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Pictures and Names: Making the Connection

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In order to identify an object sensory input must somehow access stored information. A series of results supports two general assertions about this process: First, objects are identified first at a particular level of abstraction which is neither the most general nor the most specific possible. Time to provide names more general than "entry point" names is predicted by the degree of association between the "entry point" concept and the required name, not by perceptual factors. In contrast, providing more specific names than that corresponding to the "entry point" concept does require more detailed perceptual analysis. Second, the particular entry point for a given object covaries with its typicality, which affects whether or not the object will be identified at the "basic" level. Atypical objects have their entry point at a level subordinate to the basic level. The generality and usefulness of the notion of "basic level" is discussed in the face of these results.

The apparent ease with which people identify common objects belies the subtlety and complexity of the operations and structures involved in

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such identifications. Somehow, a visual stimulus must be consistently mapped into a single (or small set) of representations in memory. This mapping is dependent on both perceptual factors (such as an object's shape) and cognitive factors (such as context—see Biederman, 1972; Biederman, Glass, & Stacy, 1973; Palmer, 1975). The identification of objects stands at the interface between perception and semantic memory, and hence an understanding of perceptual identification will place broad constraints on more general aspects of human cognition.

There is a substantial body of research suggesting that objects are identified first at a particular level of abstraction. For example, an apple is named or matched with the name "apple" faster than with "Delicious apple" or with "fruit" (Brownell, 1978; Hutcheon, 1970; Rosch, Mervis, Gray, Johnson, & Boyes-Braem, 1976; Segui & Fraisse, 1968; Smith, Balzano, & Walker, 1978). This line of thinking has been elegantly studied by Rosch and her colleagues and has led to the concept of "basic level" (Rosch et al., 1976; Rosch, 1978).

The basic level was defined empirically by Rosch et al. (1976) by the convergence of four experimental procedures. First, subjects were asked to list as many attributes and properties of verbally specified categories (such as bird, robin) as they could think of during a brief period of time (between 1 and 2 min). More people list the same attributes (called common attributes) for different objects belonging to the same basic-level concept than for objects belonging to more abstract concepts. Second, subjects were asked to describe motor behaviors they would emit in the presence of specific objects. More common motor behaviors were listed for basic-level categories than for categories at other levels. Third, objects belonging to the same basic-level category have a greater degree of shape overlap (when considering cannonical depictions) than do objects belonging to the same superordinate category but not the same basic-level category; and objects belonging to the same basic-level category do not have significantly less overlap than do objects belonging to the same subordinate-level category. And fourth, subjects were presented with drawings created by averaging the outlines of two shapes. The task consisted of naming the category to which the object belonged. Category membership could be identified from the average of the shapes of two members of a basic-level category as well as when averaging shapes from a subordinate-level category, but people were much worse at identifying category membership when the shapes were drawn from different basic-level categories belonging to a given superordinate category. For example, people easily recognized the outline shape created by averaging a Golden Delicious apple and a MacIntosh apple as an apple and with equal ease recognized the outline formed by averaging two different MacIntosh apples. However, people had difficulty in identifying the average of an apple and of a banana as a member of the category fruit. All four experimental procedures converged in implicating a particular level of abstraction, which was called the "basic level." In the experiments we present in this paper we explore the role of the basic level and the role of typicality in determining the level of abstraction at which objects are identified.

There are several empirical findings that demonstrate that people can name objects or match names with pictures faster at the basic level than at other levels (Brownell, 1978; Hutcheon, 1970; Rosch et al., 1976; Segui & Fraisse, 1968; Smith et al., 1978). One interpretation of these results is that objects are first identified at the basic level, and that this initial identification causes speedy naming and matching at this level. The basic-level advantage has been found also when using artificial tool-like objects paired with arbitrary names (Murphy & Smith, 1982). This evidence suggests that the effects associated with basic level concepts were not confounded by factors such as word frequency, conjoint frequency of pictures and names, order of learning (i.e., whether one learns the basic-level name first or later, see Anglin, 1977), or by the length of the names at the different levels, which could have explained earlier results. Despite the ample demonstrations of the effects and importance of the basic level, there have been no experiments specifically designed to study the processing responsible for the basic-level advantage. Little is known about how objects are identified at this level or at more specific or more general levels.

EXPERIMENT 1

If people really do identify objects first at the basic level, how is superordinate-level identification achieved? Two straightforward possibilities immediately come to mind. The first involves a process of "semantic mediation": Objects are first identified at the basic level, and then are categorized into superordinate classes using information in semantic memory. A second possible mechanism involves no semantic mediation. Rather, identification at the basic level and at the superordinate level proceed by "purely perceptual processes," but these processes are slower for superordinate-level concepts than for basic-level concepts.

Anderson and Reder (1974) suggested something like the "semantic-mediation" hypothesis for semantic decisions about category membership using words as input. Anderson and Reder (1974), using multiple regression techniques, provided evidence that subjects decide that an object does not belong to a specified class of objects by retrieving the superordinate concept to which the objects belong and comparing this concept with the one specified. In contrast, a model similar to the "purely perceptual" point of view has been proposed by Murphy and Smith (1982).

In their view, superordinate-level categorization is slower than basic-level categorization because superordinate concepts are more perceptually disjoint, and thus require more features to be extracted from the stimulus and matched to stored memory representations.

The two notions make different predictions about the necessity of activating the basic level when making superordinate-level decisions using pictures as input. On the semantic-mediation hypothesis, the activation of basic-level concepts is a necessary step to achieve superordinate-level categorization, whereas on the purely peceptual hypothesis, the basic level is normally activated first, but this activation is not necessary in order to achieve superordinate-level categorization.

On the face of things, it seems unlikely that people routinely identify objects directly at levels more abstract than the basic level. What set of perceptual attributes distinguishes fruits from vegetables, or vehicles from weapons? Furthermore, as Rosch et al. (1976) have shown, the basic level is the most abstract level at which people are able to form an integrated perceptual representation of a category. However, it is possible that people can match the incoming image with a disjoint set of visual features that together represent the superordinate category (perhaps by combining some representative exemplars). Thus, this process may allow one to access superordinate-level concepts directly without prior access of basic-level representations. Furthermore, because the set of features is disjoint (i.e., one set of features does not represent the whole category), more time would be required to make the match between the perceptual input and a superordinate concept. This would explain why more time is required to name an object using a superordinate name, or to make a positive match between an object and a superordinate word.

Consider a simple task: A person sees a written word or sees a picture, for example the word "apple" or a picture of an apple, and says the superordinate name corresponding to the word or picture (in this case, "fruit"). In order to say "fruit" when the word "apple" is presented, it seems that one must activate the concept corresponding to the word (i.e., the concept of "apple"). Then, one activates the appropriate superordinate via one's knowledge of class membership. Thus, when a word is to be categorized at a superordinate level, one cannot proceed directly from the word to the superordinate concept. Rather, processing proceeds via the activation of a concept associated with the word (which is at the basic level in our example), followed by a search of semantic memory.

The important issue here concerns the kind of processing involved when a picture must be named at a level superordinate to the basic level. Suppose that the time to provide a superordinate after reading a basic-level name is positively correlated with the time to name the corresponding picture using its superordinate-category name. This is exactly what we would expect if both tasks, naming the picture and providing the word's superordinate, involve the activation of the basic-level concept. Models positing direct perceptual access to superordinates do not make this prediction; in these models there is no a priori reason to expect that the processes invoked when the word "apple" is to be named "fruit" should have anything in common with the "direct perceptual processes" required to encode a picture of an apple as a member of the category "fruit." Thus, if there is a positive correlation between naming a picture and naming a word at a level superordinate to the basic level, we will have evidence that the process of naming a picture at the superordinate level involves the activation of the basic level followed by a search of semantic memory.

Method

Subjects

Eight Harvard undergraduates, all native speakers of English, volunteered to participate as paid subjects. No subject in this experiment participated in any other experiment reported in this paper.

Materials

The stimuli were 24 slides (35 mm) of watercolor pictures drawn by a professional artist. The pictures consisted of six exemplars from four categories. The four categories were fruit, vegetable, clothing, and furniture. According to earlier research these categories are at the superordinate level and their members are at the basic level (Rosch et al., 1976; Smith et al., 1978). For each category, three exemplars were typical and three exemplars were atypical members of the category. Typicality was determined by mean ratings obtained in a prior ratings experiment. A list of 28 words that included the basic-level names of the objects and the four category names was also used. The names of the exemplars used are included in Appendix 1. Two different random orders of these items were prepared. Four additional words and pictures were used in practice trials.

Procedure

Subjects were first familiarized with the four category names and with the six exemplar names associated with each category. Subjects heard the complete list of names and attempted to recall it after each of two successive presentations. After the second recall attempt, the experimenter read any words on the list that were omitted by the subject on the final trial. Every subject performed every one of four subtasks, as quickly as possible while keeping errors to a minimum. These subtasks were (1) reading a word presented on a cathode ray tube, (2) saying the superordinate name of a word presented on a cathode ray tube, (3) naming a picture using a basic-level name, and (4) naming a picture using a superordinate-level name.

For half the subjects, the first two tasks were those involving words, whereas for the other subjects the first two tasks were those involving pictures. The order of the different word-naming and picture-naming tasks was counterbalanced within each of these groups. The two word-naming and picture-naming blocks used two different random orderings of the complete set of stimuli. These orders were counterbalanced with the order in which the subjects performed the various subtasks. Every subject performed the entire sequence of

TABLE 1
Correlation Matrix for Naming Times in the Four Tasks of Experiment 1

	W_{basic}	W_{super}	P_{basic}	P_{super}
W_{basic}	1	−.08	.34**	−.04
W_{super}		1	−.04	.52**
P_{basic}			1	.14*
P_{super}				1

Note. The cases in the correlation are the means of the four replications of a task for each subject (8), item (24), and condition. Thus, there were 192 cases (8 × 24). W_{basic} = name a word at the basic level (reading); W_{super} = name a word at the superordinate level; P_{basic} = name a picture at the basic level; P_{super} = name a picture at the superordinate level (* = .05, ** = .0001, two tailed). N = 192; all subjects and all four categories are presented.

four tasks a total of four times. The subjects were randomly assigned to counterbalancing conditions that differed in the order in which the four subtasks were performed. Each new task was preceded by a set of four practice trials.

Reaction time for each verbal response was measured from the onset of the stimulus to the onset of the verbal response, by means of a voice-activated relay. Once a block of trials was initiated, the interstimulus interval was 2 sec. The entire experiment required approximately 45 min per subject.

Results

Average verbal reaction times for each naming task and item (pooled over the four replications of each task) were computed for each subject. As a correction for obvious outliers, reaction times greater than twice the mean of the other replications were discarded, which resulted in the loss of less than 1% of the observations. When an observation was discarded a mean based on the remaining replications for that item, condition, and that subject was substituted for the rejected value.

The mean picture-naming time at the basic level was 736 msec (SE = 8.9), while it was 895 msec (SE = 12.9) at the superordinate level, $t(190) = 10.98$, $p < .0001$. This result replicates the finding that pictures are named faster at the basic level than at the superordinate level, and supports the claim that these objects are identified first at the basic level. The mean word naming time (i.e., reading) was 493 msec (SE = 4.2) at the basic level and 921 msec (SE = 11.9) at the superordinate level, $t(190) = 33.10$, $p < .0001$.

The correlations between the naming latencies for corresponding items in the four experimental tasks are presented in Table 1 (the individual cases going into these correlations are means over replications for different items in each task for each subject). As is evident in Table 1, the correlation between naming a picture at the category level and naming a written word at the category level is positive and highly significant.

TABLE 2
Correlation Matrices for Naming Times in the Four Naming Tasks in Experiment 1

	W_{basic}	W_{super}	P_{basic}	P_{super}
Fruit				
W_{basic}	1	−.09	.21	−.05
W_{super}		1	.34*	.57****
P_{basic}			1	.16
P_{super}				1
Clothing				
W_{basic}	1	−.18	.42**	−.05
W_{super}		1	−.20	.43**
P_{basic}			1	−.01
P_{super}				1
Vegetable				
W_{basic}	1	.01	.22	.01
W_{super}		1	.01	.57****
P_{basic}			1	.22
P_{super}				1
Furniture				
W_{basic}	1	−.19	.52****	−.07
W_{super}		1	−.08	.49***
P_{basic}			1	.20
P_{super}				1

Note. The cases going into the correlations are the mean times (over the four replications in each task) for subjects and items, within each of the four superordinate categories. Thus, there were 48 cases in each correlation (six items per category for each of eight subjects). W_{basic}, W_{super}, P_{basic}, & P_{super} have the same meaning as in Table 1 (* = .02, ** = .003, *** = .001, **** = .0001, two tailed). $N = 48$ for each category.

A correlational analysis was also performed on the data from each category considered separately. The main reason for this analysis is to eliminate the possibility that the observed correlations listed in Table 1 were due to response factors. That is, due to differences in the time to say the actual words in the different categories. In the data from a given category, the same name was the correct response (at the superordinate level) for all stimuli in the category. Thus, there should be no systematic variance associated with response factors in the data from a given category. The correlational results for each of the four categories are presented in Table 2. Again, in each of the categories, the correlation between naming a picture with a superordinate name and naming a word with the same superordinate name was positive and significant.

Separate correlations were computed for data from individual subjects using all the items. For every subject the correlation between word and picture superordinate naming was significantly greater than zero. This result demonstrates generality over subjects.

As a further precaution against possible artifacts produced by pooling, we computed 32 separate correlations between mean superordinate naming time for words and pictures using the data from each subject and each category. Six cases went into each correlation. Of these 32 correlations 25 were positive and 7 were negative ($p < .001$, by sign test), indicating that the positive correlations shown in Tables 1 and 2 are not an artifact of our pooling data over subjects or over response categories.

The correlation between reading a word and naming the corresponding picture using the same word was also significant in most cases (see Tables 1 and 2). These correlations are probably due to response factors, given that different responses were given to the different items when they were named at the basic level. In the aggregated data (Table 1) the correlation between the time to name a picture at the basic level and the time to name it at the superordinate level was marginally significant. This relation is not surprising if basic-level concepts must be activated in both cases. However, due to quite different semantic-memory and motor-output requirements in the two cases, the correlation is quite small. Only one other correlation of the 24 presented in Table 2 reached a significant magnitude: the correlation between the time to say the superordinate name of a written word and the time to name a picture at the basic level, for the category fruit. However, this result may well be due to chance given that this correlation was obtained in only one of the four categories, and it will not be discussed further.

Discussion

The results were as expected if two steps are required to identify visually presented objects as members of categories superordinate to the basic level: First, the basic-level concept is activated, and then one proceeds to search semantic memory—just as one would if the basic-level concept had been activated by a word. The significant positive correlations between naming pictures and words at the superordinate level suggest that the same processes are used to name words and pictures at the category level. For words, it seems virtually impossible to verbalize the category name without first reading the word itself and activating the concept associated with the word (which was the basic-level concept for the corresponding picture). Thus, it seems that the only reasonable explanation of our correlations between word and picture naming at the superordinate level is that pictures also required the activation of the basic-level concept before they could be named at this level. Also, the primacy of basic-level activation is supported by the shorter naming times at this level than at the superordinate level.

Our correlations are not an artifact of aggregating data from different subjects or from different response categories. First, if aggregating over subjects caused our correlations, then we would expect not just three significant positive correlations in Table 1; rather, all six would be positive and significant. Clearly this is not so. Also, correlations computed for each subject were significant in every case. Thus, we can be confident that the correlations are not due to some subjects responding quickly to all stimuli and other subjects responding more slowly to all stimuli. Another possible artifact could result from the fact that four different superordinate-level words were used in the experiment. Thus, if preparing to say and saying some of these words is slower than for some other words, then we would observe positive correlations between naming a word and the corresponding picture. However, this counterinterpretation does not apply to analyses performed on data from separate categories. In these data, the superordinate name was the same for all superordinate responses and thus could not contribute to the correlation. Finally, correlations computed on data for each category using data from each subject separately also showed a positive relation between superordinate naming for words and pictures. Thus, we can be confident that the observed relations are not due to aggregating artifacts.

Data from an experiment by Potter and Faulconer (1975) provide additional evidence that our correlations are not confined to our particular stimuli or subjects. Their subjects named 96 pictures and words using basic-level words. The correlation between the time to name each item using a word or a picture as input was .25 ($p < .02$, two tail), which is similar in magnitude to the correlation in this experiment (.34). In the same experiment, subjects also named the items using superordinate-level names (these results were not published in the original report),[1] and the correlation was .51 ($p < .0001$, two tail), which is also very similar in magnitude to the correlation in this experiment (.52).

Potter and Faulconer (1975) also report data in which subjects were provided with the name of a superordinate category before the presentation of one of their 96 pictures or one of the 96 corresponding basic-level words. The task consisted of pressing one button, as rapidly as possible, if the picture or word designated an object belonging to the category, and of pressing another button if the object did not belong to the category. In this task the correlation between picture and word superordinate categorization was much smaller than in the naming experiment, $r = .19$, $p > .06$, two tail, when the picture or word belonged to the category. Also, the correlation was near zero when the picture or word did not belong to the category, $r = .11$, $p > .28$, two tail. Thus,

[1] We thank Molly Potter for providing us with these results.

Potter and Faulconer obtained a correlation between pictures and words in the time to provide a superordinate category name, but not in the time to match a picture and a word to a superordinate category.

At first blush, these data could appear damaging to the notion that the correlation between picture and word categorization times in the *naming* case is due to the common activation of a basic-level concept followed by a search of long-term memory. If so, why should the correlation become so small or vanish when superordinate *matching* is required? The answer stems from the fact that subjects can prepare for particular exemplars when matching is involved, but they cannot prepare in the naming paradigm. When the category label is given before presenting a picture, subjects presumably can activate or prime the exemplars of the category (and/or their names—see Collins & Loftus, 1975). Upon seeing the picture (or the word), a match at the level of primed exemplars (or names) may often be sufficient to initiate a response. Thus, we would expect a reduced correlation (or no correlation) because the semantic-memory search may only occur on a fraction of the trials, and perhaps not at all.

The fact that the time to name a picture and the corresponding word at the superordinate level share a significant amount of variance strongly suggests that common mechanisms are involved in the two cases. Why then is the correlation not larger? A simple answer to this question is that the encoding processes for these two tasks are quite different. There is no reason to expect that the time to read a word and the time to encode the corresponding picture would have much in common. However, these processes should take some time to execute and contribute to the variance in the naming data, and thus attenuate the correlation between picture and word naming times.

EXPERIMENT 2

The results of Experiment 1 suggest that superordinate-level categorization of objects occurs after the necessary activation of its corresponding basic-level concept. Furthermore, we argued that the activation of the superordinate concept proceeds via semantic memory. In this experiment we provide further evidence for these claims and we examine how people identify objects as members of categories subordinate to the basic level.

On logical grounds, the semantic-memory search mechanism used for superordinate-level categorization cannot underlie how we identify members of superordinate-level concepts. Consider again the superordinate case. Suppose we have identified an object at the basic level and that we need a more general characterization. For example, we may know that an object is an apple but we wonder if it is a fruit. This decision can be made without the need for further perceptual analysis—one can infer the superordinate category name using only semantic information. In contrast, suppose that we have identified an object as a bird, but we wish to know if it is a robin. In this case we cannot unambiguously infer which of the several possible subordinates may have activated the basic-level concept. Thus, more information is required before one can decide whether the bird is a robin.

Rosch et al. (1976) suggested that basic-level concepts are activated faster than subordinate concepts because they are more perceptually distinctive (see also Seymour, 1973). On this view basic-level concepts have associated shapes that are quite different compared to that of other basic-level concepts, and thus are easy to discriminate. Subordinate concepts have more similar shapes and thus would be activated after a search for distinguishing features. Murphy and Smith (1982) suggest similar process but do not assume that basic concepts are privileged in any way with respect to subordinate concepts. In their *preparation model,* categorization at the basic level and at the subordinate level uses identical processes. However, subordinate categorization requires the extraction of additional features and results in longer response times (categorizing an object as a Delicious apple, for example, requires all the features of apple and then some). Current explanations of the superiority of categorization at the basic level over categorization at the subordinate level agree that the advantage results from the need for additional perceptual processing when categorizing object at levels subordinate to the basic level. However, there have been no experiments showing directly that additional perceptual processing is required for subordinate-level categorization. The purpose of this experiment is to demonstrate the presence of additional perceptual processes when people decide that an object belongs to a subordinate-level concept compared to decisions about category membership in a basic-level category. Also, we wish to provide converging evidence that assigning membership into superordinate-level categories does not involve additional perceptual processing, but rather proceeds via stored semantic information.

In this experiment subjects had either a relatively long period of time (the long-exposure condition) or only a short period of time (the short-exposure condition) to encode a picture. This difference in exposure duration was intended to create two conditions that differed in level of perceptual difficulty. Thus, differences in performance between the two conditions would be diagnostic of the involvement of perceptual processes. The task required subjects to decide whether a word named a picture seen previously. The word to be matched was either subordinate, at the same level as, or superordinate to the basic-level concept of the picture.

In the long-exposure condition we expected longer verification times whenever the word was at a level other than the basic level. Such results would provide a straightforward replication of the basic-level advantage. However, we expect the exposure time to have different effects on categorization at different levels. If additional perceptual processing is necessary for subordinate-level categorization, then verification should be more difficult when a subordinate name is used in the short-exposure condition than in the long-exposure condition. In the short-exposure condition the brief exposure of the picture should make it more difficult to extract the additional perceptual information required to categorize the object more specifically than at the basic level. Thus, subjects should make more errors and take more time to make their decisions.

In contrast to the large expected effect of exposure duration on subordinate-level categorization, the effects on superordinate-level categorization should be much smaller. Suppose that the activation of concepts superordinate to the basic level proceeds by activating the basic-level concept, and then solely via semantic memory, as suggested in Experiment 1. Then, the exposure duration of the picture should have little or no effect on the difference in the time to verify words that match the basic-level concept and the time to verify words that match the superordinate-level concept of the picture. If, on the other hand, perceptual processing is involved in superordinate categorization, then we expect to observe an effect of the degree of perceptual difficulty. If the results show an effect of exposure duration for subordinate concepts and no effect for superordinate concepts, we will have strong converging evidence that pictures are spontaneously identified first at a particular level of abstraction in memory. Furthermore, we will have additional evidence for the notion that superordinate concepts are activated via semantic memory rather than via slow "direct" perceptual processes.

Method

Subjects

Sixteen volunteer Harvard University summer school students and local high school students participated as paid subjects. All were native speakers of English and no subject in this experiment participated in any other experiment reported in this paper.

Materials

Twenty-four pictures were used in this experiment. Half of these picture were the 12 typical basic-level objects used in Experiment 1. The other half were 12 new typical objects; these were three member of the categories "bird," "boat," "car," and "dog" (see Appendix 1 for a complete list of the items). Note that the four new category names are at the basic level and that the item names for these categories are at the subordinate level, whereas for the four old categories (used in Experiment 1) the category names are at the superordinate level and the item names are at the basic level. In this paper, we will call the new categories Basic High categories and we will call the old categories Basic Low categories. Basic High categories are tested at the subordinate level and at the basic level and Basic Low categories are tested at the basic level and at the superordinate level. Thus, by comparing performance between these two sets of categories we can look at differences between basic and superordinate categorization (using the categories used in Experiment 1; i.e., Basic Low categories), and we can also look at differences between basic and subordinate categorization (using the four new categories; i.e., Basic High categories).

Procedure

Subjects saw a picture and 1 sec later they heard a word. The task was to decide whether the word correctly named the picture (at any level of categorization). If subjects heard a word that correctly named the picture they were to respond, as quickly as possible, by pressing the "true" key; otherwise they were to respond, as quickly as possible, by pressing the "false" key. Each picture was followed by a visual mask. The mask consisted of lines and patches of color drawn in watercolor (using the same tones as in the drawings of the stimulus objects) and lines drawn in felt-tip pen. The purpose of the mask was to eliminate afterimages or icons left by the presentation of the pictures and thus to terminate perceptual encoding of the pictures. The picture was in view for either 1000 msec (in the long-exposure condition) or 75 msec (in the short-exposure condition) before the onset of the mask, and the word was always presented 1000 msec after the onset of the picture. Subjects received eight practice trials before proceeding with the actual experiment.

Each of the 24 pictures was shown four times for a total of 96 trials. Of the 96 test trials, 48 were "true" and 48 were "false." In both the "true" and the "false" trials, 24 trials used exemplars from the categories "bird," "boat," "car," and "dog," and 24 trials used exemplars from "clothing," "fruit," "furniture," and "vegetable." All subjects saw the same sequence of 96 pictures; however, four different audio tapes of the words accompanied these pictures, allowing each individual picture to be paired once with a "true" or "false," exemplar or category word. For a given subject, each picture appeared either briefly on all four presentations (in the short-exposure condition), or for a long time on all four presentations (in the long-exposure condition). This constraint on presentation duration was to prevent a subject from using information about a picture garnered during a long-exposure presentation in a later trial involving only a brief presentation of the same picture. In each of the four tape sequences, half of the pictures were in the short-exposure condition and the other half were in the long-exposure condition. Two versions of the sequence were used for each tape, varying only in which pictures were presented at the two durations. Each picture occurred equally often in all eight different counterbalancing conditions in the experiment (two exposure durations, two word levels, and two truth values).

Two subjects were tested in each of the eight counterbalancing versions of the experiment. For each of the eight counterbalancing groups, one subject used his or her dominant hand for "true" responses and one used his or her dominant hand for "false" responses. The experiment was conducted in two consecutive blocks of 48 trials separated by a brief rest period.

Results

Reaction Times

The data from "true" trials were submitted to an analysis of variance in which we considered the effects of the level of the word (exemplar or category), type of category (categories with the basic level at the level of the items, Basic Low = "clothing," "fruit," "furniture," and "vegetables''; categories with the basic level at the level of the category name, ''Basic High'' = ''bird,'' ''boat,'' ''car,'' and ''dog''), exposure duration (75 or 1000 msec), subjects, and items.[2] (Exemplar names were at the subordinate level for Basic Low categories and at the basic level for Basic High categories.)

The mean verification time and percent error rate (in parentheses) for each condition are illustrated in Fig. 1. As can be seen in Fig. 1, we replicated the basic-level advantage reported in the literature while using a different paradigm than previously used (i.e., picture followed by a word): More time was required when the level of the word did not correspond to the level of the basic name of the picture, $F(1,15) = 60.0$, $p < .001$. However, this interaction between the level of the word and the level of the basic name was mitigated by the amount of time the picture was exposed. The interaction was exactly as predicted by the notion that additional perceptual information is necessary to activate the appropriate subordinate concept once an object has been identified at the basic level: When a short exposure duration was used, it was especially difficult to evaluate names subordinate to the basic level. This pattern of means resulted in a significant three-way interaction between word level, type of category (Basic High/Basic Low), and exposure duration, $F(1,15) = 12.6$, $p < .005$.

This pattern of times contributed to various other significant differences when the data contributing to the means illustrated in Fig. 1 were pooled. First, less time was required in Basic Low categories than in Basic High categories, $F(1,15) = 20.8$, $p < .001$. Second, responses were slower with exemplar-level words than with category-level words, $F(1,15) = 5.16$, $p < .05$. Third, responses were slower for categories with the basic level at the category level (Basic High), but this difference was greater in the short-exposure condition than in the long-exposure condition, $F(1,15) = 6.5$, $p < .05$. And fourth, although response times were about equal for exemplar and category level words in the long-exposure condition, responses for exemplar-level words were longer than for category-level words in the short-exposure conditon, $F(1,15) = 17.0$, $p < .001$.

In addition, to ensure that our results were not confined to only a few of our stimuli, we performed separate analyses on each of the items in

[2] In the analysis reported here, times from trials in which errors were committed were replaced by the mean of the other data points in its cell for that subject. Some concern may arise from this procedure because of the very high error rate in the short-exposure condition. For this reason we also performed an unweighted means analysis of variance in which we considered subjects, exposure duration, type of category, and level of word as factors. The results were identical in all important respects to those reported here. In particular, none of the probability values in the reported analysis need to be changed in light of the unweighted means analysis.

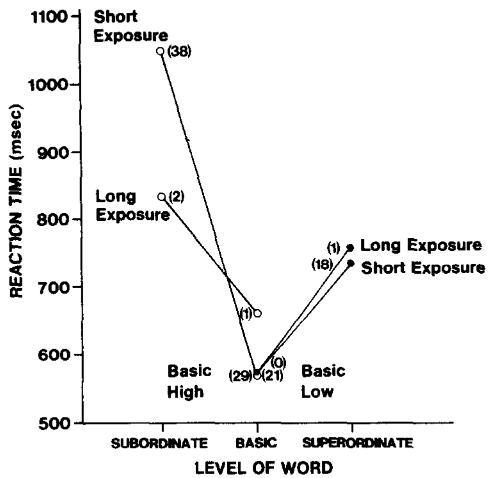

FIG. 1. Mean reaction time and percent error (in parentheses) in each condition of Experiment 2.

the experiment. First, consider the categories in which categorization was required at the basic level and at the superordinate level (Basic Low categories; fruit, vegetable, clothing, and furniture). Of these 12 items 11 required more time for superordinate verification than for basic verification, as expected, $p < .0032$ by sign test. Furthermore, for 11 of the items, the difference between basic and superordinate verification did not change depending on the exposure duration of the picture, $p < .0032$ by sign test. The story is quite different, however, when we consider items requiring basic and subordinate verification (Basic High categories; bird, dog, car, and boat). For all of these items, basic-level verification was faster than subordinate-level verification, $p < .0003$ by sign test. In addition, the magnitude of the difference between mean-subordinate-level and mean-basic-level categorization time was larger in the short-exposure condition than in the long-exposure condition for all items except one, $p < .0032$ by sign test. Thus, the aggregated data presented in Fig. 1 are not the results of only a few unusual items; rather, they represent an effect that seems quite general over the stimuli we used.

Errors

The error rates associated with each condition (see Fig. 1) were compared with their respective mean response times. In the comparisons of interest there were no speed–accuracy trade-offs, with the exception of one case: pictures from Basic Low categories matched with either basic-level or superordinate-level words in the short-exposure condition. In this case, there is a small tendency for the error rate to decrease as mean response time increases. However, the difference in error rates was relatively small (21 versus 18%), and the difference did not even approach statistical significance, $\chi^2(1) = 1.50$, $p > .20$. Furthermore, on a speed–accuracy trade-off interpretation of this difference, the interaction for Basic Low categories and exposure duration would be in the direction opposite that for Basic High categories. Therefore, the observed interaction between exposure duration, name level, and basic level of the category would be even greater than currently observed. Thus, there was no indication that the results were due to speed–accuracy trade-offs.

Discussion

The results were exactly as expected if objects are identified first at the basic level and concepts subordinate to the basic level are activated only after additional perceptual processing. When subjects are asked to verify a word subordinate to the basic-level concept, reaction times were much longer when the perceptual task was more difficult than when the task was easier. This strong interaction implies that the identification of objects at levels subordinate to the basic level requires perceptual information that is not necessary for the identification of the object as a member of a basic-level category. Thus, people do not immediately identify objects at the most specific level possible. Rather, objects are identified first at the basic-level and more specific identifications are made only later, via additional perceptual processing.

When verification requires the activation of a concept that is superordinate to the basic-level, no additional perceptual processing is logically necessary. And, in fact, no additional perceptual processing occurs: The degree of difficulty of the perceptual task had no effect on the time difference between verifying a basic-level and a superordinate-level word with a picture (see the response times for Basic Low categories in Fig. 1). If the difference in time between verifying a basic-level and a superordinate-level name was due to additional perceptual processing, we should have observed the effect of the difficulty of the perceptual task as we did in the case when the nonbasic word was a subordinate. This result supports the notion that at least part of the basic-level advantage over superordinate terms is due to an effect of subjects' cognitive structure. Superordinate-level categorization appears to be mediated by the prior identification of objects at the basic level, rather than by a slow perceptual feature-matching process.

EXPERIMENT 3

The previous results provide additional evidence for the advantage of the "basic level" of categorization and implicate specific processing mechanisms to account for the advantage. In the next two experiments, as in the first two, we are concerned with the notion that objects make contact with long-term memory at one particular level of abstraction. However, we wish to question the generality of the basic-level advantage. Although objects may make contact with semantic memory first at one particular level, perhaps this level is not always the basic level. Intuition suggests that atypical exemplars of a basic-level category are not identified first at the basic level, but rather are identified first at the subordinate level. For example, a picture of a penguin is probably identified as a penguin before it is identified as a bird. If so, the hypothesis that objects are identified first at the basic level is not a general characterization. This possibility, discussed by Rosch et al. (1976) and by Brownell (1978), has never been tested directly. We believe that the possibility that many objects may not have their entry point to semantic memory at the basic level has far-reaching implications for the usefulness of the concept of basic level (almost any natural category one can think of has a large proportion of atypical members). These implications are discussed in the General Discussion.

Several labels can be used to name any one object. One interesting way in which labels can vary is in the level of abstraction at which they categorize an object. For example, an apple can be called "apple" or "fruit." If people initially identify objects at a single level of abstraction in memory, as suggested by the results of the first two experiments, and this level also is associated with a name, then we would expect people to use this name rather than names at other levels when asked to name objects. In fact, Segui and Fraisse (1968), among others, found that subjects tend to use basic-level names most often when naming objects. This result makes good sense if people name objects with the name most closely associated with the first level of abstraction that is activated, and if this level is the basic level.

By this logic, if some objects are identified first at the subordinate level, then we would expect subjects to have a tendency to name the objects with subordinate names rather than with basic names. In the following experiment we simply asked subjects to name pictures of objects as quickly as possible. The objects belonged to different categories and differed in how typical they were of these categories. Furthermore, the categories differed in the level of abstraction of the basic level with respect to the usual exemplar names of the objects. For half the categories, the names of exemplars in the category corresponded with the level identified by Rosch et al. (1976) as the basic level (clothing, fruit, furniture, and vegetable; see Appendix 1 for a complete list of the items). For example, the category "fruit" has members such as apple, orange, etc. The basic level for these objects is at the level of each exemplar in the category (i.e., apple and other fruits are their own basic levels). The other half of the categories had the basic level at the level of the category name rather than at the level of the exemplars (bird, boat, car, and dog; see Appendix 1). For example, the category "bird" has its basic level at this level, and exemplars of the category "bird" are subordinate to the basic level. If atypical exemplars of basic-level categories are identified first at the subordinate level rather than at the basic level, then more subordinate-level names should be used for these objects than basic-level names.

Method

Subjects

Eighteen Harvard undergraduates participated in the experiment as paid volunteers. Half were female and half were male. All subjects were native speakers of English, and no subject in this experiment participated in any other experiment in this paper.

Materials

As in Experiments 1 and 2, the stimuli were 35-mm slides of watercolor pictures drawn by a professional artist. The pictures consisted of six exemplars from eight categories. Four of the eight categories were tested at the subordinate level and at the basic level (Basic High categories: bird, car, boat, and dog), whereas the other four categories were tested at the basic level and at the superordinate level (Basic Low categories: fruit, vegetable, clothing, and furniture). For each category three exemplars were typical and three exemplars were atypical members of the category. Typicality was determined by subject ratings in a prior experiment. The complete list of stimuli is given in Appendix 1.

Procedure

The pictures were randomly ordered with the constraint that consecutive pictures were always exemplars of different categories. Each picture was shown to the subject on a rear projection screen and subtended about 25° of visual angle. The subject's task was to name the picture as rapidly as possible using any appropriate name. Naming latency was measured and recorded by a microcomputer, with timing beginning with the opening of a high-speed shutter and terminating with the closing of a voice-activated relay triggered by the onset of the subject's verbal response. Each picture remained in view until the subject's response. A new picture appeared 5 sec after the last response. Half the subjects saw the pictures in one order and half in the reverse order.

Special care was taken to instruct subjects to use the first name that came to mind. They were told that a single picture could have more than one "correct" name; for example, they were told: A rose could be named "rose" or "flower." It was emphasized that the experiment was not a test of their knowledge of the specific names of the pictures. Rather, we simply wanted the first name that was evoked by a given picture, and the same name could be used for more than one picture.

Results

The level of the names used and the naming latencies were analyzed separately.

Level of Abstraction of Names

The most important results concern the level of abstraction of the names used by subjects for typical and atypical exemplars of Basic High

TABLE 3
Frequency and Percentage (in Parentheses) of Names at the Basic Level, and at Levels Subordinate and Superordinate to the Basic Level in Experiment 3

	Type of picture			
	Basic Low		Basic High	
	Typ	Atyp	Typ	Atyp
Superordinate names	1 (.5)	0 (0)	0 (0)	0 (0)
Basic names	202 (94)	163 (75)	150 (69)	88 (41)
Subordinate names	0 (0)	0 (0)	53 (25)	113 (52)

Note. The percentages in the various columns do not add to 100% because of errors.

and Basic Low categories. Table 3 displays the count and percentage of trials (aggregated over subjects and items) in which basic-level names, names more general (superordinate), and more specific (subordinate) than basic-level names were used. The percentages in each column do not add to 100% because of errors.[3]

The proportions shown in Table 3 vary significantly from column to column, $\chi^2(3) = 245, p < .0001$. ($\chi^2$ was computed only on the bottom two rows of Table 3 given that there were virtually no superordinate-level responses.) As is evident in Table 3, the largest contribution to χ^2 comes from the large number of names below the basic level used for atypical exemplars of Basic High categories. To test this hypothesis a new χ^2 was computed just on the data from Basic High categories. This χ^2 was also highly significant, showing that typical and atypical exemplars elicited names at different levels, $\chi^2(1) = 38, p < .0001$.

More detailed analyses were performed on individual items to assess the generality of our results. For all the items in the Basic Low categories (fruit, vegetable, clothing, and furniture) more subjects used basic names than superordinate names (in fact, only one superordinate response occurred in the whole experiment). For typical items in Basic High categories (bird, car, boat, and dog), more subjects used basic names than

[3] Errors were few in most conditions and usually resulted from a hasty decision on the part of the subject. In the Basic Low atypical condition, however, there were many more errors than in the other conditions, as can be seen in Table 3. A closer inspection of the data showed that 53% of the errors in this condition were due to only two items, which people had difficulty in identifying as a result of the particular drawings we used (these items were coconut and avocado). However, these items were not as problematic in order experiments.

subordinate names for 10 of the 12 items (the 2 deviant items were sailboat and Volkswagen). In contrast, for atypical items in Basic High categories, more subjects used subordinate names for 7 of the 12 items, whereas the opposite pattern was found for the remaining 5 items. Thus, there is a shift in the preferred level over items (2:10 for typical items, and 7:5 for atypical items, $\chi^2(1) = 4.44$, $p < .035$). The atypical items for which more subjects preferred the basic level were dachshund, Rolls Royce, afghan, tugboat, and Porche; those for which subjects preferred the subordinate level were penguin, jeep, submarine, raft, ostrich, poodle, and peacock. At first glance, it appears that the items for which subjects did not use subordinate names were those for which many subjects may not have known the more specific names.

The data from individual subjects were also analyzed separately. All subjects preferred basic names over superordinates in Basic Low categories for both typical and atypical items, $p < .0001$ by sign test. For Basic High categories, 16 subjects showed the shift in ratio, observed in the aggregated data, of basic to subordinate names from typical to atypical items, whereas only 2 showed the opposite pattern, $p < .0007$ by sign test. Thus, we can be confident that our results are not due to a few subjects' data, but represent a general tendency exhibited by most people.

Naming Latencies

We also examined the naming latencies for the cases in which the pictures were named at the most common naming level (i.e., at the basic level for Basic Low categories, at the basic level for typical members of Basic High categories, and at the subordinate level for atypical members of Basic High categories). The mean naming latency was 985 and 1104 msec for typical and atypical Basic Low items, respectively; and the mean latency was 1018 and 1171 msec for typical and atypical Basic High items, respectively. An analysis of variance in which we considered subjects, category type (Basic Low/Basic High), categories, typicality, and items as factors revealed that typical exemplars took less time to name than atypical exemplars (1002 versus 1138 msec), $F(1,16) = 21.8$, $p < .001$; in all eight categories atypical objects required more time to be named than typicals. Typicality did not interact with the hierarchical position of the basic level (i.e., Basic High or Basic Low), $F < 1$, or with the particular categories themselves, $F(6,96) = 1.29$, $p > .1$. In addition, the analysis revealed that the naming times varied depending on the category to which an item belonged, $F(6,96) = 21.2$, $p < .0001$, and on the individual items, $F(32,512) = 5.69$, $p < .0001$. Naming times did not vary depending on whether categories were in the Basic High or the Basic

Low category groups, $F(1,16) = 2.88$, $p > .1$, nor were there any other significant factors in the analysis, $p > .1$ in all cases.

Discussion

Two important facts emerge from this experiment. First, for Basic High categories (bird, car, boat, and dog) subjects use basic names more often than subordinate names for typical exemplars, but they prefer to use subordinate names more often than basic names for atypical exemplars. This result is just as expected if atypical members of basic categories tend to be identified first at the subordinate level rather than at the basic level. Second, when typicality is defined with respect to a superordinate category, subjects prefer to use basic-level names; virtually all responses for objects in categories with the basic level at the exemplar level (fruit, vegetable, clothing, and furniture) were basic-level names, regardless of typicality.

Clearly, atypical exemplars are named differently than typical exemplars, but only for Basic High categories. This result may appear surprising at first. Why was there no effect of typicality on the level of naming for Basic Low categories? The answer is that typicality was always defined with respect to the most superordinate concept in the hierarchies we used. For Basic Low categories this resulted in typicality being defined at the superordinate level, whereas for Basic High categories typicality was defined at the basic level. It may not matter very much that a lime is an atypical fruit because there is a strong tendency to name the object "lime" to begin with (i.e., to name it at the basic level—the "limyness" of the lime will not depend on the fact the lime is an atypical fruit; similarly, the "birdyness" of a bird does not depend on whether bird is a typical animal or not). On the other hand, for Basic High categories, typicality was defined at the basic level. An atypical exemplar may be distinguished from the other members of the category, which results in a tendency to identify the object first at a subordinate level and thus to name the object at this level, as we found.[4] Had we

[4] While none of the names given to typical Basic Low exemplars were at the subordinate level, 25% of responses for typical Basic High exemplars were at the subordinate level. One may wonder if Basic Low and Basic High categories in our experiments are not somehow fundamentally different. We believe they are not. First, 43% of the 25% of subordinate responses given to typical Basic High items were due to only two items (sailboat and Volkswagen). This still leaves more responses at the subordinate level than that found for Basic Low categories. However, the "problem" may not be as severe as it first appears. Second, we used *lexical* typicality as a rough guide to determine which exemplars would be named at the basic level and which would be named at the subordinate level. Perhaps an index of *pictorial* typicality would have been better. In any case, the difference in results between the different category types seems to support further our central claim that the

used atypical instances of Basic Low categories with typicality defined with respect to the basic level (e.g., beanbag chair, crab apple), then we would have expected these atypical items also to be named at the subordinate level. This is in fact what one of us found in a separate experiment described in more detail in the General Discussion (see also Murphy & Brownell, 1983).

Although subjects in this experiment showed a strong tendency to use subordinate names for atypical exemplars of Basic High categories, there was also a sizable tendency to use basic names for some of these items (see Table 3). If atypical members of Basic High categories are first identified at the subordinate level, why are names at other levels used so often? One possibility is that the names of atypical objects may not be as easily retrieved as the names of typical objects. And, in fact, our analyses of naming latencies revealed that naming atypical objects took more time than naming typical objects for all categories. Perhaps the time required to retrieve the names of atypical objects was sufficiently long to allow the activation of related concepts. If the names of these other concepts were relatively easily retrieved, subjects may have used them, even though the subordinate-level concept was the first one to become activated (see Collins & Loftus, 1975). Thus, a subject may have named a picture of a dachshund a "dog," because the label "dachshund" takes so long to retrieve that the label "dog," which is retrievable only after a search of semantic memory, is nonetheless available as a suitable response before "dachshund." This account is consistent with a well-known finding in the literature on naming, namely that objects named with infrequent words take longer to name than objects named with frequent words (Oldfield & Wingfield, 1965; Wingfield, 1968). Despite this factor, subjects preferred, on average, to use subordinate names for atypical members of basic-level categories. In turn, this suggests that these objects are not identified first at the basic level. Rather, there is a tendency to identify these objects first at the subordinate level, and this issue is explored further in the following experiment.

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entry-point level differs for items within a given category. Finally, later experiments have required subjects to name and/or categorize objects at all three levels of abstraction (subordinate, basic, and superordinate) rather than at just two levels. These experiments have replicated our basic finding: Atypical exemplars tend to be named at the subordinate level more often than at other levels and they are categorized faster into subordinate categories than into basic or superordinate categories (see the General Discussion). Thus, the present findings were not a consequence of our particular choice of categories and of levels at which we tested items within these categories.

EXPERIMENT 4

This experiment is designed to provide more direct evidence that atypical exemplars of basic categories tend to be identified first at a level subordinate to the basic level. Subjects in Experiment 3 showed a tendency to name objects using subordinate names for atypical exemplars of basic categories. However, basic names rather than subordinate names were also used relatively frequently for atypical exemplars of Basic High categories, perhaps—as we speculated earlier—because of difficulty in retrieving the subordinate name of some atypical objects. In this experiment, we use another methodology to examine the claim that atypical objects have their entry point at the subordinate level rather than at the basic level.

If subordinate concepts are the first to be activated for atypical basic exemplars, then, *all else being equal,* these objects should be named faster with subordinate names than with basic names. In this experiment we asked people to name objects either with subordinate or basic names (for Basic High categories), and with basic or superordinate names (for Basic Low categories). There were two main motivations for the experiment. First, we wished to make all the names equally available as names qua names. A difference in the availability of the responses themselves for typical and atypical objects may have been a factor attenuating the effect of typicality on the level of naming in Experiment 3. To achieve a greater equality in the availability of the names, we familiarized subjects with all the names to be used in the naming task prior to every eight trials. Although differences in the availability of the names of typical and atypical objects could still exist after our familiarization procedure, this factor should play a much smaller role in the present experiment. Second, by instructing subjects to use names at all possible levels we will be able to determine which names are output fastest. This information could not be extracted from the reaction-time data of Experiment 3 because, in certain cases, subjects never used names other than basic names.

Segui and Fraisse (1968), Rosch et al. (1976), and Smith et al., (1978) asked subjects to name objects using either basic-level or non-basic-level names. Their subjects were faster when responding with basic rather than nonbasic names. Unfortunately none of these experiments included atypical members of basic categories (but see Brownell, 1978). Thus, their data cannot be used to determine whether atypical members are identified first at a level subordinate to the basic level. In this experiment we hoped to demonstrate a subordinate-level advantage for atypical "basic-level" objects.

Method

Subjects

Sixteen Harvard undergraduates, eight men and eight women, volunteered to be paid subjects. All were native speakers of English, and no subject had participated in any other experiment reported in this paper.

Materials

The same set of pictures used in Experiment 3 was used in this experiment.

Procedure

Subjects were informed that they would see pictures of common objects that would be presented in blocks of eight. Prior to each block the subjects memorized a list of exemplar names and a list of category names. Once both exemplar and category names were memorized, subjects were told which list to use to name the pictures about to be presented.

The name-memorization procedure was the same for naming blocks at the exemplar and the category levels except in the order in which the names were learned. In all cases, the last names to be learned were the ones used to name the pictures. Before each block of stimuli the experimenter read a list of exemplar names or category names of the eight objects the subject was about to see (exemplar names were subordinate-level names for Basic High categories and basic-level names for Basic Low categories, category names were basic-level names for Basic High categories and superordinate-level names for Basic Low categories, see Appendix 1). The subject then attempted to recall these names from memory. Following the subject's recall, the experimenter reread the list of names and the subject again attempted to recall them. This procedure was followed until all eight names were recalled correctly twice in a row. Once the first set of names (exemplar or category) was memorized, the subject was read the other list of names (exemplars if the first set named categories, and vice versa) and she/he was asked to recall them. After these names were recalled twice in a row correctly, the subject was given a 3-digit subtraction problem involving a carry of digits in order to flush short-term memory of the most recently recalled names. The subject then named eight pictures using one of the eight names he/she had just memorized. Naming latency was recorded as in Experiment 3.

Subjects were assigned to one of four groups differing in the order in which the blocks of pictures were presented and whether exemplar or category names were used on the first block. There were six blocks of eight pictures. Eight of the subjects saw blocks 1, 2, and 3 before blocks 4, 5, and 6; the other eight saw blocks 4, 5, and 6 before blocks 1, 2, and 3. Of the eight subjects who saw blocks 1, 2, and 3 first, four began by naming the items in the first block at the category level and four began by naming at the exemplar level. The subjects who saw blocks 4, 5, and 6 first were divided similarly into two groups of four subjects each. The level of naming alternated wtih every block. Thus, if a subject named the first block at the category level then he or she named the next block at the exemplar level, and then continued with the remaining four blocks alternating between naming blocks at the category level and naming blocks at the exemplar level. Consequently, all subjects named 24 pictures at the exemplar level and 24 at the category level. Each of the 48 pictures was named only once by a particular subject, either at the exemplar or at the category level. Which half of the pictures was named at each level was counterbalanced over subjects. Thus, overall, each picture was named equally often at the exemplar and at the category level. Four additional pictures were used in practice trials. Two of these pictures were named at the exemplar level and two were named at the category level prior to the beginning of the first experimental block.

Results

Naming Time

The naming time data from pairs of subjects with one member in each of the two counterbalancing groups were combined at random to form eight "super subjects." The data from these eight super subjects were then submitted to a repeated-measures analysis of variance in which we considered the effects of super subjects, naming level, the level of abstraction of the basic level, and the typicality of the pictured object in a fully crossed design. The mean naming time for each naming level, type of category, and degree of typicality is illustrated in Fig. 2. Figure 2 also displays, in parentheses, the percent error rate for each condition beside the corresponding response time.

The most striking aspect of the results is the fact that subjects were always faster when using a basic-level name, except for atypical exemplars of Basic High categories. In this case, subjects were faster when using a subordinate-level name than when using a basic-level name. This is just as we would expect if an object is identified first at the basic level, except when the object is an atypical exemplar of a basic-level category. The reverse effects of name level for atypical Basic High exemplars, as shown in Fig. 2, resulted in a three-way interaction between name level,

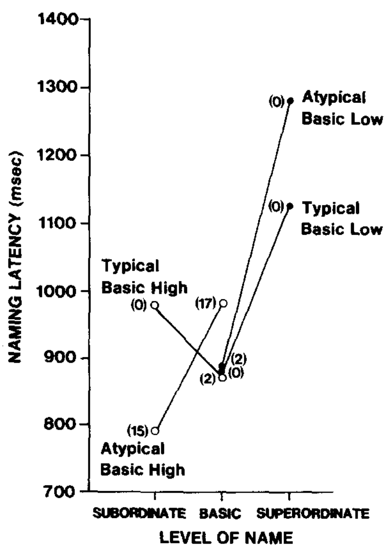

FIG. 2. Mean naming latency and percent error (in parentheses) in each condition of Experiment 4.

basic object level of the picture, and typicality of the pictured object, $F(1,7) = 9.01$, $p < .02$. There were many other significant effects in the general analysis of variance; however, they are not central for our purposes.[5]

Analyses for individual items supported the analysis on the aggregated data reported above. For Basic Low categories, all items were named faster at the basic level than at the superordinate level, $p < .0001$ by sign test. For Basic High categories, all atypical items except one were named faster using subordinate names than using basic names (the exception was Rolls Royce, only 55 msec in the unexpected direction), $p < .0032$ by sign test, which is strong confirmation that these objects are identified first at the subordinate level. For typical Basic High categories, nine exemplars were named faster at the basic level than at the subordinate level (the three items that deviated from this pattern were collie, sailboat, and rowboat), $p < .073$. This confirms that typical exemplars tend to be identified first at the basic level, and thus replicates earlier results in the literature.

The data from each super subject were also analyzed separately using items as a random factor. Every super subject showed the same pattern as in the aggregated data. For every super subject, the predicted pattern of means resulted in a statistically significant interaction between naming level, typicality, and the level of the basic level when tested with a contrast $F(1,32) > 17.0$, $p < .0003$ in all cases. These results attest to the robustness of the results and to their generality over subjects.

In our analysis of the results of Experiment 3 we interpreted a preference for names at a given level as evidence that this level tended to be activated first. We also expect that if a level is activated first, then names

[5] Exemplar-level names generally were used more quickly than category-level names, $F(1,7) = 39.7$, $p < .001$. Subjects also named pictures from Basic High categories faster than pictures from Basic Low categories, $F(1,7) = 40.5$, $p < .001$. However, these effects were not independent: As is apparent in Fig. 2, subjects were faster when using exemplar-level names when the stimuli were from Basic Low categories, but this difference was smaller for objects in Basic High categories, $F(1,7) = 65.6$, $p < .0001$. As is clear in Fig. 2, this effect is largely due to the fact that the atypical Basic High exemplars were named faster at the subordinate level. Although the typicality of the pictured object had no overall effect, $F < 1$, it did mitigate the effects of both name level and basic object level of the pictured object: For both typical and atypical objects, subjects were quicker when using exemplar-level names than category-level names, but this difference in naming speed with name level was more accentuated when the objects were atypical, $F(1,7) = 41.3$, $p < .001$. Also, atypical objects were named faster than typical objects if the basic object level was at the category level, whereas atypicals were named slower than typicals if the basic object level was at the exemplar level, $F(1,7) = 14.4$, $p < .01$, which seems to be a result of the effect of atypical Basic High items. All other effects in the analysis were not significant, $p > .20$ in all cases.

at that level should be output fastest. These hypotheses lead us to expect that if a particular level of name was preferred in Experiment 3, subjects in this experiment should be able to use names at that level faster than names at other levels. To verify this hypothesis we computed a correlation between results from the two experiments over the 24 items in Basic High categories, which are central to our arguments concerning the effects of typicality on the level of contact between visual objects and semantic memory. For each item we obtained the number of subjects using a subordinate-level name in Experiment 3 and the difference between the mean naming time at the basic level and the mean naming time at the subordinate level in Experiment 4. A positive difference between naming times indicates that subjects were faster when using subordinate-level names than basic-level names, which should correspond with a greater tendency to use subordinate names in Experiment 3—thus the expected correlation is positive. The correlation is .54, $F(1,22) = 8.99$, $p < .007$, indicating fair agreement between the two sets of results. It is likely that better agreement between the two experiments was not obtained because many subordinate names may not have been available in Experiment 3.[6]

Errors

In most conditions subjects made very few errors (see Fig. 2). However, as is evident in Fig. 2, there were many errors for Basic High atypical exemplars. Inspection of the data revealed that these errors were almost entirely due to two items (Porsche and tugboat accounted for 45% of all the errors in this condition—it appears subjects were not familiar with the appearance of these two items). Many of the errors in the Basic High, atypical, basic-level naming condition were caused by subjects

[6] Three additional experiments were conducted to control for possible counterexplanations of the main results. One experiment addressed the possibility that the typicality effect on response time was due to different degrees of discriminability of the exemplars used in the experiment. Subjects in this experiment made "same–different" judgments when presented with either identical pictures or pictures of different objects. The time to respond "different" should reflect the discriminability of two pictures. Estimated discriminability, however, did not account for the results of Experiment 4. Another experiment considered the possible role of the frequency in the English language of the names of the exemplars. Word frequency did not predict patterns of naming times in Experiment 4. Finally, the third experiment investigated the possible role of the "goodness of depiction" of the drawings we used. Subjects in this experiment rated how well each picture depicted the concept intended by the artist. Estimated goodness of depiction did not predict the naming results in Experiment 4. None of the above control experiments provided evidence that the results were confounded by any of the factors we considered. Readers interested in the details of these control experiments may write to the first author for a more complete description.

using a subordinate-level name instead of a basic-level name (e.g., calling a penguin "penguin" instead of "bird"). In any case, there is no indication that the response time results are due to a speed–accuracy tradeoff.

Discussion

The results clearly supported the hypothesis that objects are not always identified first at the basic level. In this experiment, atypical exemplars of basic-level categories were named faster with subordinate-level names than with basic-level names. Apparently, these objects are identified first at the subordinate level rather than at the basic level.

In Basic High categories, atypical exemplars named at the subordinate level (i.e., with specific names) had the shortest naming latencies in the experiment. In contrast, in Experiment 3 atypical members were always named more slowly than typical members. We hypothesized that subjects may have had difficulty in retrieving the names of some atypical exemplars in Experiment 3. Two consequences of a difficulty in retrieving names would be slow reaction times and a tendency to use more available names. Thus, subjects may have had a tendency to use basic-level names in Experiment 3 for some objects identified first at the subordinate level. In this experiment, however, we attempted to reduce differences in the availability of the names of typical and atypical objects. It seems that our familiarization procedure was successful in making the names of typical and atypical exemplars roughly equally available, as indicated by the fact that mean naming time did not differ for typical and atypical objects.

GENERAL DISCUSSION

Together, the results from Experiments 1 and 2 suggest that objects are identified first at a particular level of abstraction, and that this level is often the basic level. The correlational analyses in Experiment 1 supported our claim that identification at the superordinate level is achieved by the activation of the basic level followed by a search through semantic memory. This view was also supported in Experiment 2, in which we found that the difference between the time to make a basic-level versus a superordinate-level categorization was not affected by the degree of perceptual difficulty in encoding objects. The results of Experiment 2 suggested that categorization at the subordinate level is slower than categorization at the basic level because more perceptual analysis is required in the former case. The data were consistent with the view that basic-level identification occurs first and is followed, some time later, by subordinate-level identification.

Taken together the results of Experiments 3 and 4 demonstrate that objects are not always identified first at the basic level. After completing these experiments we learned about similar results obtained independently by Murphy and Brownell (1983). In one of their experiments, Murphy and Brownell used a verification paradigm in which a word was presented first and followed 1 sec later by a picture. The task consisted of responding "yes" (by button press) if the object belonged to the category defined by the word, and to respond "no" otherwise. Although they used different items and drawings than ours, they found that subjects categorized atypical exemplars of basic-level categories faster at the subordinate level than at the basic level, as we did.

One of us also recently replicated these findings in another experiment which used yet another set of items and categories. In this experiment four superordinate categories were used: animal, utensils, clothing, and furniture. Each superordinate category had two basic-level categories as members, and each basic-level had two subordinate-level categories as members, one of which was typical and one of which was atypical. Furthermore, each subordinate category was represented by two different exemplars of the category (e.g., two depictions of "kitchen chair"). The basic-level categories and the subordinates were dog—collie, poodle; fish—bass, seahorse; spoon—tablespoon, Japanese spoon; knife—kitchen knife, cleaver; pants—slacks, overalls; shoe—casual shoe, sandal; chair—kitchen chair, rocking chair; and table—kitchen table, pool table. In a "free-naming" situation subjects used predominantly basic-level names for typical items and predominantly subordinate-level names for atypical items. Furthermore, a reaction-time experiment (a word followed 1 sec later by a picture) in which subjects verified category membership at all three levels for each exemplar showed a strong basic-level advantage for typical objects and a strong subordinate-level advantage for atypical objects.

Finally, some recent research by Hoffmann, Ziessler, and colleagues lends further support to the present findings (see Hoffmann, 1982; Hoffmann, Denis, & Ziessler, in press; Hoffmann, Ziessler, & Grosser, 1983). Thus, there is every indication that the effect of typicality on the level at which people identify objects is quite general and robust.

Implications for the Notion of Basic Level

The level at which objects are identified first depends on typicality. Does this simply mean that some objects have "their basic level" at a level other than the "usual basic level"? That is, can "bird" be the basic level for "robin" and "penguin" be the basic level for "penguin"? Although this proposal may seem reasonable, at first glance, it in fact contradicts the original notion and definition of "basic level." The concept of "basic level" is defined for entire categories and should therefore apply to categories as a whole (i.e., basic-level categories are those that maximize "cue validity"—a measure based on a weighted sum of shared and nonshared attributes; see Rosch et al., 1976 and Rosch, 1978). Thus, the notion of "basic level," it seems to us, is meant to convey something that is general and applies to all the exemplars of a category at this level. Otherwise there is nothing basic about the *level* per se. Rather, the notion then applies to only some of the members at that level (i.e., the typical members). If so, what is "basic" about the level as a whole?

We propose instead, for the purpose of object identification, the notion of "entry point level." In this view, every object has one particular level at which contact is made first with semantic memory. This level corresponds to the basic level for many objects, but in many instances it does not. If an object is a very distinctive or atypical exemplar of a basic-level category, then that object may have its own entry point into semantic memory defined at the subordinate level. The notion of entry point, therefore, is an attribute of individual exemplars rather than an attribute of categories.

Rosch et al. (1976) identified one important determinant of the level of the entry point for a large number of objects: For typical members of "basic-level" categories, the entry point is usually at the "basic level," as shown by several experiments using the word/picture verification paradigm (Brownell, 1978; Gellatly & Gregg, 1975; Hutcheon, 1970; Murphy & Smith, 1982; Rosch et al., 1976; Smith et al., 1978) or the naming paradigm (Gellatly & Gregg, 1975; Hutcheon, 1970; Segui & Fraisse, 1968; Smith et al., 1978).

We have demonstrated the importance of another factor influencing the entry point, namely the typicality of an object with respect to a basic category. There are probably other factors, yet to be investigated, which in all likelihood will be found to influence the entry point. For example, expertise in a particular field is likely to shift the entry points of many objects toward subordinate levels (Rosch et al., 1976). This is not surprising if the entry points correspond to "nodes" in semantic memory (see Collins & Loftus, 1975) for which we have stored elaborated "perceptual routines" (see Smith & Medin, 1981) designed to recognize objects. For many objects and most situations the basic level may be the most appropriate level of abstraction at which to store perceptual routines for the identification of objects. However, this is not the whole story. For many objects (and perhaps many situations) we use identification routines at levels other than the basic level.

Implications for Common-Code and Dual-Code Theories of Semantic Memory

Several experiments in the literature have investigated whether information about objects is stored in a single, amodal store accessed by pictures and words (the common-code view), or whether there are two distinct stores—one accessed by pictures and one accessed by words (the dual-code view; see te Linde, 1982, for a recent review). Most of the experiments addressing this issue have required subjects to make decisions about various aspects of natural concepts using pictures and words as input. The literature has focused on the question of whether the same pattern of results obtains for pictures and words. If so, this is taken as evidence in support of a common-store view, otherwise the results would count as evidence for the dual-store view (te Linde, 1982). However, our results suggest that the situation is not so simple. It is possible to obtain different response patterns using pictures and words as input for reasons other than the notion that pictures and words access two distinct codes. Different results could arise because the word chosen to correspond to the picture did not match the entry point for the picture. If so, pictures and words could indeed access a common semantic-memory representation, however they could do so initially at different levels of abstraction. The difference in initial point of entry could cause performance differences in semantic decisions between pictures and words. Thus, it is important to ensure that the words corresponding to the pictures match the entry point level of the pictures.

APPENDIX 1

The following table shows the names of the categories and of the 48 exemplars used in the experiments reported in this paper. Words were always presented auditorily in the experiments. The table shows the exemplars divided according to the category to which it belonged, whether it was a typical or an atypical exemplar of the category, and whether the category had its basic level at the exemplar or at the category level.

Categories	Exemplars		
Basic Low[a]			
Fruit			
Typical	apple	pear	orange
Atypical	lime	coconut	pineapple

[a] Basic level is at the exemplar level.

Categories	Exemplars		
Vegetable			
Typical	carrot	peas	corn
Atypical	pepper	pumpkin	avocado[7]
Clothing			
Typical	pants	shirt	dress
Atypical	glove	scarf	hat
Furniture			
Typical	chair	table	sofa
Atypical	fan	stove	refrigerator
Basic High[b]			
Bird			
Typical	robin	dove	canary
Atypical	penguin	ostrich	peacock
Dog			
Typical	collie	beagle	retriever
Atypical	dachshund	poodle	afghan
Car			
Typical	sedan	VW	station wagon
Atypical	Jeep	Porsche	Rolls Royce
Boat			
Typical	sailboat	rowboat	speedboat
Atypical	raft	tugboat	submarine

[b] Basic level is at the category level.

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[7] After some of the experiments were completed, we discovered some minor errors of classification with some of the items we used. For example, technically, green pepper, pumpkin, and avocado are all fruits rather than vegetables. Also, refrigerator and stove might be thought of as appliances rather than as atypical furniture. However, these items did seem to be considered as atypical exemplars of their respective categories, as indicated by the results of Experiments 3 and 4 in which there were no interactions between naming reaction times and the different categories. Thus, there is no evidence that these potential problems in category membership definitions had any effect on our results other than those expected on the basis of the associated atypicality of the questionable items.

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