DOCUMENT RESUME

ED 136 931 PS 009 176

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TITLE Semantic Organization and Reference: Acquisition of Two Aspects of the Meaning of Color Terms.
PUB DATE Mar 77
NOTE 20p.; Paper presented at the Biennial Meeting of the Society for Research in Child Development (New Orleans, Louisiana, March 17-20, 1977)

EDRS PRICE MF-$0.83 HC-$1.67 Plus Postage.
DESCRIPTORS *Cognitive Development; *Cognitive Processes; *Color; Concept Formation; *Language Development; *Preschool Children; Preschool Education; Research; *Semantics

ABSTRACT

This study investigates acquisition of two aspects of the meaning of color terms: semantic organization and reference. A longitudinal, repeated measure design was used, and data were collected from 33 subjects, 2 to 4 years old at first testing. Four tasks were used: one to assess semantic organization (the acquisition of the superordinate/hyponymic relation between "color" and various color terms); two to assess acquisition of correct specific referents for color terms; and one to assess acquisition of a more general reference (knowing that color terms refer to the dimension of color as opposed to another dimension such as size). Results indicate that semantic organization precedes acquisition of correct specific referential meaning. Results from the general referential task show that most subjects had acquired an appropriate dimensional meaning. (Author/SB)

SEMANTIC ORGANIZATION AND REFERENCE: ACQUISITION OF TWO ASPECTS OF THE MEANING OF COLOR TERMS

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Paper presented at the biennial meeting, Society for Research in Child Development, New Orleans, La., March 17-20, 1977.

In this paper, I will present data from a longitudinal study of children's acquisition of meaning for color terms. These include the word "color" itself and the eleven basic color terms of English: "black," "white," "red," "green," "blue," "yellow," "orange," "purple," "pink," "brown," "gray".

This particular study focuses on two aspects of meaning: semantic organization and reference.

By semantic organization, I mean the relation of one word to another within a particular lexical domain. In this study, I will focus on the superordinate/hyponymic relation between the word "color" and the various individual color terms. That is, does the child know that words like "red" or "green" are examples of the word "color". Or - to put it another way - will the word "color" serve as a cue to retrieve color terms (and only color terms) in answer to a question such as "What are the names of some colors?" Or: "What color is this?"

The second aspect of meaning is reference: do individual color terms serve as names for specific colors and does that word "color" itself serve to name a particular dimension of experience?

Clearly, for adults, these meanings form a complex and systematic whole. But things probably don't begin that way. And that main purpose of my research has been to obtain em-

pirical evidence about how this organization actually gets started.[1]

Perhaps the simplest notion of how children learn color terms would go like this: you show a child a color and say its name. And after giving the child a few examples, you might say: "Now show me the red one." Or perhaps, "What color is this?" If the child answers correctly, you give the child a suitable reward and you repeat the process until you're sure that an association between the word and the color seems to be established.

Now we can dress the notion up in various ways to make it sound like a reasonably respectable scientific theory. But the basic point remains: what a child first learns is to associate a particular name with a particular color. There are theories about which colors might be easier to learn -- and these are often based on studies of color perception. (For example, see Bartlett, in press.) But the point I want to stress is that most accounts are based on the assumption that these terms first enter the lexicon as names for specific colors. This is essentially the position of Eleanor Rosch

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[1]One problem in reporting the results has always been how to label the various components of meaning before they get themselves organized into an adult-like system. Reference is easy enough, but the part which I am calling "semantic organization" is more difficult because the words imply a kind of structuring which is clearly just beginning to develop in the child. It is therefore important to remember that in this paper I am using this label in a very special and restricted way to refer only to the kind of relation that children seem to have between the word "color" and the individual color terms. It is intended to refer to a relation that exists between words in the lexicon, but it is not intended to imply that any of these words have appropriate referents.

and her colleagues - and just about anyone else who has ever studied the acquisition of color terms. (e.g., Heider, 1971; Johnson, 1977) And of course the notion has a long and venerable history in psychology.

However, the point of my paper is to convince you that this notion - at least with respect to the acquisition of color terms - cannct be entirely correct.

To do this, I will focus on data from children who are just beginning to acquire a few color terms - for it is here, in the beginning stages, that we are likely to get the most clear-cut evidence about how the different meanings actually come in.

The data come from 33 middle class children who were between the ages of 2 1/2 and 4 years when we started. All were tested four times at roughly six-week intervals. Each test battery included several color-naming and sorting tasks, four of which will be reported today. Since our children were very young, it was important to keep the testing as brief as possible, so each battery was administered in four sessions within a ten day period.

In describing the results, I'll begin with data from the color-term production and comprehension tasks. These assessed acquistion of referential meanings for the color terms. On the production task, the experimenter displayed monochromatic objects one at a time, and asked: "What color is this?" There were eleven in all, five at one session and six at another. The colors matched as closely as possible the focal colors established for these terms by Heider, 1972.

At the next two sessions, a comprehension task was administered. The same objects were used. The experimenter displayed a set of five or of six and said, "Show me the red (or green or whatever) one," using the names of the eleven colors.

Results of these tasks can be scored in several ways. When we look at whether a child answered both the production and comprehension questions about a given term correctly, we find that there were 24 subjects with four or more correct terms at the first assessment and nine with less than three terms. When we look at comprehension scores alone we find that - for the 24 more advanced namers - comprehension far exceeded production but for the nine less advanced namers, comprehension was never much better than production and indeed never rose beyond what we would expect by chance.

Given the scores on our comprehension task, then, it seems reasonable to select as beginners those nine children who were performing at chance level. Of these, two could name two colors correctly, three could name one, and four had no correct names at all.

Now, how can we characterize their lexicons? First of all, every child produced at least one color term and some were producing as many as five or six. But referentially, these terms were clearly very odd. For example, one child responded by calling every object "blue." Another called six objects "blue," and five "pink," seemingly in a random order. A third called the yellow, orange and green objects

"red," but the red object, "green." In short, their responses appeared to be quite unorganized.

But the surprising thing, it seems to me, is not so much the seeming lack of order as it is the considerable amount of appropriate linguistic organization. Take the syntax, for example. Children responded to our questions by saying: "That color is green." "That cup is black." "It's a red one." And so forth. The referential meanings were all wrong, of course, but if you couldn't see the objects, then the responses sounded just fine.

Curiously, too, these responses show at least a rudimentary kind of semantic or lexical organization. That is, the question "What color . . ." did serve to elicit items from an appropriate area of the lexicon.

Overwhelmingly, then, these children answered our questions with color names - but occasionally, they did make a certain kind of mistake. Sometimes, when the experimenter asked: "What color is this?" a child would answer with the name of an object instead. This happened about 14% of the time with our beginners and just about as often with our advanced namers. Now, if the experimenter continued by probing, "But what color is it?" then the child usually went on to produce a color term, although often an incorrect one. In all, there were only fifteen instances in which a child failed to produce a color term in response to the probe (and virtually all of these are accounted for by two subjects whose data I'll describe in a moment). But before I do, I just want to stress

the point that even when the words "what color . . ." seemed to produce an anomolous response, a simple repetition of the question was usually sufficient to elicit an appropriate kind of word.

Now for two of our beginners, this was clearly not the case. Their responses are listed in Table I. As you can see, both children are clearly able to produce color names - John produces "red" at the first session and Mary produces "yellow," "pink," and "blue." But unlike the rest of our beginners, these children have not yet achieved much semantic organization. The difficulty may lie with the word "color": neither child seems able to map it with any consistency onto any particular area of the lexicon.

John's pattern is perhaps the more clear-cut. At session one, the words "what color . . ." elicit mostly object names or functional descriptions. But even by the next session - which occurs only a day later - some progress had been made, for the word "color" in the probe question, at least, is now beginning to elicit color terms quite consistently. (By contrast, Mary's progress is less consistent: if anything, we would have to say that her organization seems to deteriorate slightly from one session to the next.)

These two subjects, then, have the least mature set of responses in our sample and, together, they give us some sense for what the lexicon might look like before lexical mappings are firmly established. For the rest of our subjects, however, the responses are both appropriate and consistent. That is,

they always answered our question "what color . . . " with color terms.

Unfortunately, however, these responses give us little information about how the lexical knowledge is actually represented. It is possible, of course, that these responses do indicate a full superordinate/hyponymic organization. But it is also possible that they merely indicate a set of learned routines. Perhaps these children simply have some fairly isolated selection restrictions attached to some of these words so that, for example, they simply know that "red" is what you say when someone else says "what color."

To get some information about this, we used a hyponym elicitation task. This was administered at the start of the first two testing sessions, before any test stimuli were displayed. It consisted of the following simple question: "Do you know the names of any colors? What color names do you know?" It was intended to tell us whether the word "color" explicitly served to define a kind of name or area of the lexicon, and whether children had access to this organization through a direct question.

Again, our results are quickly summarized. All but three children in our sample responded with color terms and only color terms - and of the three, only one was a beginning namer. This indicates that for all but one beginner, the word "color" does indeed serve to define an area of the lexicon and that these children seem to have good control of their access to that relation.

Of the three children who failed this task, one - as we might suspect - was John, the child whose data are presented in Table I. When we asked him "Do you know the names of any colors?" at session one, he answered, "Color of leaves?" The experimenter went on to say, "Yes, any colors, which ones do you know?" But that was as much as John could manage and he changed the subject. By the next session, however (and this is certainly consistent with the data in Table I), things were better organized and he answered by saying, "Red. And white. And I know blue. And a red and white fire engine with hooks on it." So clearly, he has achieved some organization, although it is apparently quite fragile.

The other non-responders were from our group of advanced namers. Both responded with the names of objects and it is hard to know how to interpret their behavior. Conceivably they misinterpreted our task. But in any case, the important result is that all of our beginners, except John, did produce color terms and only color terms, which indicates that these subjects have achieved some kind of superordinate/hyponymic organization, despite the fact that their referential responses are still quite unorganized.

Can we say then that children's first meanings are not referential and that a substantial amount of semantic organization seems to occur prior to any referential map?

Well, in one sense, yes: clearly, we have no evidence that our beginners map these terms in any systematic way onto any well-defined area of the color space. But even so, this doesn't mean that these children have achieved no referential

organization whatsoever. Indeed, it is entirely possible that these terms map in some general, but nonetheless systematic way onto some concept of the general dimension of color without any further specification of an actual range of hues to which they might refer.

Essentially, then, we want to ask whether our beginners do have a referential meaning after all - one which roughly corresponds to what an adult would have for the dimensional word "color." And - related to this is the question of whether children do indeed have a referential meaning for "color" as well.

To investigate these questions, we administered two more tasks. They are very similar but since the one which assesses children's referential meanings for "color" is a little simpler to explain, I will begin with that.

In that task, the experimenter presented arrays of six objects, pairs of which could be grouped according to object category (e.g., two chairs or two wooden beads) or functional relations (e.g., knife and plate). Additionally, two were always the same color (e.g., a yellow bead and a yellow chair). In presenting the objects, the experimenter asked: "Which ones are the same color?" The pair of identically colored objects always consisted of items which could belong to other groupings so that in choosing the "same color" objects, the child always had to make a clear-cut decision about how to group the array. Each child was given three such problems to solve.

The results of the task are presented in Table II. The numbers in the boxes are numbers of responses: each child contributes three responses to the total. There are two headings for the columns: +color means that the child responded by selecting identically colored objects. -color means that he did something else. In the case of our advanced namers, if a child didn't pick the identically colored objects, then he always - without exception - picked the two from the same object or function category. Our beginners did that about half the time. The rest of the time, they either gave all six objects to the experimenter or they chose one, seemingly at random. Although it would be interesting to speculate about the meaning of these non-color responses, the important thing to note is that - overwhelmingly, the words "same color" did lead our advanced namers to organize these arrays in terms of the dimension of color while for our beginners, this was simply not the case.

Along with information about the referential meaning of "color," I also wanted to find out whether the individual color terms which our beginners were producing - terms like "red" and "green" - mapped in any systematic way onto the general dimension of color - despite the fact that they clearly had no consistent referential mapping onto any specific color. To answer this question, I used the same basic task, but modified it in certain ways. I reasoned that if a child had such a meaning for these terms, then if we presented him with the same kinds of arrays and asked him to select the "two

red ones" (where "red" was a non-referenced term in his lexicon) then he would be more likely to select pairs of identically colored objects (even if these were tan or peach or maroon) than pairs of objects that were related in other ways. The point here is not that I expected children to choose a color like tan as a referent for "red" but that, if children do indeed have a general dimensional meaning for these terms, then I would expect them to take the color term as a cue to search an array for any items which are identical in color. So for this task, I used similar sets of six items, but substituted colors like tan or peach for the ones used in the original pairs. The experimenter also changed his verbal request by saying, "Show me the two red (green or whatever) ones," where the color name was a term which the child had produced but which seemed to have no correct referent in his lexicon at that time. (Thus, for example, an array might consist of six items, two of which were tan and the others each a different color, the only restriction being that no item in the array would actually be the color named by the experimenter.)

In scoring the task, a child was given credit for having a general dimensional meaning for this word if he chose the pair of identically colored objects. If he explicitly said that an object of such a color was not present (which was in fact that case) he was given credit for having a correct referent for the term after all.

Now unfortunately, by the time we realized that our children were producing many non-referenced color terms, much of our longitudinal assessment was already completed. Thus, we were forced to investigate this particular question with another group of children. The data were collected from 18 subjects who were comparable in age to our main sample; ten of these children were beginning namers. In all, they produced 38 non-referenced color terms. Thirteen were produced by the advanced namers and 23 by the beginners. The data are summarized in Table III. Essentially, the results are the same as those obtained on the "same color" task: the advanced namers had no difficulty interpreting the task in terms of color while for the beginners this kind of response rarely occurred.

So then, what can we conclude about the lexicons of our beginners? Well, clearly they are producing color terms. And clearly these terms do not seem to be names for specific colors. The most important evidence for this is that these children performed at a chance level on the color term comprehension task. Consistent with this is the fact that while some children did name one or two colors correctly, four children with stable lexical mappings had no correct referential maps at all.[2]

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[2]Nor are these results unusual. Data reported by Istomina (1963), Decoudres (1921) and Dougherty (1975) all support this conclusion, as do anecdotal accounts of early color naming in Binet (1969), Church (1961) and Leopold (1949).

Thus, although these children were indeed producing color terms, these terms did not seem to be entered in the lexicon as names for specific colors. This finding is further supported when we examine the consistency of children's errors across assessments. These are analyzed in Bartlett, in press. Briefly, the data show that errors among our beginners tend to be quite inconsistent. Thus, for example, if a beginner uses the word "blue" to label a red object at our first assessment in November, then if he makes an error with "blue" in January, he is more likely to use it to label a completely different color than to use it to label the red object again.

Indeed, construction of a correct referential map was apparently quite difficult for all our subjects. We can see this once again in our longitudinal data. For example, at the November assessment, our subjects produced a total of 36 color terms without correct referents. By January, 19 of these were still without correct referents and in March, this was still true of 11 terms (or almost one-third of the original total).

By contrast, the semantic organization appears to occur very quickly. By the January assessment, not a single child in our sample was producing anomalous answers to our questions. Further, when we compare the responses of John at sessions one and two (Table I) we have evidence that some measure of this semantic organization can be achieved quite literally overnight.

In conclusion, then, it is surprising how little a child apparently needs to know about color or color naming in order to enter at least a few color terms into his vocabulary. Clearly, he need not know the particular color to which the term refers - nor, apparently, need he even have a particular color in mind. Indeed, some of our evidence indicates that the child need not even have conceptualized color as a separate, nameable dimension at all. And although it is clear that children do establish consistent superordinate/hyponymic mappings between "color" and the individual color terms very early, it is also clear from data in Table I that some children can use these terms even before such mappings have cohered into a stable, consistent system. The point, then, is that surprisingly little is required for a child to achieve some minimal use of these terms.

This makes a certain amount of adaptive sense, for as soon as a child can begin to use and recognize a word he can begin to find out by trial and error what it means. But if he must know a great deal about what it means before he can use or recognize it, then the child may never accumulate enough information to get the system going in the first place.

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TABLE I

Responses to question: "What color is this?"

John's data, first assessment

Session One

Stimulus	Child's response to question
brown shoes	These colors are color shoes **[a] (n.r.)[b]
pink watering can	That color is thing gets water in it just like Mommy has **(n.r.)
green lamp	That lamp is you turn on a light ** (n.r.)
white cup & saucer	That color is a tea toy ** my daddy drinks it too
purple paper	That color is red
yellow chair	That color is a chair, sit down ** for sit down

Session Two

orange heart	A think ** what color
blue pot	A pot ** blue
black star	Color is red
grey paper	That color is blue
red plate	A plate ** red and white

Mary's data, first assessment

Session One

Stimulus	Child's response to question
yellow chair	It's yellow
green lamp	It's housey ** (n.r.)
purple paper	Color is this one ** (n.r.)
pink watering can	You water it ** color is pink
white cup & saucer	Cup ** blue
brown shoes	Shoes is color ** (n.r.)

Session Two

red plate	A plate ** color is the plate
blue pot	Saucey ** color is saucey
grey paper	Color is blue
black star	Star ** (n.r.)
orange heart	Heart ** heart is blue

[a] Double asterisks indicate that at this point, the experimenter used the probe question: "But what color is it?"

[b] (n.r.) indicates that the child failed to respond to the probe question.

TABLE II

Responses to "same color" questions

	+color responses	-color responses
advanced namers	56	16
beginners	6	21

TABLE III

Responses to questions about incorrectly-references color terms

	+color responses	-color responses
advanced namers	11	2
beginners	6	17