✓vR									✓v
		70 wolf	✓v	✓v			✓v	✓v	✓v	✓v	✓v		✓v	✓v		✓v		✓v			✓v
	N	71 chinese junk																			
		72 saucepan																			
		73 pins																			
		74 skis																			
		75 coffee pot																			
		76 suitcase																			
BREAD	INSTANCES	77 oatmeal	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
		78 rye	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
FLOWER		79 rose	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
		80 daisies	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
MONEY		81 25¢ 1 45¢ coins			✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
		82 bills	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
APPLE		83 mackintosh	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
		84 small apple	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
FRUIT		85 pear			✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
		86 lemon		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
HORSE		87 horse front	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
		88 horse back	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
BIRD		89 seagull	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
		90 bird on twig	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
DOG		91 black labrador	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
		collie type	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

16 possible) children whose errors to C stimuli were probed reversed their decision whereas only two out of 59 reversals were made for PS stimuli and none out of 38 were made for PS + C stimuli. Also, some of the children's comments again suggested that the errors to C stimuli were not as stable as for PS stimuli. For example, for the pot with dirt in it, after one child had said "Yes" in response to the question "Is this a flower?" he remarked, "Well, you put flowers in it," suggesting that his affirmative response may not have been a direct answer to **our** question but rather a statement by him that he saw a connection between vases and flowers. One final point about errors to C stimuli: Most of the errors to C stimuli (11 out of 19) were made by the youngest children in this study--the four two- to three-year-olds. The three- to five-year-olds made very few such errors. In contrast, all age groups made a fairly large number of errors to PS stimuli and PS + C stimuli.

The PS + C stimuli again produced a fairly large number of over-extension errors--a total of 43. The PS + C stimuli which produced the most errors were the picture of the mule and the picture of the wolf. Eighteen children said that the picture of the mule was a 'horse,' and 12 children said that the picture of the wolf was a 'dog.' None of the 38 errors to PS + C stimuli which were probed resulted in reversals.

In Table 4 we have tried to summarize the main findings from

Insert Table 4 here

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experiments 1 and 2. Table 4 shows the total number of errors and the percentage of possible errors for each of the different kinds of stimulus. Table 4 suggests that with respect to the three attributes of non-instances

Table 4

Total number of errors and percentage of possible errors for (1) perceptually similar (PS), (2) perceptually similar and contiguous (PS+C), (3) contiguous (C), (4) functionally similar (FS), (5) perceptually similar, contiguous and functionally similar (PS+C+FS) and (6) neutral (N) stimuli used in overextension studies.

Type of Stimulus	PS N=29	PS + C N=29	C N=29	FS N=9	PS+C+FS N=9	N N=29
Total Errors	96	67	39	0	3	1
% of Possible Errors	33.1	38.5	5.9	0.0	16.7	0.09

which have been the focus of this investigation (1) perceptual similarity is the most powerful determinant of the child's overextension errors, (2) association through contiguity is weaker and less stable but still does occasionally seem to be a factor in causing younger children to include a non-instance in a given concept, and (3) there is no evidence that functional similarity by itself ever entices the child to overgeneralize a given term of reference. Approximately one-third of the time (33.1%) that children were presented with PS stimuli they included them within the concept for which they were being tested. Only about six percent of the time did children make errors on C stimuli. None of the time did they make errors on F stimuli although admittedly there were only 18 opportunities for such errors. It is interesting to note that PS + C stimuli produce more errors (38.5%) than PS stimuli (33.1%) and, in fact, produce a percentage of errors that is very close to the sum of the percentages of errors for PS stimuli and for C stimuli. The PS + C + FS stimuli do not produce as great a percentage of errors as the PS stimuli but it should be remembered (1) that there were only 18 opportunities for such errors and (2) that the concept 'car' for which these non-instances were used is one of the earliest grasped of the child's first terms of reference. The neutral stimuli elicit just one error out of a possible 1,156 which suggests to me that if a non-instance is neither perceptually similar to nor likely to be associated through contiguity with an instance of another concept, then it is a virtual certainty that children will not make the mistake of overgeneralizing the concept to that non-instance, at least in a test of comprehension done along the lines of experiments 1 and 2.

Experiment 3

Experiments 1 and 2 were studies of the child's tendency to overgeneralize a term of reference in tests of comprehension. We thought that it would be profitable to study overgeneralization in a test of production as well. That is to say, rather than ask of each child, "Is this a flower?", "Is this money?", etc., we decided to examine the names that children provided when asked of the various pictures, "What is this?" Our ultimate hope was to see if the factors identified as determinants of overextension in tests of comprehension also appeared to be the important sources of overextension in a test of production.

Method

Subjects were five children whose ages ranged from three years, one month to four years, one month. We decided to use the pictures we had used in experiment 1 (excluding the neutral stimuli) since we were curious to see to what extent children would provide the names of the categories which we were studying in that test of comprehension in this test of production. Thus, each child was shown a total of 44 pictures which were presented to him in a random order by the experimenter one at a time. For each picture the child was simply asked, "What is this?" His responses to this question were recorded for each picture as the experiment progressed.

Results

Table 5 shows the names given by each child for each of the 44

Insert Table 5 here

Table 5

Names given by 5 children for 44 pictures used in overextension studies. Classification of names into categories (1) correct (√), (2) perceptually similar (PS), (3) perceptually similar and functionally similar (PS/FS), (4) perceptually similar and contiguous (PS/C), (5) perceptually similar, functionally similar, and contiguous (PS/FS/C), (6) contiguous (C), (7) statement of function (F), (8) "don't know" (DK) and (9) difficult to classify (?) is shown for each name.

Table 5

NAMES GIVEN

STIMULUS	S1 (3:2)	S2 (3:1)	S3 (3:2)	S4 (4:1)	S5 (3:1)
mattress	pillow for a couch PS/FS/C	DK DK	DK DK	cookie PS	DK DK
cork block	book PS	DK DK	sponge PS	ham PS	book PS
lunch bag	grocery bag ✓	bag ✓	bag ✓	bag ✓	bag ✓
black lunch pail	purse; FS/FS suitcase PS/FS	purse PS/FS	purse PS/FS	doctor kit PS/FS	lunchbox ✓
feather duster	duck ?	monkey ?	paintbrush PS	brush PS/FS/C	round circle and a pen ?
ribbon	ribbon ✓	ribbon ✓	DK DK	ribbon ✓	turtle PS
painted vase	pot PS/FS	bowl PS/FS	DK DK	bottle PS/FS	bowl PS/FS
pot with dirt	dirt ✓	plant C	dirt ✓	plant C	bowl PS/FS
animal medals	pennies PS	sheep ✓	seals ✓	money PS	balls PS
buttons	pennies PS	wheels PS	buttons ✓	money PS	fish ?
plastic black purse	purse ✓	purse ✓	purse ✓	purse ✓	rocking chair ?
cash register	typewriter PS	for papers; F machine ✓	typewriter PS	typewriter PS	building ✓
balloon	balloon ✓	balloon ✓	balloon ✓	balloon ✓	ball PS
rubber ball	ball ✓	ball ✓	egg PS	ball ✓	ball ✓
knife	knife ✓	knife ✓	knife ✓	knife ✓	stick to hit drum PS
basket	dirt bowl PS/FS	basket ✓	basket ✓	put dirt inside F	sand ✓
balloons	balloons ✓	balloons ✓	balloons ✓	balloons ✓	birdie ?
mandolin	ball; PS guitar PS/FS/C	egg PS	balloon PS	guitar PS/FS/C	bottle PS
dishware	cups and plates ✓	cups and plates ✓	dinner C	house C	table ✓
plate	plate ✓	plate ✓	plate ✓	plate ✓	table ✓

(Continued on next page)

NAMES GIVEN

STIMULUS	S1 (3:2)	S2 (3:1)	S3 (3:2)	S4 (4:1)	S5 (3:1)
cowboy	cowboy ✓	boy ✓	man ✓	cowboy ✓	cowboy ✓
covered wagon	car PS|FS	tunnel PS	covered wagon ✓	wagon ✓	owl PS
bridle	snake PS	stairs PS	for reins for horses F	for horses; F leash PS|FS	rope PS
western saddle	bird; PS horse C	DK DK	saddle ✓	saddle ✓	birdie PS
donkey	doggie PS|C	sheep PS|C	DK DK	horse PS|C	horsie PS|C
mule	2 horses PS|C	cows PS|C	horses PS|C	horses PS|C	water ?
birdhouse	post; PS box on T.V. PS	birdhouse ✓	house ✓	birdhouse ✓	box PS
bird nest	nest ✓	nest ✓	nest ✓	bird nest ✓	doughnut PS
bird cage	cage ✓	birdhouse ✓	cage ✓	birdhouse ✓	watersink ?
forest	forest with trees and leaves and sticks ✓	trees ✓	trees ✓	trees and forest ✓	tree ✓
butterfly	butterfly ✓	butterfly ✓	butterfly ✓	butterfly ✓	butterfly ✓
locust	bat PS	butterfly PS|C	butterfly PS|C	butterfly PS|C	girl dancing PS
dog leash	belt PS	DK DK	belt PS	belt PS	belt PS
dog house	✓fence; cage;✓ house ✓	monkey cage PS|FS	pig house PS|FS	cage-house ✓	birdie; C cage for birdie PS|FS
milk bone	bone ✓	screw PS	bone ✓	dog bone ✓	bone ✓
dog dish	bowl ✓	bowl ✓	bowl ✓	bowl for dogs and cats ✓	bowl ✓
sheep	lambs ✓	sheep ✓	sheep ✓	sheep ✓	parrot PS
wolf	wolf ✓	DK DK	dog PS|C	doggie PS|C	cat PS|C
sled	roller skate PS|FS	sled ✓	ski PS|FS|C	sled ✓	airplane PS|FS
ship	boat ✓	boat ✓	boat ✓	boat ✓	boat ✓
meters	lampposters PS|C	DK DK	outside ✓	street ✓	fence PS
service station	gasoline C	for cars F	station ✓	gas station ✓	gas station ✓
fire engine	fire truck ✓	fire engine ✓	fireman truck ✓	fire engine ✓	store ?
	truck ✓	truck ✓	truck ✓	truck ✓	building PS

pictures used in this experiment. For each picture we tried to classify each response into one of ten categories: (1)✓: correct--if the child's name was a correct name for the object depicted in the picture (e.g., 'bag' for lunchbag); (2) PS: perceptually similar--the child's name was not correct but the object depicted in the picture was perceptually similar to an instance of the concept overgeneralized (e.g., 'egg' for ball); (3) C: contiguous--the child's name was incorrect but the object in the picture was likely to be experienced in the presence of an instance of the concept overgeneralized (e.g., 'plant' for pot with dirt); (4) FS: functionally similar--the child's name was incorrect but the object in the picture served the same function as an instance of the concept overgeneralized (As it turned out, there were none of these.); (5) PS/C--the child's name was incorrect but the object in the picture was perceptually similar to, and likely to be experienced in the presence of an instance of the concept overgeneralized (e.g., 'horses' for mules); (6) PS/FS--the child's name was incorrect but the object in the picture was perceptually similar and functionally similar to an instance of the concept (e.g., 'airplane' for sled); (7) C/FS--the child's name was incorrect but the object in the picture was likely to be seen in the presence of and was functionally similar to an instance of the concept overgeneralized (As it turned out, there were none of these.); (8) PS/FS/C--the child's name was incorrect but the object in the picture was perceptually similar to, functionally similar to, and likely to be associated through contiguity with an instance of the concept overgeneralized (e.g., 'guitar' for mandolin); (9) F: statement of function--the child's response was a statement of the function of the object depicted in the picture (e.g., "for horses" for the picture of a bridle); (10) DK: don't know--the child said he did not know what the object depicted was (e.g., "I don't know" for the picture of a mattress).

Two adult judges went through each of the pictures and attempted to classify each response of the children into one of these ten categories. In each of the cells of Table 5, in addition to the actual name given by a child to a picture, we have included the classification of that name by the two adult judges. The judges felt comfortable in classifying every response except for nine (out of 229) into one of the ten categories outlined above. These nine responses which were difficult to classify are indicated by a question mark (?) in Table 5.

Table 6 shows the total number of each type of classification

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Insert Table 6 here

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for the names given by the children for all the pictures used in this experiment. There were a total of 229 names to be classified since nine of the children gave two names for one of the stimuli. Approximately one-half (116 out of 229) of the names provided by children were correct names. (If a child named something in the background of the picture rather than the object in the foreground it was counted as correct. For example, for stimulus #20, a picture of a plate resting on a table, one child said it was a 'table' which was counted as a correct response.) Among the errors the most frequent kind were PS names. Forty-four overextension errors were such that the objects depicted in the picture were judged to be perceptually similar to instances of the concept

Table 6

Total number of each type of classification for the names given by 5 children for the 44 pictures used in the overextension experiments.

NOTE: There were 9 instances of multiple naming yielding a total of 229 (rather than 220) names.

Key to Classifications:

(✓)= correct
(PS)= perceptually similar
(PS/FS)= perceptually similar and functionally similar
(PS/C)= perceptually similar and contiguous
(PS/FS/C)= perceptually similar, functionally similar, and contiguous
(C)= contiguous
(F)= statement of function
(DK)= "don't know"
(?)= difficult to classify

Type of Classification	✓	PS	PS/FS	PS/C	PS/FS/C	C	F	DK	?	ALL
Total Number	116	44	18	15	5	7	5	10	9	229

overgeneralized. Examples are 'cookie' for mattress, 'paintbrush' for feather duster, 'pennies,' 'money,' and 'balls' for animal medals, 'typewriter' for cash register, 'ball' for balloon, 'egg' for rubber ball, 'snake,' 'stairs,' and 'rope' for bridle, 'doughnut' for birdnest, 'belt' for dog leash, etc. There were far fewer C errors than PS errors (7 versus 44). Thus, children infrequently overgeneralize concepts to non-instances which are only likely to be experienced in the presence of instances of those concepts, although such errors do occasionally occur. Examples are 'plant' for a pot with dirt, 'dinner' for dishware, 'house' for dishware, 'horse' for a western saddle, 'gasoline' for a service station, etc. There were no FS errors at all. Thus, children never overgeneralized concepts to non-instances which were only functionally similar to instances of those concepts. It is important not to confuse FS errors with F responses which are not really errors but rather statements of the function of the object depicted in a picture. There was a total of five F responses. Examples are 'put dirt inside' for a picture of a basket, 'for papers' for a picture of a cash register, 'for reins for horses' and 'for horses' for a picture of a bridle, and 'for cars' for a picture of a service station.

There were 18 cases of PS/FS errors (e.g., 'bowl' for a picture of a painted vase), 15 cases of PS/C errors (e.g., 'horses' for a picture of two mules), and five cases of PS/FS/C errors (e.g., 'brush' for a picture of a feather duster). It is possible to speculate that perceptual similarity between the non-instance and an instance of the concept overgeneralized plays the predominant role in enticing the child to make these errors since in this experiment and in the previous ones, when it is possible to disentangle the effects of perceptual similarity, contiguity, and functional similarity as determinants of the child's overextension errors, perceptual similarity always appears to be the most powerful factor.

Finally, there were ten "Don't Know" responses and nine which were difficult to classify. The fact that there are so few "Don't Know" responses is consistent with the results of previous studies--children seem more inclined to label an unfamiliar object incorrectly than to admit that they don't know what it is. The fact that the number of difficult to classify responses is so low suggests that when children do make overextension errors they will usually be to non-instances which are perceptually similar to or contiguous with instances of the concepts overgeneralized. Children produce very few overextension errors for which neither of these factors seems to be playing a role.

This test of production did not usually elicit the exact names of the categories for which the stimuli had been chosen in experiments 1 and 2, although in some cases it did (e.g.,'money' for animal medals, 'horse' for saddle, 'dog' for wolf, etc.). Thus, the format of experiments 1 and 2 involving questions of the form "Is this a flower?" may sway the child to overgeneralize 'flower,' etc. more than he would if simply asked to name the pictures. Nonetheless, children make many overextension errors in this test of production and, in general, the factors that appear to be important in enticing the child to overgeneralize in naming are the same ones that were seen to be important in the tests of comprehension.

Conclusions

Of the factors we have investigated in both studies of comprehension (experiments 1 and 2) and in the study of production (experiment 3) perceptual similarity between the non-instance and an instance of a concept appears to be the most powerful determinant of overextension errors in young children. Association through contiguity is a much weaker determinant and errors in which a concept is overgeneralized to a non-instance which is likely to be experienced in the presence of an instance of that concept appear to be far less stable than errors due to perceptual similarity. Nonetheless, such errors do occur occasionally in both tests of comprehension and production. Functional similarity between a non-instance and an instance of a given concept by itself never appears to be enough to entice a child to overgeneralize that concept. Linguistic factors also appear to play a role in determining whether or not a child will overgeneralize a given term of reference. Specifically, if the child has a correct name for a non-instance, he will be far less likely to include that instance incorrectly in some other category than if he does not know what to call it.

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