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ABSTRACT

Four experiments were conducted to investigate the extent to which infants of different ages respond to facelike drawings on the basis of stimulus complexity and/or resemblance to the human face. Infants' responses to stimulus patterns were assessed using the corneal reflection technique developed by Robert Trantz. In the first two experiments, 5-, 10-, 15-, and 20-week-old infants were shown four stimulus patterns differing in degree of resemblance to the face and degree of stimulus complexity. In the other two experiments, 10- and 15-week-old infants were shown six stimuli which represented three levels of complexity and two types of organization. The three stimulus patterns with nonfacial organization differed only in stimulus complexity. Those in the set with facial organization differed from each other in degree of facial resemblance as well as in complexity. The results of these four experiments indicated that there is a change between the ages of 10 and 15 weeks in the dimensions which underlie infants' response to facelike patterns. Older infants, 15 and 20 weeks, responded to both the degree of facial resemblance and the degree of complexity while younger infants, 5 and 10 weeks, responded only the complexity of facelike patterns. (Author/JMB)

DEVELOPMENTAL CHANGES IN INFANTS' RESPONSE TO COMPLEX FACELIKE PATTERNS

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Four experiments were conducted to investigate the extent to which infants of different ages respond to facelike drawings on the basis of resemblance to the facial configuration and/or on the basis of stimulus complexity. Infants' response to stimulus patterns was assessed using the corneal reflection technique developed by Robert Fantz.

Subjects for the first two experiments were groups of 5-, 10-, 15-, and 20-week-old infants. The four stimulus patterns differed from one another along two orthogonal dimensions: degree of resemblance to the face and degree of stimulus complexity.

In the other two experiments, 10- and 15-week-old infants were shown six stimuli which represented three levels of complexity and two types of organization. The three patterns with Nonfacial organization differed from one another along only one dimension, stimulus complexity. Those in the set with Facial organization represented the same three complexity levels but also differed in degree of facial resemblance.

The results of these four experiments indicate that there is a change between the ages of 10 and 15 weeks in the dimensions which underlie infants' response to facelike patterns. Older infants, 15 and 20 weeks, respond to both the degree of facial resemblance and the degree of complexity in such patterns. Younger infants, 5 and 10 weeks, respond only to the complexity of facelike patterns. The same conclusion is reached regardless of whether the two dimensions are orthogonal to one another or are positively correlated in a set of stimuli. Thus it would appear that, by the age of 15 weeks, the infant can respond to at least one meaningful stimulus configuration, that of the human face.

DEVELOPMENTAL CHANGES IN INFANTS' RESPONSE TO COMPLEX FACELIKE PATTERNS[1]

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Recognition of facelike stimuli is a topic which has been of considerable interest in the literature on infants' visual preferences. The face appears frequenly in the environment and, consequently, may be one of the first organized and meaningful visual configurations which is recognized by the infant. Because of the social significance of the face, discrimination of facelike stimuli is important as a precursor of social responsiveness. In addition, a detailed description of the ontogeny of the discrimination of facelike patterns may provide information about the importance of stimulus organization in the infant's visual environment.

In the last 15 years, over 20 reports dealing with the infant's response to facelike stimuli have been published. Recognition of the face has been demonstrated with infants between the ages of four and six months (Caron, Caron, Caldwell, & Weiss, 1973; Fagan, 1972; Haaf and Bell, 1967; McCall & Kagan, 1967). However, the evidence presently available does not permit a similar inference concerning subjects of younger ages. Although some investigators have observed a preference for faces over other stimuli with infants less than four months of age, attempts to replicate this phenomnnon have not been uniformly successful (Fantz, 1966; Fantz & Nevis, 1967; Hershenson, 1967; Koopman & Ames, 1968; Lewis, 1969; Thomas, 1973, experiments CB-I and CB-IV).

In studies of younger infants, facelike patterns have been compared with dissimilar stimuli, with distorted faces, as well as with stimuli containing facial features in a scrambled arrangement. It should be noted that differential responding in these comparisons is not necessarily indicative of facial recognition since the effective stimulus dimension cannot be specified unequivocally (Hershenson, 1967). Infants may look at the face because it possesses particularly attractive stimulus elements, because it represents an optimal level of complexity, or because the facial configuration is perceived and recognized. Furthermore, discrimination between a single pair of stimuli such as a schematic face and a scrambled version of equal complexity is not a necessary result of facial recognition.

The purpose of the present experiments was to determine whether

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young infants respond to facelike patterns on the basis of stimulus complexity or on the basis of degree of resemblance to the human face. Subjects for these studies were between the ages of 5 and 20 weeks.

Experiment 1 (Haaf, 1974)

Method

Subjects. The subjects were 24 5-week-old (35 + 3 days) and 24 10-week-old infants (70 ± 3 days). There were 12 males and 12 females at each age level. Names were selected from birth announcements in the local newspaper; parents were contacted initially by letter and then, a few days later, by telephone.

Stimuli. The stimuli, which are shown in Figure 1, are similar to those used by Haaf & Bell (1967). The four patterns varied along two dimensions: (1) degree of resemblance to the configuration of the human face and (2) degree of complexity. Resemblance to the face was determined by the number of appropriately positioned facial features. Complexity was the number of details or elements. The number of facial features, as well as the number of elements, in each stimulus is shown in Table 1. Since the two dimensions are orthogonal to one

TABLE 1.
STIMULUS CHARACTERISTICS AND THE ORTHOGONAL COMPONENTS USED IN STATISTICAL ANALYSIS

	Stimulus			
	A	B	C	D
Stimulus characteristics				
Number of facial features	10	7	4	1
Complexity, Number of elements	13	[illegible]	4	22
Orthogonal components				
Facial resemblance linear	3	1	−1	−3
Complexity linear	−1	3	−3	1
Quadratic	1	−1	−1	1

another, the extent to which each influenced the subjects' response ordering could be determined by statistical analysis. The stimulus patterns were positive achromatic transparencies approximately 10 x 13.5 cm in size.

Apparatus. The observation chamber was constructed so that the target panel, which contained a 15 x 18 cm stimulus aperture, was approximately 26 cm from the infant's eyes. The stimulus was placed over this aperture and was illuminated from the rear. A piece of translucent white plastic above the opening blocked the subject's vision between trials. A small hole 11 cm below the stimulus opening on the target panel permitted observation of the infant's eyes as he lay below in an infant seat. Length of trials and intertrial intervals was signaled by electronic timers. Responses were recorded on a printout counter, as was the onset and offset of each trial.

Procedure. Subjects received 12 30-second trials, three repetitions of each stimulus; the intertrial interval was 15 seconds. The stimuli were presented in a nonsystematic order, with the restriction that each pattern appear once in every block of four trials. One experimenter placed the stimulus on the target panel at the beginning of a trial and removed it at the onset of the intertrial interval. A second experimenter recorded fixation time. The subject was judged to be looking at the stimulus when its reflection was superimposed over the pupil on the cornea of his eye.

Results and Discussion

Since the four stimulus patterns varied along two independent dimensions, it was possible to analyze response differences to the stimuli in terms of the three orthogonal components listed in Table 1: a linear facial-resemblance component, a linear complexity component, and a quadratic component. If subjects show a preference for intermediate levels of complexity the quadratic component would be positive in sign but if they show a preference for intermediate levels of facial resemblance its sign would be negative.

Fixation time for each repetition of each stimulus was converted to a percentage of the total amount of time a subject spent looking at the stimuli and the percentage fixation time scores were subjected to an Age x Sex x Stimulus x Repetitition analysis of variance. Instead of testing for a Stimulus main effect with 3 df and an Age x Stimulus interaction with 3 df, the corresponding sums of squares were partitioned into six, single degree of freedom, orthogonal components; that is, the significance of each of the three components listed in Table 1 was tested at each of the two age levels.

Analysis of percentage fixation scores yielded only two significant effects: the Quadratic stimulus component for the 5-week-old subjects, $F\ (1, 132) = 6.08$, $p < .025$, and the Linear Complexity component for the infants at 10 weeks, $F\ (1, 132) = 15.47$, $p < .001$. Since the Quadratic component at 5 weeks was positive in sign, it would appear that these subjects were responding to the degree of complexity in the stimuli, with a preference for intermediate levels. An analysis of raw fixation time scores produced similar results. The data are presented graphically in Figure 2.

There was no evidence of response to the facial resemblance dimension by either of the age groups used in the first experiment. The 10-week old infants showed a linear preference for increasing levels of stimulus complexity. At 5 weeks the Quadratic stimulus component was significant. The most compelling interpretation of this latter finding is that it represents preference for an intermediate level of complexity. Thus it would appear that the visual behavior of subjects at both ages was controlled by the complexity of the stimuli and that there was a developmental shift from preference for an intermediate level of complexity at 5 weeks to a positive linear preference at 10 weeks. This shift in preferred level of complexity among the present stimuli is consonant with infants' response to checkerboards which vary in complexity.

Experiment 2

Method

Subjects for the second experiment were 32 15-week-old (105 + 3 days) and 32 20-week old (140 + 3 days) infants. There were 16 males and 16 females at each age level. None of these infants had shown extreme position biases. Stimuli were the same as in Experiment 1. However, in Experiment 2 the paired comparisons procedure was used. The target panel of the observation chamber contained two 14 x 18 cm stimulus apertures. The stimuli were approximately 30 cm from the infant's eyes and the center of each stimulus aperture was 12 cm off midline of the target panel. All possible pairs of the four stimuli were presented during 12 30-second trials; intertrial intervals were 10 seconds in length.

Results

The results of Experiment 2 are presented in Figure 3.[2] One way analyses of variance of percentage fixation time scores were used to test for differences in response to the four stimuli. The data from each age level were analyzed separately. For both groups, the response orderings showed a Linear Facial-Resemblance component, $F\ (1,31) =$ 9.60 at 15 weeks and 20.05 at 20 weeks; a Linear Complexity component, $F\ (1, 31) = 27.12$ at 15 weeks and 11.03 at 20 weeks; and a Quadratic component, $F\ (1, 31) = 43.11$ at 15 weeks and 27.83 at 20 weeks. All were significant at, or beyond, the .005 alpha level.

Discussion

With respect to complexity, it would appear that 15 and 20-week old infants, like younger infants, do respond to the complexity of facelike patterns. However, with respect to the degree of facial resemblance, 15 and 20 week-olds respond quite differently than 5 and 10 week-old subjects. Unlike the younger infants, subjects at 15 and at 20 weeks show increasing attention to the more facelike patterns. Similar results have been reported for 18 week-old infants by Haaf and Bell (1967).

The results of Experiments 1 and 2, as well as of Haaf and Bell (1967), lead to the conclusion that there is a change between 10 and 15 weeks of age in the stimulus dimensions which underlie response to facelike patterns. Although 15 and 20 week-old infants respond to both facial resemblance and stimulus complexity, infants at 5 and 10 weeks respond to the complexity dimension and act as though they were oblivious to the facial organization of the stimuli. One tempting speculation is that this shift reflects a developmental change in the infant's perceptual capabilities. Perhaps the young infant is capable of responding only to physicalistic stimulus dimensions such as complexity. Viewing the visual world in terms of its complexity might then facilitate the construction of more meaningful dimensions to which only the older infant can respond, such as degree of facial resemblance. Although the data are consonant with this speculation, they do not provide unequivocal support for it. Experiments 3 and 4 were designed to provide atditional information concerning young infants' responsiveness to the dimension of facial resemblance.

Experiment 3

On the basis of Experiments 1 and 2 (and Haaf & Bell, 1967) it can be concluded that there is a change between the ages of 10 and 15 weeks in the dimensions which underlie the infant's response to facelike patterns. Although one possible inference is that this developmental shift reflects a change in the infant's basic perceptual capabilities, one alternative explanation is equally plausible. The procedure used in Experiments 1 and 2 can be viewed as a test of relative dimensional salience. The young infant may be capable of responding to the dimension of facial resemblance but may fail to do so when a highly salient dimension, such as complexity, competes for his attention. Thus response to the facial resemblance dimension at 15 and 20 weeks may reflect a developmental change in dimensional salience rather than an ontogenetic change in perceptual capabilities. The purpose of Experiments 3 and 4 was investigage infants' response to facelike patterns with stimuli in which the dimensions of complexity and facial resemblance are positively correlated with one another (these dimensions are orthogonal to one another in the stimuli of Experiments 1 and 2).

Method

Subjects. The subjects for Experiment 3 were 36 10-week-old infants (70 ± 3 days). There were 18 males and 18 females. None of these subjects had shown extreme position biases.

Stimuli and Design. The stimulus patterns, which are shown in Figure 4, were positive achromatic transparencies, each approximately 10 x 13.5 cm in size. The three patterns with Facial organization differed from one another in terms of the number of appropriately positioned facial features. As a result, these stimuli varied concomitantly along two dimensions, stimulus complexity (number of elements) and degree of resemblance to the facial configuration. The corresponding patterns in the set with Nonfacial organization contained the same numbers of stimulus elements. However, these elements were not positioned appropriately with respect to the facial configuration and, as a result, the stimuli varied along only the complexity dimension. Although subjects would be expected to attend longest to the most complex stimulus within each set, the major focus of the present investigation was upon differences in response between one set and the other. If 10-week old infants are not responsive to the dimension of facial resemblance, their differential response to the three levels of complexity should be independent of the type of organization imposed upon the stimulus elements. The relationship between complexity and fixation time should be the same for the Facial as for the Nonfacial set of stimuli. However, if subjects are responsive to the facial-resemblance dimension, their responses to these two sets of stimuli should be different; that is, the discriminability of stimuli which differ in both complexity and facial resemblance should be greater than of stimuli which vary only in complexity. In terms of the 2 x 3 factorial design represented by these stimuli, a significant interaction between complexity level and type of organization would provide evidence of responsiveness to the dimension of facial resemblance.

Apparatus and Procedure. The observation chamber was identical to the one in Experiment 2. The paired comparison procedure was used, in which a pair of stimuli was presented on each trial. There were 14 30-second trials, with an intertrial interval of 10 seconds. On trials 1 - 12 each of the six stimuli was presented four times, twice in each lateral position. One block of six trials involved a complete paired comparison presentation of the three patterns with Facial organization. The other block of six trials involved the six pairs of Nonfacial stimuli. There were two stimulus sequences; half of the subjects received the six pairs of Facial stimuli on trials 1 - 6 and half received these pairs on trials 7 - 12. The stimuli on trials 13 and 14 were identical to one another in complexity but differed in type of organization. The pair of stimuli which was presented on trial 13 was repeated on trial 14 with lateral positions reversed. Half of the infants received the two patterns of high complexity on both trials (13 and 14) and half received the two patterns of low complexity.

Results

In order to determine whether subjects responded differently to the stimuli with Facial organization than to those with Nonfacial organization, raw fixation time scores derived from trials 1 - 12 were subjected to an Organization x Complexity x Stimulus Sequence analysis of variance. The main effect due to Complexity, F (2, 68) = 27.33, $p<.001$, and the Organization x sequence interaction, F (1, 34) = 6.11, $p<.025$, were both significant. However, the relationship between fixation time and complexity was not different for the two types of organization; that is, the Organization x Complexity interaction was not significant.

The complexity main effect reflects the infants' increased attention to the higher levels of complexity. Average fixation times (summed over stimulus repetitions) were 32.12, 41.41, and 54.44 seconds to the low, medium, and high levels of complexity, respectively.

The Organization x Sequence interaction indicates that infants looked longer at the Facial than at the Nonfacial stimuli in the Facial-Nonfacial sequence, but not in the Nonfacial-Facial sequence. A decline in attention between the first and the second block of six trials would ordinarily be expected. However, fixation time declined only when the Nonfacial stimuli appeared in the second block of trials. When the Facial stimuli were presented in the second block, the level of attention remained constant across blocks. Average fixation times to the Facial and the Nonfacial sets, respectively, were 42.79 and 37.57 seconds for the Facial-Nonfacial sequence and were 44.68 and 45.58 seconds for the Nonfacial-Facial sequence.

Analysis of fixation times on trials 13 and 14 failed to demonstrate differential response to facelike and nonfacelike stimuli. Half of the subjects were exposed to the two patterns of high complexity and the other half were shown the two low complexity patterns (in the latter case, equipment malfunction prevented recording data from these last two trials for one subject). Two t tests for correlated means were computed to determine whether infants responded differently to the stimulus with Facial organization than to the one with Nonfacial organization. Neither comparison was significant; t (17) = 0.25, $p>.10$, for the pair of high complexity patterns and t (16) = 1.96, $p>.05$, for the low complexity pair. Of course, the results of these two comparisons should be interpreted with caution. Discrimination between stimuli on trials 13 and 14 may have been lessened as a result of fatigue or as the result of habituation to the patterns.

As has been noted by Thomas (1973), data which are averaged across subjects may not accurately reflect the behavior of individual infants. However, such does not appear to be the case in the present experiment. For each infant, coefficients for a linear complexity comparison were used to produce a linear trend score for each set of stimuli. Fixation time to each pattern within a particular set was multiplied by the corresponding coefficient and the products were summed to produce the trend score. The linear complexity trend scores were greater than zero (that is, positive in direction) in both sets of stimuli for 25 of the 36 infants and were negative in both for only one infant. The percentage of positive trend scores was 81 in the Facial organization condition and was 86 in the Nonfacial condition.

Discussion

The results of Experiment 3 are consonant with the data from Experiment 1. In both studies, 10-week-old infants were found to respond to the complexity of facelike patterns. In experiment 3, the relationship between fixation time and complexity level was no different for stimuli which vary concomitantly along two dimensions (complexity and facial resemblance) than for those which vary only in complexity. Thus there was no evidence of response to the dimension of facial resemblance by 10-week-old infants.

Since the Facial and the Nonfacial sets of stimuli differ only with respect to the configuration of elements within the patterns, the Organization x Sequence interaction appears to indicate that the organization of stimulus elements does affect response to visual patterns by 10-week-old infants. However, as Hershenson (1967) has indicated, differential response to two stimuli (or in this case, to two stimulus conditions) is not sufficient to permit an inference about the effective stimulus dimension underlying infants' behavior. Therefore, no positive conclusion concerning 10-week-old infants' responsiveness to the facial-resemblance dimension can be drawn from the interaction between Type of Organization and Stimulus Sequence.

Experiment 4

Method

The purpose of Experiment 4 to determine whether the lack of response to the facial-resemblance dimension in Experiment 3 was related to the subjects' age level or was caused by the use of an insensitive procedure. Although the entire sample has not yet been completed, data from 32 15-week-old infants (105 ± 3 days) have been collected (16 males and 16 females). None of these infants had shown extreme position biases. The stimuli, apparatus, and procedure were the same as in Experiment 3.

Results and Discussion

An Organization x Complexity Level analysis of variance was performed on the raw fixation time scores from trials 1 - 12. Both main effects and the Organization x Complexity interaction were significant. F (1, 31) = 4.81, $p < .05$, for the Type of Organization main effect; F (2, 62) = 49.21, $p < .001$, for Level of Complexity; F (2, 62) = 9.56 $p < .001$, for the interaction. Average fixation times to the Facial and the Nonfacial sets of patterns were 40.06 and 36.37 seconds, respectively. Mean looking times to the three levels of complexity, from lowest to highest, were 21.43, 42.60, and 50.62 seconds. The Organization x Complexity interaction is presented graphically in Figure 5.

Neither of the comparisons based on the data from trials 13 and 14 was significant. For the pair of low complexity patterns, t (17) = 0.77, $p > .05$, and for the high complexity pair, t (13) = 1.49, $p > .05$.

The 15-week-old infants, like the 10-week-olds in Experiment 3, showed an overall increase in attention to the higher levels of complexity. In addition, at 15 weeks fixation time was higher to the stimuli with Facial organization than to those with Nonfacial organization. And most importantly, there was evidence of response to the dimension of facial resemblance by the 15-week-olds. Differential responding to the three levels of complexity was greater for the patterns with Facial organization than for those with Nonfacial organization; in other words, response differences were larger for stimuli which vary both in complexity and facial resemblance than for those which vary only in complexity. Given these results, absence of response to the facial-resemblance dimension in Experiment 3 can be ascribed to the subjects' lower age level rather than to a procedural artifact.

General Discussion

The results of these four experiments can be summarized quite simply: there is a change between the ages of 10 and 15 weeks in the dimensions which underlie response to facelike patterns. Older infants respond to both the degree of facial resemblance and the degree of complexity in such patterns. The same conclusion is reached regardless of whether the two dimensions are orthogonal to one another (Experiment 2) or are positively correlated in a set of stimuli (Experiment 4). Thus it would appear that, by the age of 15 weeks, infants are able to recognize at least one meaningful, organized stimulus configuration---that of the human face. Of course, recognition of a meaningful, organized stimulus configuration does not necessarily imply that meaning has, in fact, been attached to the configuration.

There was no evidence to suggest that younger infants (5 and 10 weeks) respond to the facial-resemblance dimension. Young infants respond to the complexity rather than to the facial resemblance of facelike patterns (Experiment 1). Their differential response to stimuli which vary both in complexity and facial resemblance is no different than to stimuli which vary in complexity alone (Experiment 3). Null results, of course, fail to prove that 5-and 10-week-old infants cannot recognize the facial configuration. Nevertheless, from the evidence presently available, it would appear that they are quite reluctant to admit that they can.

Miscellancy

Position bias and the paired comparison procedure

When pairs of stimuli are presented simultaneously there is the possibility that infants will show strong position biases. "Position bias" simply means greater fixation, over trials, to one position than to the other. Typically, as in Experiments 2, 3, and 4, stimuli are counterbalanced with respect to position so that stimulus differences will not be confounded with position biases. Even so, some investigators have taken additional precautions when analyzing stimulus differences in the presence of strong position biases. The original design of Experiment 1 called for a complete paired comparison procedure. Position biases were extremely strong in the first 10 subjects and, as a result, the design of the experiment and of the looking chamber were modified for single stimulus presentation. Subjects with extreme position biases have been excluded from data analysis (for example: Koopman & Ames, 1968; Experiments 2, 3, and 4 in the present paper). Statistical corrections for position biases have also been applied (Hershenson, 1964).

Data from Experiment 3 were subjected to additional analyses in order to investigate the effects of position bias upon infants' visual fixation of stimuli. The order in which the present experiments were conducted was 1, 3, 2, 4, not the order in which they were discussed.

After data were collected on 24 subjects in Experiment 3, an analysis was undertaken to determine whether there was a relationship between degree of position bias and the extent to which subjects discriminated among the six stimuli. The amount of time an infant spent looking at each of the six stimuli was determined and the standard deviation of these six observations was computed for each subject, as a measure of discrimination among stimuli. If babies with extreme position biases were simply staring in one direction rather than responding to stimulus differences, attention should be relatively uniform to the various stimuli and, consequently, the standard deviation would be low. A scatter diagram was prepared showing the relationship between the degree of position bias (percentage of time spent looking in the dominant direction) and the measure of stimulus-discrimination (standard deviation). This scatter plot resembled a rectangular goose egg with a tail. The degree of discrimination among stimuli was unrelated to the extent of position bias except for subjects with position preferences greater than 95 per cent. For these infants the measure of discrimination was uniformly low. This analysis indicates that stimulus discrimination is constrained only in the case of extreme position biases. As a result, these subjects were excluded from data analyses, as were subsequent infants with position biases of more than 95 per cent.

Fixation time scores for trials 1 - 12 were subjected to two additional analyses. Each infant's preferred position was identified (the position which received more than 50 per cent of that subject's total fixation time). The length of time spent fixating each stimulus in the subject's preferred position was computed and an Organization x Complexity analysis of variance was performed on these scores. Only the Complexity main effect, F (2, 70) = 18.78, $p < .001$, was significant. A similar two-way analysis of variance was performed on raw fixation time scores derived from both stimulus positions. As in the previous analysis, only the Complexity effect was significant, F (2, 70) = 27.02, $p < .001$. Since the results of these two analyses were the same, it would appear that the presence of position biases of 95 per cent, or less, do not place constraints upon the interpretation of data derived from the paired comparisons procedure.

Ontogeny and alternative response measures

With the method of the present experiments, there are three different measures which can be used to assess infants' differential response to stimulus patterns: number of fixations, average duration of fixation, and total fixation time. Only total fixation time (and percentage fixation time) was analyzed in the present experiments. Several investigators have commented upon the relative utility of these alternative response measures, as well as upon ontogenetic changes in each (Ames & Silfen, 1965; Cohen, 1973; Lewis, Kagan, & Kalafat, 1966). No analyses of the relationship among measures, or of the consistency of stimulus differences across these measures, have been performed upon the present data. However, analyses of ontogenetic changes in these measures have been carried out by Carol Saunders and Shirlee Fenwick.

The four experiments described earlier involved two different combinations of stimuli and two different procedures, the single-stimulus and the paired comparison procedures. Even so, it was possible to look at developmental changes across three pairs of age levels for which stimuli and procedures were identical: 5 to 10 weeks in Experiment 1; 10 to 15 weeks in Experiments 3 and 4; and 15 to 20 weeks in Experiment 2.

Three measures were computed for each subject: number of fixations, total fixation time, and average duration of fixation. The scores were summed over stimuli and repetitions. Developmental changes in these measures were assessed by t-tests for independent samples.

There were no changes in any of the three measures between the ages of 5 and 10 weeks (Experiment 1). Each of the three t-tests was nonsignificant at the .05 alpha level.

Between 10 and 15 weeks (Experiments 3 and 4) all three measures changed. There was an increase in the number of fixations, t (66) = 4.64, p <.001; a decrease in the average duration of fixation, t (66) = 4.47, p <.001; and a decrease of marginal significance in total fixation time, t (66) = 1.99 (the critical value at the .05 level, with 60 degrees of freedom, is 2.00).

There were age related changes in two of the measures between 15 and 20 weeks (Experiment 2). Average duration of fixation continued to decline, t (62) = 2.92, p <.01. Total fixation time also decreased, t (62) = 5.61, p <.001.

To summarize: The number of fixations increased significantly between 10 and 15 weeks. Average duration of fixation decreased between 10 and 15 weeks as well as between 15 and 20 weeks. There was a decline of marginal significane, between 10 and 15 weeks in total fixation time; and a significant decline between 15 and 20. In general, the older infant appears to show a relatively large number of fixations, each of which lasts for only a relatively short duration. Ames and Silfen (1965) reported similar changes for infants at 7 - 8, 16, and 24 weeks of age. In their data, the number of fixations increased with age but total fixation time and average duration of fixation decreased developmentally; however, no statistical tests were reported.

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Footnotes

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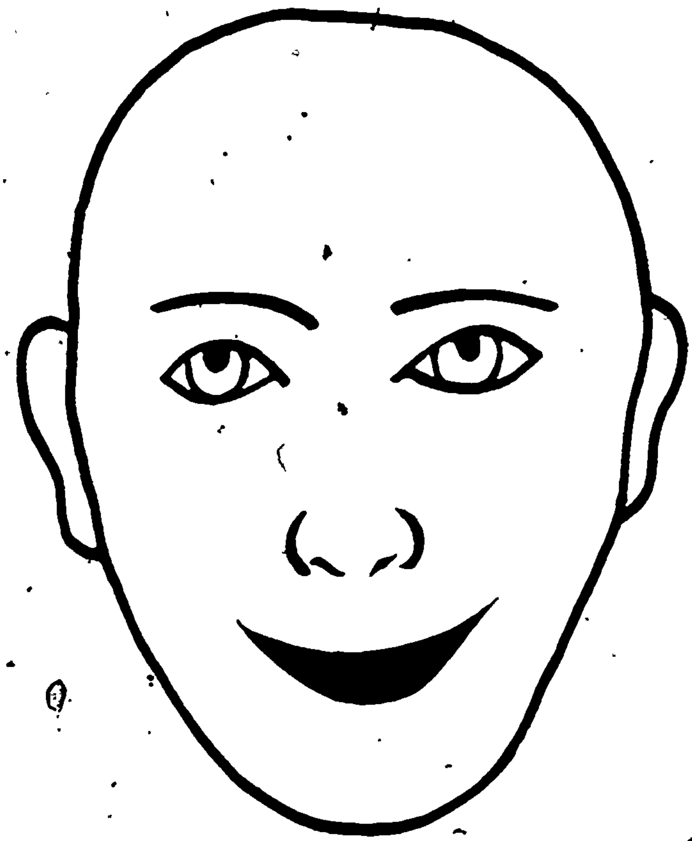
The subjects and their parents, too

2. Figure 3 represents data from the 15-week-old sample. However, results for the 20-week-olds were nearly identical. Average percentage fixation times were .323, .267, .149, and .260 at 15 weeks and were .321, .267, .161, and .250 at 20 weeks for stimuli A through D, respectively.

List of Figures

A



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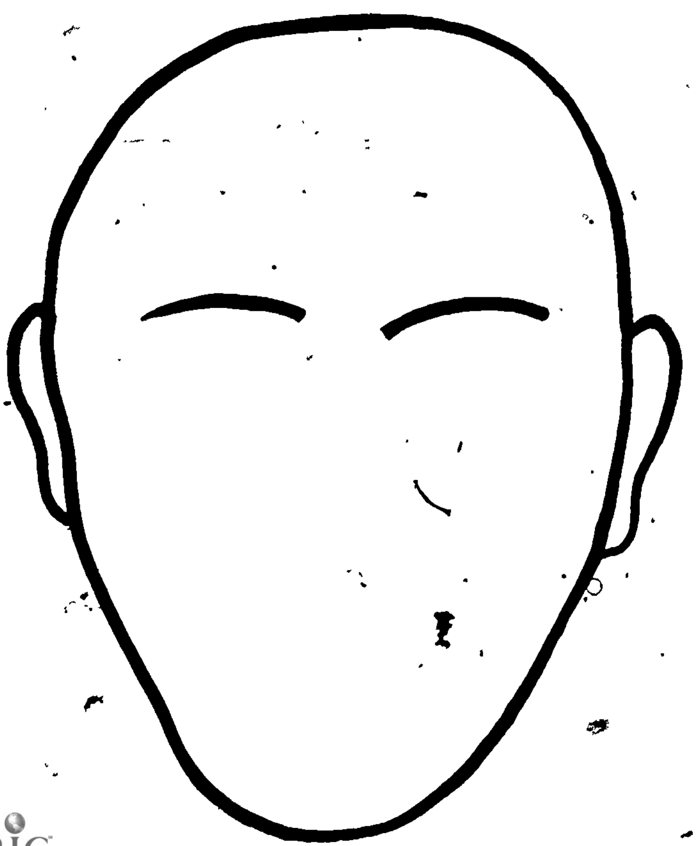

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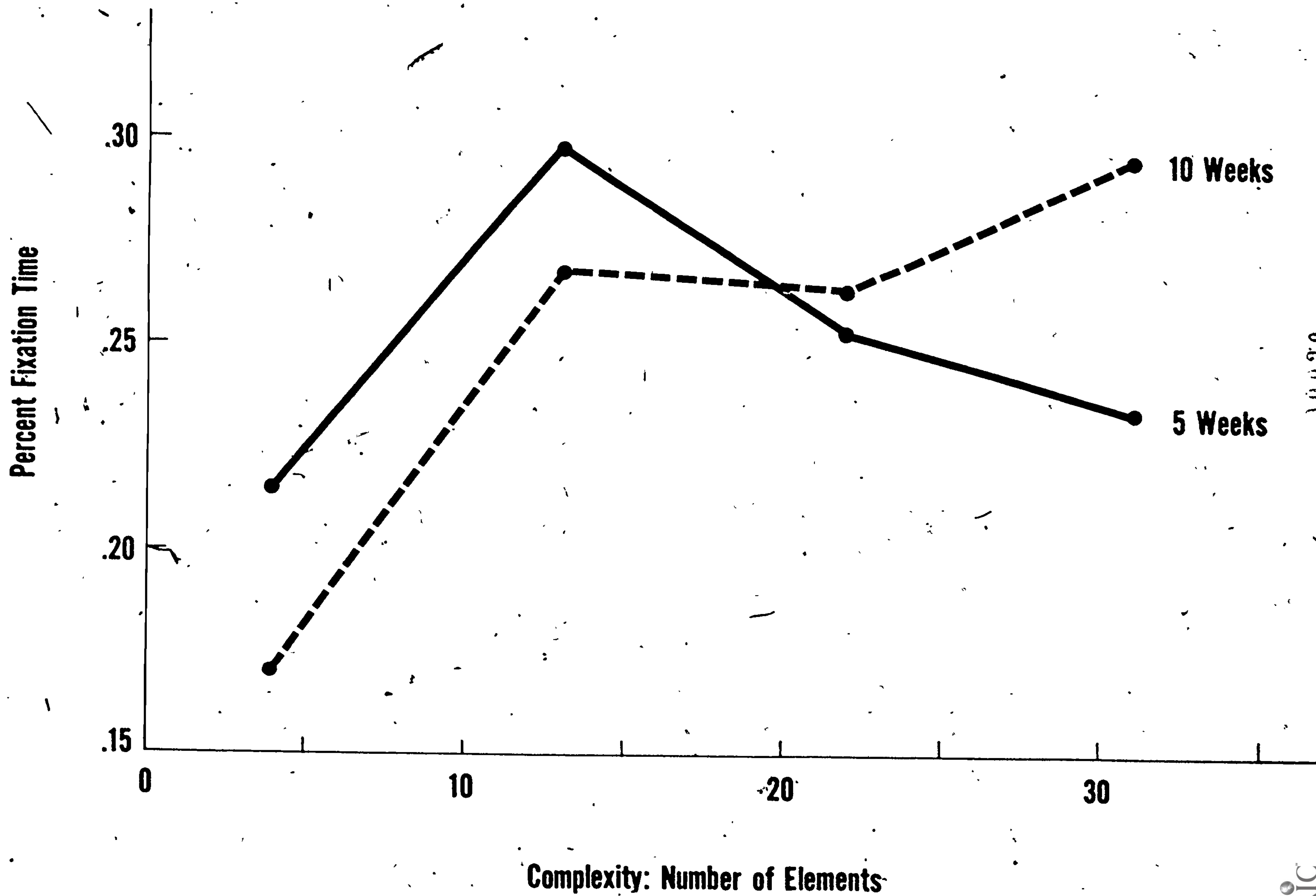
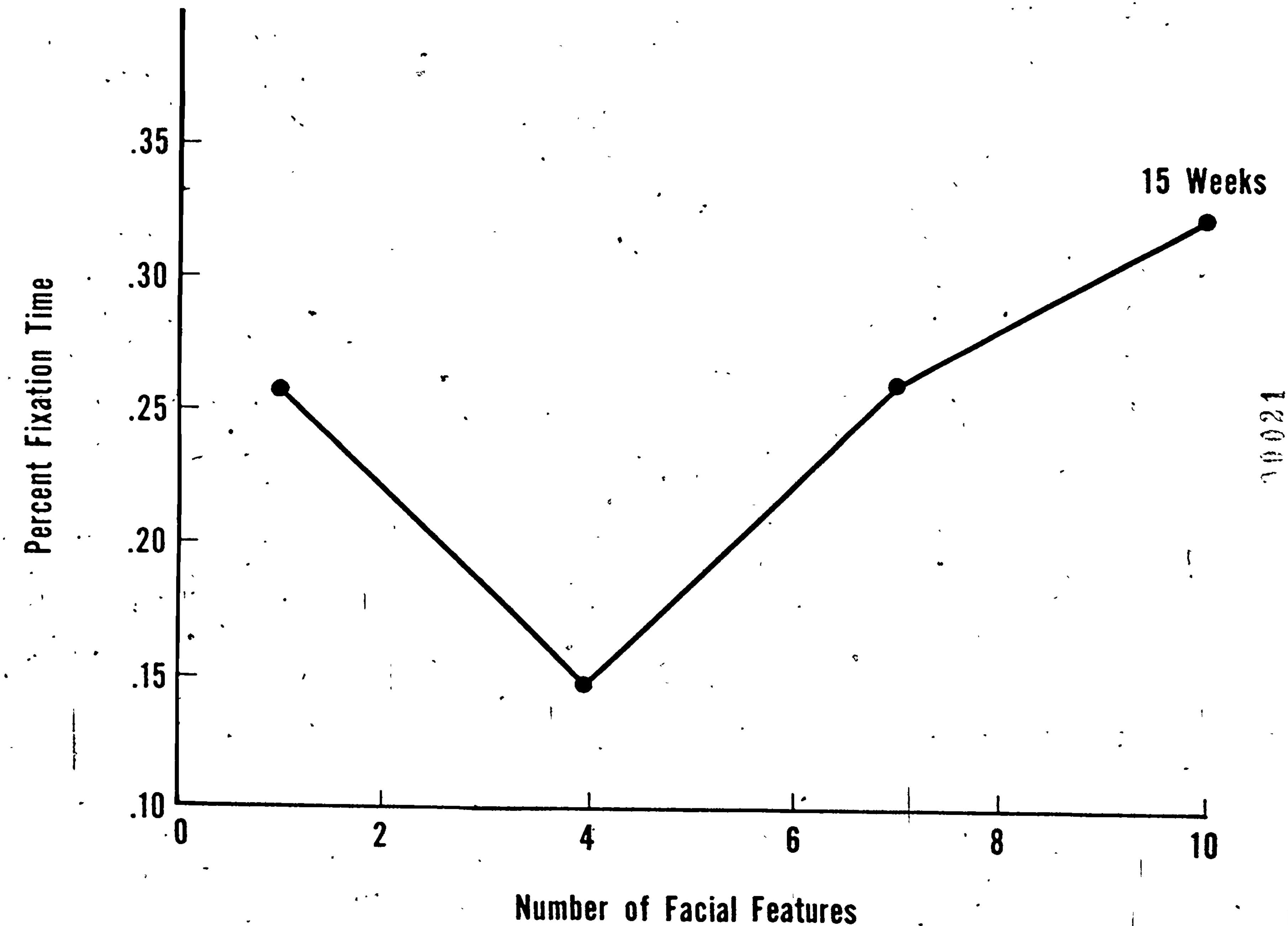
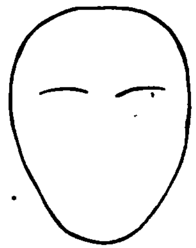
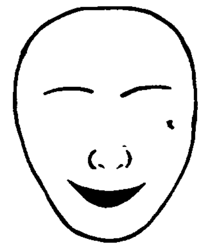
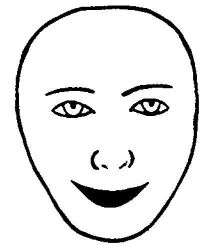
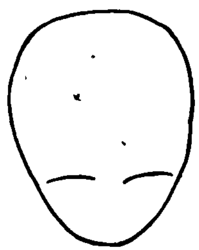
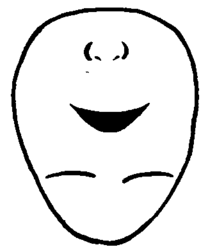
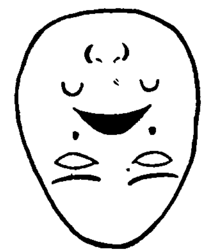
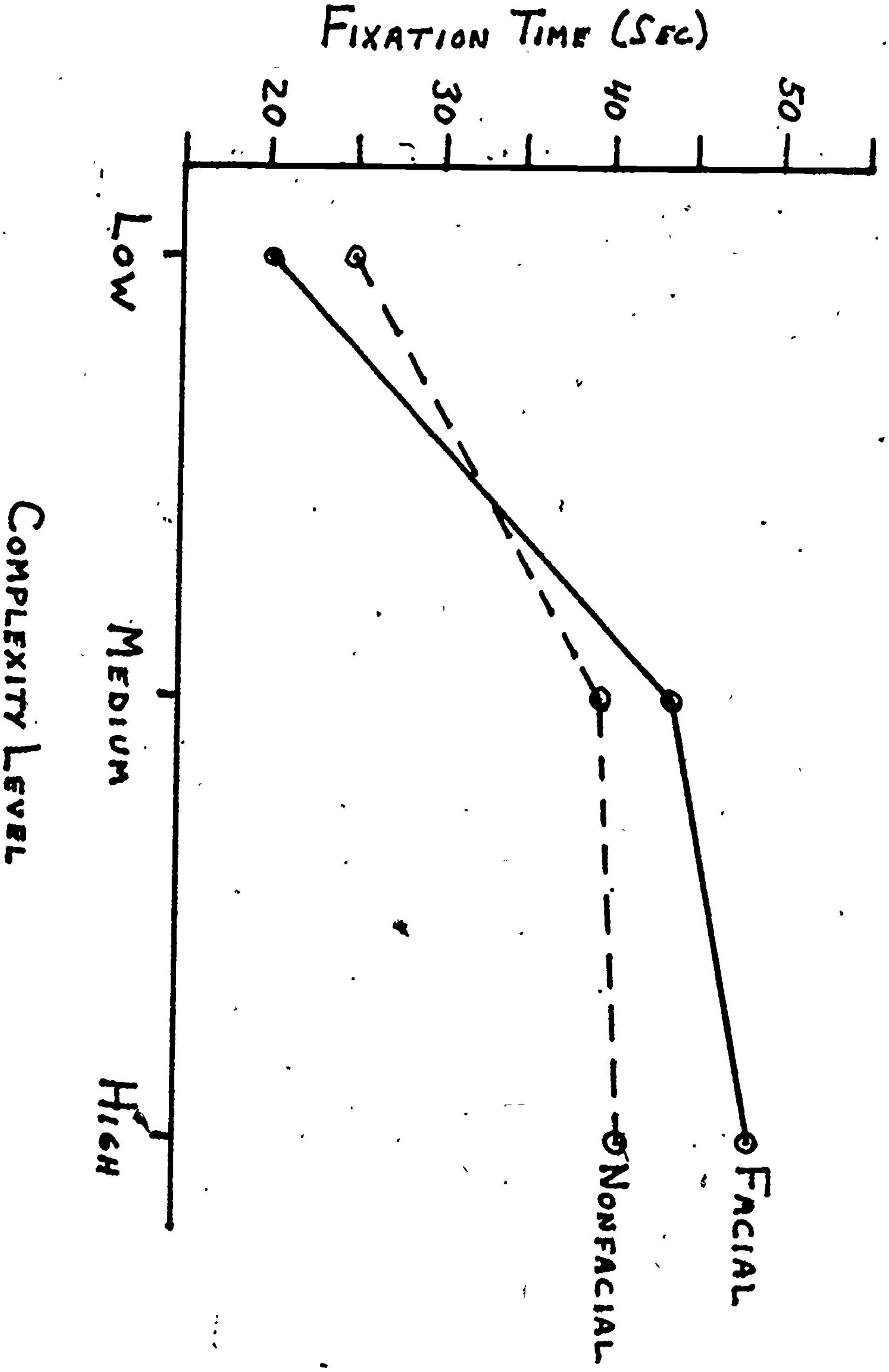

Percent Fixation Time
.30
.25
.20
.15
0
10
20
30
10 Weeks
5 Weeks
Complexity: Number of Elements


Percent Fixation Time
.35
.30
.25
.20
.15
.10
0
2
4
6
8
10
Number of Facial Features
15 Weeks

Type of Organization	Complexity Level		
	Low	Medium	High
Facial			
Nonfacial			



Fixation Time (Sec)
20
30
40
50
Low
Medium
High
Complexity Level
Nonfacial
Facial