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ABSTRACT

This study was interested in determining whether (1) novelty produces greater or less attention than familiarity and incongruity, and (2) if children's labeling behavior was related to their attentive behavior. Using 3- to 5-year-old children, the results indicate that attention, at least for the stimuli presented, is an increasing function from familiar to incongruous to novel. Moreover, the subjects' speed and accuracy of labeling was related to their attentive behavior, with familiar stimuli producing mostly correct labels with short latencies while incongruous or novel stimuli produced mostly incorrect or no labels with long latencies. These results were discussed in relationship to the concept of novelty. (Author)

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RESEARCH BULLETIN

ATTENTION AND VERBAL LABELING BEHAVIOR:

A STUDY IN THE MEASUREMENT OF INTERNAL REPRESENTATIONS

Michael Lewis

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Attention and Verbal Labeling Behavior: A Study in the Measurement of Internal Representations[1]

Michael Lewis

Educational Testing Service

Of central concern to the study of cognitive development is the exploration of schemata or internal representations. One way to derive these representations is to measure attentive behavior (Lewis, 1970). It has been assumed that external events which elicit attention do not have a fully articulated correspondence to the organism's internal representation of that event, while external events which elicit little or no attention have fully articulated corresponding internal representations. It has been argued further that external events for which there is no internal representation also elicit little or no attention (Berlyne, 1960; McCall & Kagan, 1967; Piaget, 1954). Berlyne has called these events "novel." Familiar events are those for which there is a fully articulated internal representation, while incongruous events are those which do not have a perfect or fully articulated representation.

According to this theoretical system there should be a curvilinear relationship between the amount of attentive behavior and familiar, incongruous/discrepant, and novel stimuli--familiar and novel stimuli eliciting little and discrepant stimuli maximum attention. While the theory has intrinsic appeal, there is little direct evidence to support this relationship. Careful examination of the results of the McCall and Kagan study fails to find support for their theoretical position. Moreover, the whole notion of novelty is somewhat puzzling. The concept requires that the organism not be capable of finding any aspect of the external event in his

past experience. Nothing can be familiar. While it is true that infants are more likely to experience new events than older children are, it is hard to imagine, even for the very young, an event in which nothing, perhaps only a line or an angle, is familiar. Moreover, evidence suggests that an important cognitive rule guiding human behavior may be the desire to reduce stimulus uncertainty, that is, to find meaning (see Kreitler & Kreitler, 1968; Lewis, 1970; Pribram, 1967). For example, young children will often look at an amorphous event--a cloud--and try to find some aspect to label--to find familiar to meaningful elements.

Thus, both the experimental failure to demonstrate this theoretical curvilinearity as well as the theoretical and logical difficulty with the notion of novelty raise the issue of its relevance. Perhaps novel events are not qualitatively different but rather exist on the same continuum as other experienced events, only further along. If this were the case, novel events (no matter how defined) should elicit more rather than less attention when compared to both familiar and incongruous/discrepant events

Part of the difficulty in studying this issue is the circularity in reasoning that is usually found. On the one hand we wish to see the effect of novelty on attentive behavior, but at the same time we define a stimulus as novel by the attentive behavior it elicits. Two methods of studying this problem have been attempted. In the first, the experimenter selects stimuli which are believed novel for the infant. This selection must be based on the assumed past experience of the infant (see Lewis, 1969). The serious handicap in this method is the risk of choosing incorrectly. An alternative way of selecting or producing novel events is through direct experimental manipulation. Lewis and Goldberg (1969) have discussed an

experimental paradigm based on the use of the orienting reflex in which familiarity is defined as a repeated event and novelty as the violation of that event by the presentation of a different one. This technique, however, requires that novelty be defined as violation (of expectation) but this is not the only definition of novelty available.

Perhaps one way of maintaining the more naturalistic method, rather than the experimental technique, is to explore novelty and familiarity by using the subject himself to inform us of his categorization of the stimuli and at the same time avoid the circularity mentioned previously. The relationship between simple verbal labeling (the acquisition of the lexicon), attention, and internal representations may be such a way.

In order to use the subject's labeling behavior it is necessary to make certain assumptions. It is safe to state that if a child has a correct label for an event he has a highly articulated internal representation of that event. Less clear is the meaning of no label. It is reasonable to assume that while the lack of a label does not imply a lack of internal representation (infants certainly have representations although they have no verbal labels), a label indicates a more articulated representation than does no label. There are many words for snow in the Eskimo language which reflect more articulated perception and a richer set of representations of different types of snow events. Thus, as a first approximation no label may be considered to be associated with a novel event. The labeling behavior for incongruous events is also not clear; however, it is hypothesized that these events should in general elicit incorrect labels. This follows from the belief that organisms seek to reduce stimulus uncertainty and by doing so with incongruous events are therefore likely to mislabel them. Thus a bird head-horse body will most likely be labeled "bird."

By making these assumptions it is possible to select a set of events which are assumed to be novel, discrepant, and familiar and to observe the relationship between this a priori classification and the child's attentive behavior. Moreover by obtaining a subject's labeling behavior it is possible (1) to observe the relationship between the subject's labeling and attentive behavior as well as (2) to observe the relationship between this a priori classification system and the subject's labeling behavior.

Such a procedure was followed in this experiment. It was hypothesized that:

(1) Attentive behavior is not a curvilinear function of familiarity, incongruity, and novelty (in that order), but rather is a monotonic increasing function.

(2) An a priori classification system determined by the experimenter would be related to the subject's verbal labeling such that familiar events would have correct labels, incongruous or discrepant events would have predominantly incorrect labels, and novel events would have no labels.

(3) The subject's attentive behavior as a function of correct, incorrect, and no labels would be a monotonically increasing function.

Method

Subjects

Forty-three children from a local Montessori Nursery School were used. There were 14 two- to three-year-olds, 21 three- to four-year-olds, and eight four- to five-year-olds of mixed socioeconomic background, including children of professional parents as well as children of parents on welfare.

Apparatus and Stimuli

Each subject was tested individually in an enclosed room approximately two meters square. There was a chair and table, and directly in front of the table was a built-in screen through which pictures could be presented by rear screen projection. Six line drawings, equated by independent judgments for

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Insert Figure 1 about here

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complexity, were used as stimulus events (see Figure 1). On an a priori basis the horse and bird were selected as the familiar events while the horse head-bird body, bird head-horse body and two-legged horse were selected as the incongruous or discrepant stimuli. After much pilot work the anteater was selected as the novel event. It was believed not to be seen, in general, by children in this age level.

Procedure

Each subject was brought into the room and told that he was to watch the screen and look at the pictures that would appear. There was a total of 19 trials, each of the events being presented three times. The order was: filler, horse, bird, horse head-bird body (H-B), horse with 2 legs (H-2), anteater (AE), bird head-horse body (B-H), H-B, AE, B-H, horse, bird, H-2, B-H, bird, AE, horse, H-2, H-B.

Each trial was 15 seconds long with a 15-second intertrial interval. The first trial was a filler event not related to the other events, the function of which was to eliminate the specious effects of the first trial. The data for this trial were not recorded. After the series of trials an experimenter asked each subject to label the pictures which were shown

again. Both the verbal label as well as the latency between the time the picture appeared on the screen and subject responded were recorded on tape.

Measurement

Fixation time was recorded by looking through an observation window and determining the amount of time the image of the event appeared on the subject's pupil. Interobserver reliability was .93. Also recorded was the amount of time the child smiled and the length of each vocalization (amount of time producing sounds or making comments). The interobserver reliabilities for half the subjects were .84 and .92 respectively.

Results

Attention as a Function of Familiarity, Incongruity, and Novelty

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Insert Figure 2 about here

Figure 2 presents the total fixation data for the three categories across age. As is readily observable, there is a monotonic increase in fixation, familiar events eliciting least fixation, followed by incongruous events, and the novel events eliciting the most.

An analysis of variance indicates a significant age effect ($F = 3.25$, df 2,74, $p < .05$) and a significant stimulus event effect ($F = 4.74$, df 2,74, $p < .025$). The age effect was produced by the significantly shorter fixations of the three-year-old group while the stimulus effect was produced by differences among all three classes of stimulus events.

Insert Figure 3 about here

The vocalization data are presented in Figure 3 and again indicate an increase in response, the novel events eliciting the most vocalization, followed by the incongruous and familiar events. While there was no significant age effect, there was a significant stimulus event difference ($F = 6.67$, df 2,74, $p < .005$), the familiar events eliciting significantly less vocalization than either incongruous or novel ones.

Insert Figure 4 about here

Finally the smiling data, as seen in Figure 4, also indicate increases in response strength as a function of familiar, incongruous, and novel events ($F = 2.86$, df 2,74, $p < .10$). While this difference is only a trend, it is consistent with the other results.

The results of all three measures of attentive behavior indicate increased response strength over the three event categories and fail to support the curvilinear relationship.

Relationship between Child's Verbal Labeling Behavior and Stimulus Event Categories

Verbal labeling was employed as an alternative measure of degree of articulated quality of the internal representations. It was hypothesized that no labels, incorrect labels, and correct labels would be associated with novel, incongruous, or familiar events respectively.

Insert Table 1 about here

Table 1 presents the labeling behavior. The three stimulus event categories are presented across the upper heading, while the three possible

labeling behaviors are presented vertically along the left side. Nine cells are thus created. In each of these cells are presented the total number of responses possible and the total number observed, along with the percentage scores. For the stimulus category "familiar" there were two stimulus events and 43 subjects totaling a possible number of 86 responses. Out of this, 85 responses were determined to be correct (98.8 per cent), none were determined incorrect, and only one response was determined as no label (1.2 per cent). The same analysis applies to the other two stimulus categories. For the incongruous category, approximately 48 per cent of the responses were correctly labeled, that is, to bird head-horse body the children responded "that's a bird head-horse body," 40 per cent of the incongruous stimuli were incorrectly labeled, and 12 per cent had no label. The novel category had only 7 per cent correct labels and 35 per cent had no labels. The results strongly support the hypothesized relationship between the experimenter classification system and the subjects' labeling behavior.[2] The data reinforce the belief that labeling may be used as an index of the articulation of internal representations.

Latency to Label and the Stimulus Event Categories

Also obtained for each child (data for eight subjects were lost due to bad tapes) was the latency, or the time between presentation of the event and the subject's production of a verbal label. The latency data were obtained under the belief that not only the ability to label correctly but the latency to do so would also reflect the degree of articulation of the internal representation.

Insert Table 2 about here

Latency data by stimulus category and subjects' labeling behavior are presented in Table 2. The data indicate that the latency to respond with a verbal label (for no label subjects would say "I don't know") is a function more of the subjects' labeling behavior than of the experimenter's classification system.[3] The data indicate that correct labels are associated with the fastest response time and no labels with the slowest ($F = 3.99$, df 2,58, $p < .025$). Because of the distribution of labeling behavior it is not possible to make any clear statement as to the relationship between the experimenter classification and latency data, although there appears to be little difference on this basis. Finally, there were significant age differences, with four- and five-year-olds responding across stimulus events significantly faster than three-year-olds ($F = 3.66$, df 2,29, $p < .05$).

The labeling and latency data lend support to the a priori classification system and suggest that labeling may be used as an index of articulateness of internal representations.

Attention as a Function of the Subjects' Labeling Behavior

It has been demonstrated that attention to novel events is greater than to familiar ones according to the classification established by the experimenter; however, it still remains to observe the relationship between measures of attention and the subjects' labeling behavior.

Insert Table 3 about here

Fixation, smiling and vocalization data as a function of correct, incorrect, and no label are presented in Table 3. An analysis of variance for repeated measurement was not possible because each subject did not necessarily fill all cells, i.e., some subjects only labeled correctly or incorrectly and never had a no label response, etc. The mean data for each measure (except vocalization) indicate a monotonic increase, such

that no label responses are associated with the greatest attentive response, while correct label responses are associated with the least. In order to determine if this was significant, it was necessary to select subjects who responded with all three classes of labeling behavior. Few subjects actually did this (n = 13) and the results for fixation, while in the predicted direction (9.57, 10.51, 11.01 for correct, incorrect, and no label), did not reach significance (Friedman two-way analyses of variance, $\chi^2 = 34.70$, df 2,12, $p < .10$). The attentive behavior as a function of the subjects' labeling behavior supports the hypotheses, but must, however, be viewed with some caution because of the lack of statistical significance.

Discussion

The three hypotheses stated earlier have in varying degrees been substantiated: (1) using an a priori judgment, stimuli categorized as novel elicited more attention than those classified as familiar; (2) children's verbal labeling behavior had high correspondence with the a priori classification of stimuli, such that familiar stimuli elicited mostly correct labels and few no label responses, while the novel stimulus elicited more no label than correct label responses; (3) using the children's labeling behavior, there was an indication that nonlabeled stimuli elicited more attention than did correctly labeled ones.

The difficulty in the study of such concepts as novelty, familiarity, and incongruity is easily seen. On the one hand, stimuli are defined on the basis of the attentive behavior they elicit, while, on the other, it is claimed that stimuli defined on such a basis will elicit certain attentive behavior--to wit: familiar stimuli elicit little attention

and a stimulus is familiar if it elicits little attention. The logic is certainly circular and it becomes necessary to find other measures by which to define a priori the nature of the stimulus. This is especially true when we wish to study the effects of a certain class of stimuli on attentive behavior and thereby on the study of internal representations.

It has been suggested that verbal labeling and the latency to produce these labels be used as such measures. It may be reasonable to assume, as a first approximation, that highly available and articulated internal representations--familiar events--have corresponding correct labels which are easily found in memory storage (produced with short latencies). Indeed Oldfield (1966) has found that pictures of high-frequency words elicit short latency as compared to low-frequency words. Poorly defined and difficult to locate internal representations--incongruous or discrepant events--have corresponding incorrect or no labels and are produced with longer latencies. The use of verbal labeling behavior under these assumptions appears to be valuable in the study of internal representations and their growth. It is clear, however, that for the very young, where no labeling is possible, still other behaviors (not directly associated with the process of attending) need to be found.

For the most part, the data fail to support the widely held notion of a curvilinear relationship such that familiar and novel events elicit little, while incongruous/discrepant events elicit maximum attention. Rather, the data support the belief that the notion of novelty must be carefully regarded with the view that its usefulness as a molar concept is limited.

The experience of novelty, always a function of the subject--for example, his past experience or expectations--may be also limited by the subjects' perceptual processes. A stimulus event can be described at least by its individual components as well as by its Gestalt. The experience of

novelty may be dependent on how the event is perceived. While it may be true that no perception of parts of a stimulus event are novel--that is, lines and angles have been previously experienced--it may be equally true that the Gestalt of the event is novel or incongruous. Thus, experiencing a novel, incongruous, or familiar event may be determined by how the organism perceives the event and how he organizes his experience.

This consideration is most important in generating any theoretical statement about developmental functions. For example, it generally has been assumed that a novel experience is most possible for a young infant--indeed novelty is most applicable because at first all events are new. It is possible, however, to argue that because newborn and young infants do not utilize whole perception, that is they tend to have part regard, they are incapable of experiencing incongruity or novelty. Consider, if novelty or incongruity is only possible by viewing a whole stimulus, these experiences rather than decreasing with age may increase.

In fact, the data of Nelson and Kessen (1969), Salapatek and Kessen (1966), Salapatek (1969) and Zaporozhets (1965) suggest that ocular regard is part regard in the newborn and moves toward whole regard as a developmental function.[4] The data strongly suggest that if whole regard is needed for novelty, then its experience increases with age. This hypothesis is open to experimental investigation. It is the intention of this discussion only to point out the possibility that the nature of the perception of the stimulus must also be considered in the discussion of the experience of novelty. Having done so, several important issues become clear. For example, a great deal of difficulty has been experienced in demonstrating in very young infants response recovery to a new event (novel) after

repeated presentation of the same event (Lewis, Goldberg, & Raush, 1968; Pancratz & Cohen, 1970). The reasons for this problem may be a function of the nature of the stimulus rather than of the ability to produce an orienting reflex (OR). If young infants only look at a small detail of each stimulus, they may not notice the change because they never saw the original feature.[5] The design of the stimulus materials and their change may be critical in demonstrating neuronal models described by Sokolov (1963). The failure to demonstrate an OR may be a function of the stimulus material rather than the inability of the infant to construct a model.

The present data, by failing to find the generally accepted result--novelty eliciting little attention--should force us into a more careful consideration of this rather loosely considered concept.

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Footnotes

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[2]While the results were clear, we thought it best to obtain some statistical measure of significance of the relationship between verbal behavior and our a priori categorization. Because of the nature of the data a statistic was not easily available. A Friedman two way analysis of variance was used. For each subject for each stimulus event we gave the value of 1, 2, or 3 depending on the nature of the verbal label. Following this we obtained a mean rank for each category. This procedure was followed for each subject and the statistic applied. The results were significant ($\chi_r^2 = 10.07$, df 2, $p < .01$).

[3]Most subjects when giving a no label response would report, "I don't know," for those who said nothing a maximum of 20-second response time was given.

[4]The work of Kessen and his students as well as the Russian work, for example, Zaporozhets, clearly indicate that from birth through the preschool years there appears to be a developmental sequence in ocular regard. In the newborn the data strongly suggest very small part regard (for example, no more than $1\frac{1}{2}$ inches or approximately 7 visual degrees of regard in the first month). Moreover, the time spent moving from one regard to the next

is slow (possibly beyond memory limits of the infant) so that his dealing with the whole is limited. Developmentally this changes such that older infants and young children show more varied regard and faster movement from aspect to aspect. This suggests a great probability of Gestalt perception. This developmental trend is still visible in 3- to 7-year-olds. This work strongly supports the position that infants do not engage in whole perception but rather are more inclined to part regard. The rules that determine this regard, while important, are not of immediate concern for the problem we are dealing with.

[5]Jeffrey (1968) has suggested that with repeated exposures the infants attend to different aspects of an event and in this way perceive the whole event. The data on ocular regard demonstrate that small part regard is held over long periods of time rather than changing from part to part. This suggests that Jeffrey's analysis may not be applicable to the very young.

Table 1

The Number and Percentage of Verbal Response Categorized into Correct, Incorrect, and No Label as a Function of the Classification System of Novel, Incongruous, and Familiar Stimuli

	Familiar		Incongruous		Novel	
	Observed	Possible	Observed	Possible	Observed	Possible
Correct Label	85 (98.8%)	86	62 (48.1%)	129	3 (6.97%)	43
Incorrect Label	0	86	52 (40.3%)	129	25 (51.3%)	43
No Label	1 (1.2%)	86	15 (11.6%)	129	15 (34.9%)	43

Table 2

Latency to Respond with a Verbal Label as a Function Both of the Type of Label (Correct, Incorrect, or No Label) as Well as a Function of the Classification System of the Stimuli

	Familiar		Incongruous		Novel	
		n		n		n
Correct	4.44 sec.	(35)	5.86 sec.	(22)	1.80 sec.	(3)
Incorrect	0 sec.	(0)	6.65 sec.	(11)	6.07 sec.	(17)
No Label	0 sec.	(0)	8.68 sec.	(2)	8.20 sec.	(15)

Table 3

Fixation, Smiling, and Vocalization Data in Seconds as a Function of the Verbal Labeling Behavior

	Correct Label	Incorrect Label	No Label
Total Fixation	9.70	10.17	10.52
First Fixation	6.65	7.48	7.83
Smiling	2.10	2.26	3.01
Vocal	1.92	2.33	1.73

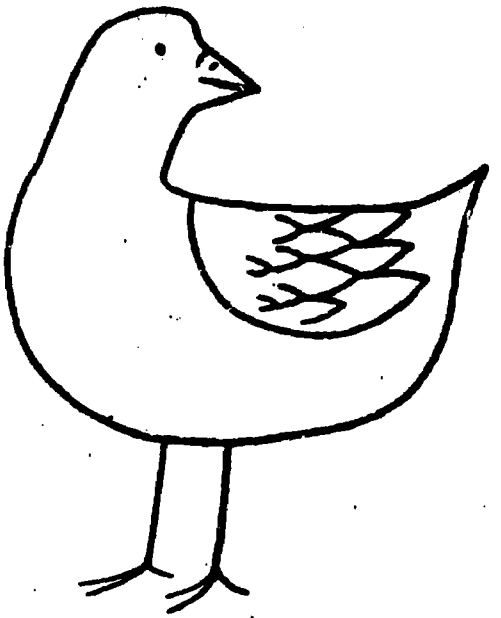
Figure Captions

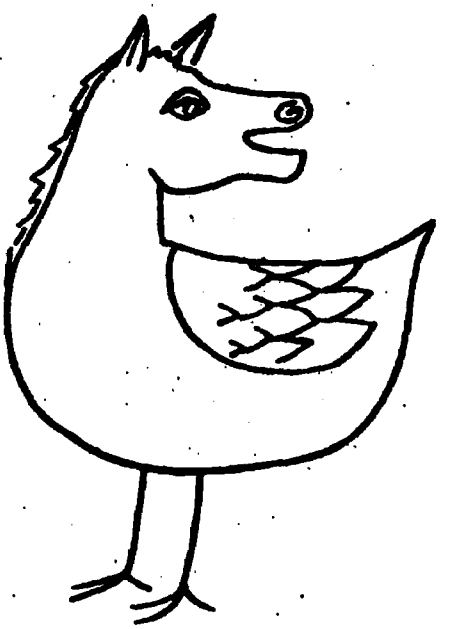
Fig. 1. Six stimuli used for the categories of familiar (bird, horse); incongruous (bird head-horse body, horse head-bird body, two-legged horse); novel (anteater).

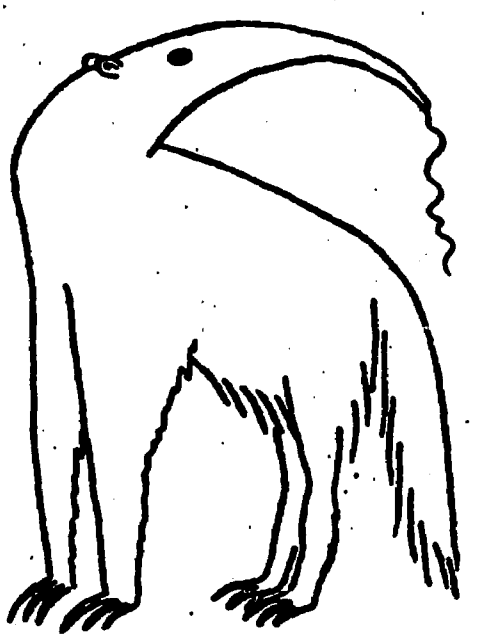
Fig. 2. Total fixation time in seconds as a function both of age and with age combined.

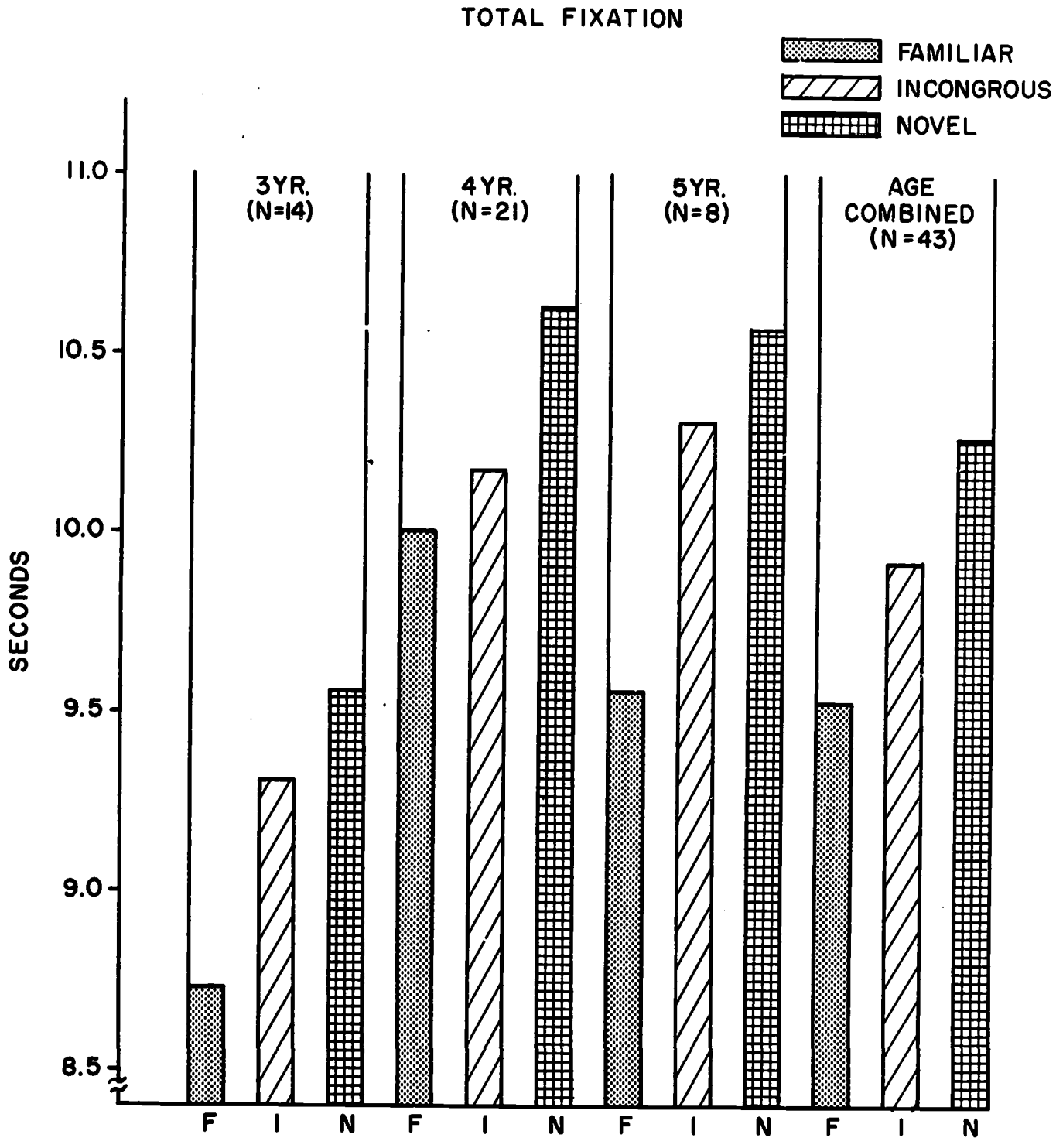
Fig. 3. Vocalization time in seconds as a function both of age and with age combined.

Fig. 4. Smiling time in seconds as a function both of age and with age combined.





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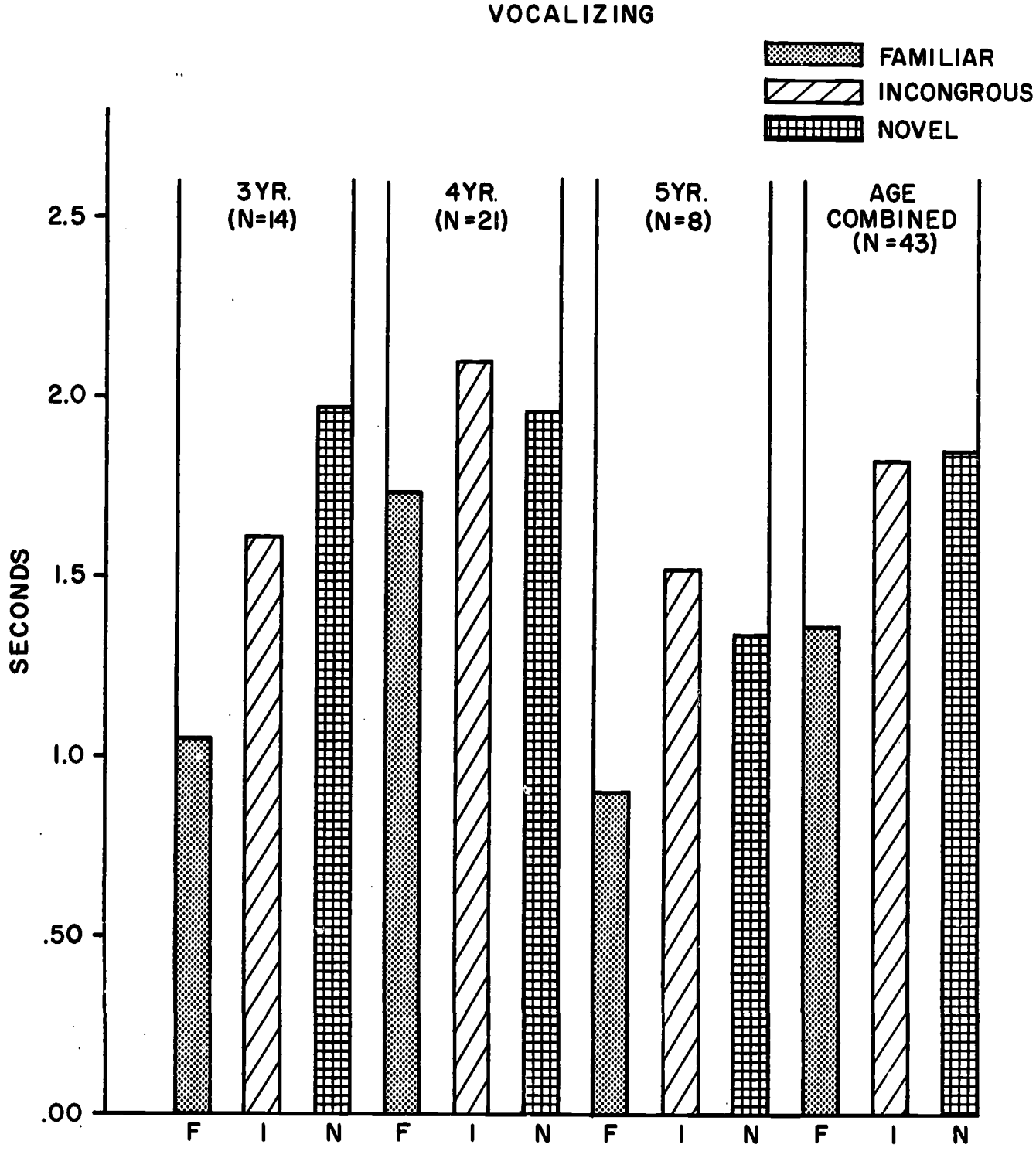
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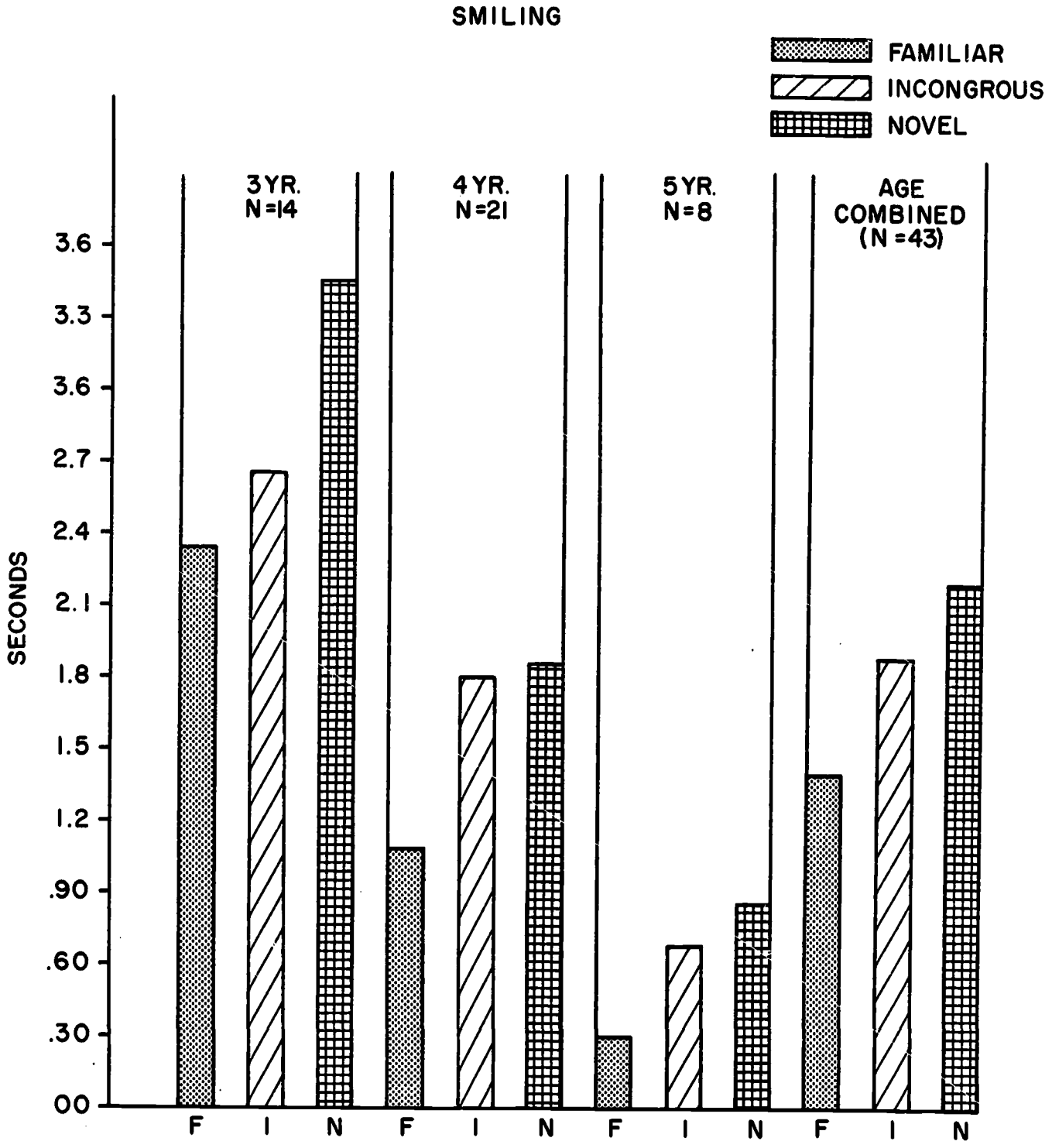
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