DOCUMENT RESUME

ED 102 826 FL 006 360

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TITLE	Intonation and Language Acquisition. Papers and Reports on Child Language Development, No. 1.
INSTITUTION	Stanford Univ., Calif. Committee on Linguistics.
PUB DATE	Mar 70
NOTE	22p.
EDRS PRICE	MF-$0.76 HC-$1.58 PLUS POSTAGE
DESCRIPTORS	*Auditory Discrimination; Child Language; Comprehension Development; Infants; *Intonation; Language Development; Language Patterns; Language Skills; Nucleation (Language Learning); *Phonology; *Psycholinguistics; *Suprasegmentals

ABSTRACT

It is the contention here that the "prelinguistic" period is an important phase of the language acquisition process. Accordingly the research reported represents an attempt to begin mapping out the types of linguistically relevant information to which a young child attends. Specifically it is hypothesized that young children are especially tuned to the linguistic information carried in the supra-segmental system of language (intonation, stress, and juncture) and that detection of such information eventually leads the child to other aspects of language patterning. The participants in the study consisted of 20 4-month-old and 20 8-month-old infants. The subjects were divided into four groups of 10 infants each, and an habituation-dishabituation paradigm was used to study their discrimination of terminal contour. The results suggest that normal falling and rising intonation contours, including the stress marker, can be discriminated by at least 8 months. The data indicate that neither group of 4-month-old infants was able to distinguish between the presented forms. Exactly when the ability to discriminate between these features appears is not clear, except that it develops somewhere between 4 and 8 months old. Several questions remain to be answered, and further research with more sensitive habituation and conditioning procedures is in process. (Author/LG)

INTONATION AND LANGUAGE ACQUISITION

Eleanor L. Kaplan

INTRODUCTION

1.0 Not quite two years after a child has uttered his first word, he appears to have mastered most basic linguistic forms. How this process develops--especially given the complexity of language structure and the limited nature of the linguistic input to the child-- has been the concern of many investigations over the past 10 years (See Ervin-Tripp, 1967; Smith & Miller, 1966; for reviews of the literature.) The scope of these studies, however, has mainly been restricted to attempts at providing systematic descriptions of the young child's productive capacities. As a consequence of focusing on the language behavior of already "verbal" children, important capacities, in particular early receptive developments occurring prior to this period, have been virtually ignored. This outcome is unfortunate, for it is probable that much is learned about language during the first year, long before any "comprehensible" utterances are produced. It is the contention here that the "pre-linguistic" period is an important phase of the language acquisition process. Accordingly, the research reported here represents an attempt to begin mapping out the types of linguistically relevant information to which a young child attends. Specifically it is hypothesized that young children are especially tuned to the linguistic information carried in the supra-segmental system of language (intonation, stress, and juncture) and that detection of such information eventually leads the child to other aspects of language patterning.

There is a good deal of evidence which suggests that young infants seem to be attentive to information signaled by the supra-segmental system. For example, there are numerous studies suggesting that distinctive intonation patterns can be detected in the young infant's early vocal behavior (Chao and Metzer & Tudor-Hart in Lewis, 1951, Lewis, 1951; Murai, 1963, 1960; Nakazuna, 1962, 1966; Tappolet cited in Weir, 1963; Weir, 1963; Werner & Kaplan, 1963; and Zhurova, 1963.). A complementary set of observations (Metzer & Tudor-Hart, in Lewis 1951; Lewis, 1951; Kagan & Lewis, 1965; Wolff, 1966.) also suggests that infants are responsive to some of the acoustic aspects of the voice which are shared by the supra-segmental system. Finally, the literature on auditory perception demonstrates the infant's potential ability for making subtle linguistic discriminations (Bartoshuk, 1962a & 1962b, 1964; Bridger, 1961; Clifton & Meyers, 1968; Steinschneider, Lipton & Richmond, 1966.)

Of course the child's attention to supra-segmental aspects of language would only be significant if such information is systematically related to other aspects of language. Several linguists (Lieberman, 1967a and 1967b; Chomsky, 1965; Chomsky & Halle, 1968; among others) have argued that in fact, supra-segmental information is meaningfully related to both surface and deep aspects of the semantic and syntactic system. For example, Lieberman points out the important relationships between intonation, stress, and juncture, and basic phonemic, syllabic, semantic, and syntactic patterning. He argues that supra-segmental patterning is not only correlated with other kinds of linguistic patterns, but that it is usually motivated by patterning at the phonemic and semantic/syntactic levels. The implications of this position for the language acquisition process are clear. If a young child could detect such supra-segmental features he would have access to other important linguistic distinctions.[1] For example, the detection of intonation contours might direct the child's attention to the location of major semantic/syntactic segmentation such as sentence and sentence constituent boundaries. Juncture might function in a similar fashion by pointing to the location of morpheme as well as higher order syntactic boundaries. Stress, on the other hand, could enable the child to detect the kinds of regularities existing at the phonemic and syllabic levels.

It is not being suggested that the early perception of supra-segmental features will inform a young child of specific information regarding morpheme class membership, e.g., whether a particular sentence is in the active or passive voice, etc. The position proposed here is far less demanding. What is suggested is that supra-segmental features such as intonation, stress, and juncture, serve as signals of and potentially permit the discovery of underlying linguistic constituents such as sentences, phrases, morphemes and syllables.

The present study represents only the initial phase of a much larger program of research to assess early receptive processes. The immediate goal of this study was to examine the ability of young infants to discriminate between two particular supra-segmental patterns, falling (↓) and rising (↑) terminal contour. Terminal contour was selected for study since there is reason to believe that it is meaningfully related to other kinds of linguistic structure (Lieberman, 1967b). The falling and rising terminal patterns were especially selected because they seem to have universal significance; that is, these patterns seem to occur in all languages (Lieberman, 1967b). It is not unreasonable to assume (Jakobsen, 1968) that those patterns with universal significance will be discriminated first.

Ordinarily, terminal contour is composed of several features including stress changes and changes in pitch (Lieberman, 1967b). Utterances ending with either rising or falling terminal contours are marked by a concomitant slow increase and subsequent rapid decrease in stress towards the terminal segment of the utterance (see Lieberman, 1967b). Thus, it is obvious that the perception of intonation cannot be attributed to simple changes in either fundamental frequency or pitch. Rather, the experience of intonation is based on a configuration of relative pitch and stress changes. It is possible to see whether changes in pitch alone are sufficient to bring about the discrimination of terminal contour by presenting cases in which terminal contour is defined only by changes in pitch. Contrasts between utterances varying only in direction of pitch change, i.e., ↑ vs. ↓ and between utterances varying in both stress and direction of pitch change, i.e., ↑ / vs. ↓ /, would provide this information.

Patterns varying in direction of pitch alone (unstressed condition) and patterns including stress as well as pitch changes (stressed condition) were presented to groups of four and eight-month-old infants for discrimination within an habituation-dishabituation paradigm. This paradigm calls for the habituation of a response pattern through repeated presentation of a particular stimulus. Discrimination is inferred if after the introduction of a second (different) stimulus, the original response pattern resumes or dishabituates. This design has been used successfully by many researchers to study the discrimination of other kinds of auditory patterns by young infants. Much of this work is reviewed by Lipsitt (1968; 1963) and by Lipton and Steinschneider (1967).

METHOD [2]

1.1 Subjects. Forty *Ss* participated in the study; 20 four month old infants and 20 eight month old infants.[3]

The *Ss* were divided into four groups of 10 infants each--4A, 4B, 8A and 8B corresponding to various experimental conditions. The median age of *Ss* in 4A and 4B was 17.8 weeks and 17.5 weeks respectively. The median age of *Ss* in 8A and 8B was 37.1 weeks and 36.6 weeks respectively. There were five males and five females in 4A; four males and six females in 4B; six males and four females in 8A; and five males and five females in 8B.

1.2 Response indices and apparatus. An habituation-dishabituation paradigm was used to study the discrimination of terminal contour. The rationale behind this procedure is as follows: repeated presentation of a stimulus is known to lead to gradual habituation of autonomic and motor orienting responses to auditory stimuli (Sokolov, 1963); if, as a consequence of a change in the stimulus, *e.g.*, a change from one intonation contour to another, there is a dishabituation of these responses (relative to points where there are no changes in stimulation), then discrimination of the change can be inferred. By carefully controlling the nature of the change in the stimulus, it is possible to map out the kinds of discriminations which the *S* is able to make.

Beckman miniature skin electrodes positioned horizontally across the chest were used to measure cardiac activity. The leads were placed one below each nipple with the ground on the sternum midway between the other two. Orienting behaviors, which included head turning and directional eye movements as well as general startle responses, *e.g.*, cessation of movement and eye widening, were recorded manually on the record alongside the heart rate tracing. Stimulus onset and offset were automatically marked on the polygraph record.

1.3 Stimuli. The two sets of intonation patterns presented for discrimination consisted of: (1) falling (↓) *vs*. rising (↑) intonation contours and (2) falling (↓/) *vs*. rising (↑/) contours as in (1) but with stress patterns also included. The falling pattern is more typical of declarative statements, while the rising form is more typical of interrogatives or questions. These four patterns were super-imposed on the three-word sentence "See the cat" producing the following two pairs of contrasting stimuli: (1) "See the cat ↓" *vs*. "See the cat ↑" used in part A of the experiment, and (2) "See the cat ↓/" *vs*. "See the cat ↑/" used in part B.

The main contrast was restricted to the end or final segment of each sentence. The beginning portion of each sentence pair was kept as similar as possible; the initial segments of the unstressed (↓ *vs*. ↑) and stressed (↓/ *vs*. ↑/) versions were similarly matched. The sentences were recorded by a well-practiced female voice and recorded at 7 1/2 ips on low print magnetic tape. Two procedures were instituted to insure that the stimuli were closely matched. First, the final set of experimental sentences was selected from a larger set of sentences by having three judges rate them with respect to such variables as equality of pitch, loudness, duration and tempo. Sentence pairs composed of ↓ and ↑ or ↓/ and ↑/ versions were presented to judges in random order. Pairs not rated equal by all three judges with respect to the established criteria were eliminated. Remaining pairs were then re-evaluated against a three point similarity scale by the same judges. The ↓ and ↑, and the ↓/ and ↑/ couplets receiving the highest mean ratings were selected as final stimulus items.

Stimuli were presented in triplets of three identical successive repetitions of each sentence, e.g., "See the cat, See the cat, See the cat". The triplets and the interval between triplets were each approximately five seconds. There were four experimental tapes consisting of six sets of 11 triplets. For each tape the sets consisted of alternating presentations of two contrasting versions. For two of the tapes the contrast was ↓ vs. ↑ (part A), for the remaining two tapes it was ↓/ vs. ↑/ (part B). Within the two tapes containing the same contrast, order of presentation was varied by starting each with a different version. Thus, a given subject heard 66 triplets divided into six sets of 11, and following each set of 11 a contrast was introduced. There were in this way five contrast points at which the stimulus changed from one intonation pattern to the other. The first sequence on each tape was included as a "warm-up" sequence; these data were not analyzed. In addition to this first introductory sequence, each experimental tape thus contained five sequences with four contrast points where the two alternating forms, e.g., ↓ vs. ↑, or ↓/ vs. ↑/, contrasted. This design is summarized in Table 1. As can be seen from the left hand column, groups 4A and 8A and groups 4B and 8B received the same stimuli. The six sets of 11 alternating triplets are shown in the columns marked 1 through 6. Half the Ss in 4A and 8A received presentation order 1, while the remaining Ss heard order 2. The same was true for Ss in 4B and 8B. The four contrast points, i.e., points where the stimulus changes, are indicated (*) at the top of the table. The change from the first to the second sequence (columns #1 and #2, respectively) was not included in the data analysis. As stated previously, sequence 1 functioned as an introductory or "warm-up" period.

1.4 Procedure. The experiment consisted of two parts, A and B; the ↓ and ↑ versions were presented for discrimination in part A and the ↓/ and ↑/ forms were presented in part B. Ten four month old and ten eight month old infants served in each part of the experiment with no infant participating in more than one part of the experiment. There were thus four groups of 10 Ss each: 4A and 8A, four and eight month olds respectively who participated in part A; and 4B and 8B, four and eight month old infants participating in part B. One-half of the Ss in each group received one presentation order while the other half heard the reverse order.

The experiment was conducted in a fully shielded, soundproofed room separated from an observation and equipment room by a one-way mirror. After the electrodes were positioned on the infant's chest, he was placed in a modified infant seat facing an observation window. A small 3" speaker delivering the stimuli was placed approximately 10 inches to the side of the infant's left ear. Locating the speaker to only one side of the infant's head facilitated the identification of motoric orienting behaviors. The infant's mother sat to the right and front of the infant, diagonally opposite from the speaker. She was instructed to maintain the same posture throughout the session, and not to interfere with or talk to the infant.

Sessions varied from 7 to 11 minutes depending upon the Ss state. Ss were required to hear a minimum of four successive sequences to be included in the data analysis. This insured that there would be at least two contrast points for each S.

Heart rate was continuously recorded throughout the session, and all observed orienting responses were simultaneously recorded alongside the heart rate tracing by E. An orienting response was defined as a cessation of ongoing activity accompanied by a head movement through the median plane (away from the mother) and toward the sound source and/or gross change in fixation through the median plane in the same direction.

RESULTS

2.0 Scoring. Patterns of responding coincident with changes in terminal contour were compared with response patterns occurring at other arbitrarily selected non-change points. Heart rate and orienting behaviors obtained in each of the six intervals immediately preceding each change point and to the two intervals immediately succeeding each change point were determined. Each interval included a five second triplet and five second silence. The index of cardiac activity used was the range in heart rate, measured in beats per minute (bpm), occurring during each of these eight 10 second periods. Each 10 second period was first divided into five 2 second intervals. Next the mean heart rate in bpm for each of the 2 second periods was computed. Finally, the range was calculated from these mean scores by comparing the maximum deviation from the first mean score within the interval.

Range scores as opposed to beat-to-beat changes in heart rate were used to measure discrimination since extensive pretesting proved this to be a more reliable index. A similar score has been used by Lewis, Kagan, Campbell and Kalafat (1966) in research with infants. In this study, as well as in the exploratory research which preceded this study, none of the heart rate curves obtained contained either the identifiable peaks or troughs that are often reported in the adult literature as well as in some of the infant literature. Instead, overall increases or decreases in variability were generally observed at the critical points. Since this was the case, no predictions concerning the direction of heart rate change were made. The only prerequisite for discrimination was an increase in cardiac activity after a change point.

Habituation and dishabituation were determined by comparing the relationship between range scores obtained for each pair of these eight adjacent intervals. There were seven such comparisons for each change point: (1) comparison of each period immediately preceding and succeeding a change point; (2) comparison of the five periods preceding this where _no_ change in contour occurred; and (3) comparison of the two periods immediately following but not including the change in contour. Habituation was said to occur when the variability within one period was greater than or equal ($\geq$) to variability in the period immediately following it; dishabituation was claimed whenever that relationship was reversed, _i.e._, when the range score within a particular period was less than ($<$) that within the succeeding period.

Orienting responses were easily scored by noting the presence or absence of such responses within each of the same eight periods surrounding each change in contour. The analyses of heart rate and orienting responses reported are based on groups data. (Individual data for both responses are reported elsewhere, Kaplan, 1969.) Heart rate data were combined by summing the number of times each individual displayed a particular pattern, _e.g._, increased cardiac activity, at each of the seven comparison points. All tests for increases in variability were then performed on this pooled data. Similarly, the frequency of orienting responses observed after each stimulus presentation were tallied within and across subjects. The resulting frequency distribution of orienting responses was then examined statistically.

2.1 _Analyses_. Since order of presentation did not appear to have any effect within groups, the data for subjects receiving the two different presentation orders were combined. In general, the results indicate that by eight months of age the ability to discriminate between intonation contours characteristic of American-English is developed. Specifically, the eight month old infants (group 8B) appeared to distinguish between the two rising and falling contours which included stress. These contours are more similar to the kinds of rising and falling contours common to American-English than are the unstressed rising and falling counterparts (presented to 4A and 8A). In normal speech, changes in intonation, especially ones involving terminal rise and fall, also involve increases in perceived stress (Liberman, 1967b). The remaining group of eight month old _Ss_ (8A) failed to distinguish between the unstressed rising and falling contours; the younger infants (4A and 4B) did not appear to discriminate between either of the two versions.

2.2 _Heart rate_. These findings are indicated in both the heart rate and orienting response data. The heart rate data for all four groups are summarized in Figure 1 a-d. The seven pairs of adjacent intervals compared are plotted along the abscissa. The significance level of the comparison of variability within these intervals is plotted along the ordinate. The critical comparison occurs at that point on the abscissa marked 11 _vs_. 1. This is the point at which the stimulus changes from one version to another, _e.g._, from ↓ to ↑, or from ↓/ to ↑/. All remaining comparisons along the abscissa represent non-change points. The significance of these seven comparisons was assessed by the sign-test with $p < .05$ as the accepted level of significance. (All values given in Figure 1 a-d are two-tailed). Points falling within the dotted lines have failed to reach the accepted level of significance. As can be seen by inspecting the graphs, almost all points falling within this region fail to reach significance at even $p = < .10$. Data points falling either above or below the dotted lines are significant at at least the .05 level. Points falling in the upper region indicate places where there was an increase in variability from one interval to the next (dishabituation); points lying below the dotted line in the lower portion of Figure 1 a-d represent intervals where major decreases in variability were observed (habituation).

As can be seen by examination of Figure 1d, there is a major increase in heart rate variability within group 8B following the change in terminal contour from interval 11 to interval 1 ($p < .002$). No other set of adjacent intervals for group 8B are related in this fashion. Figures 1 a-c indicate that there were no instances where major increases in variability between two adjacent intervals were observed for groups 4A, 4B, or 8A. Thus, the only major increase in heart rate variability occurred within group 8B immediately following a terminal contour change. Similar heart rate patterns were never observed at non-change points within this same group (8B) nor at any change or non-change points within the remaining three groups 4A, 4B, and 8A.

2.3 Orienting behavior. The distribution of observed orienting responses reveals a similar pattern. In Figure 2 the number of orienting responses observed (shown on the ordinate) is plotted against the eight intervals examined (shown on the abscissa) for each of the four groups. Focusing on group 8B it can be seen that there is a rather substantial increase in the observed frequency of orienting responses immediately following the contour change. A comparison among the eight intervals examined for group 8B shows that they differ significantly among themselves ($p < .001$, Cochran Q-test). This difference is entirely due to the large increase observed at the contour change point (interval 1), since the remaining intervals do not differ significantly among themselves. The distribution of orienting responses observed for the remaining groups 4A, 4B, and 8A shows no such trend; there are no significant differences among the orienting responses obtained within any of these latter three groups.

In summary, there are significant increases in both the heart rate variability and the frequency of observed orienting responses following changes in contour only within group 8B. Except at the change point in group 8B, there are no overall significant correlations between the distribution of orienting responses and heart rate scores within 4A, 4B, 8A, or 8B.

Although the observed increases in cardiac variability and orienting behavior are in accordance with what would be expected from the preliminary data, the habituation data are not as decisive. A gradual trend towards habituation between contrast points for groups evidencing discrimination (8B) was anticipated. For groups where no discrimination was in evidence, i.e., where systematic changes in heart rate and orienting behavior were not observed, continued habituation beyond the first block of trials was not anticipated. Although no overall trend towards gradual cardiac habituation was obtained for group 8B (see Figure 1d), the data are consistently in the direction of habituation. The rapid return to habituation following the change point, although not significant, was not expected. The inclusion of introductory trials at the beginning of each experimental session may have been partially responsible for this latter observation. Conceivably, overall habituation to the stimulus patterns could have occurred during this initial period. Since the data from this period are not available, we can only speculate on this possibility. In any event, it seems obvious that such introductory periods should be eliminated from future studies. In fact, the procedure successfully used in a related study by Moffitt (1968) suggests itself as a general alternative to the one utilized here. Briefly, Moffitt's design involved (1) the presentation of only two contrasting stimulus sequences (with no introductory period), (2) the repetition of stimuli in blocks larger than triplets, and (3) longer intervals between each block of stimuli presented.

The data from group 4A are generally what would have been expected from groups failing to show systematic increases in cardiac and orienting behavior at change points (Figures 1a and 5). As can be seen from Figures 1b and 1c for groups 4B and 8A respectively, there are several points in the stimulus sequences where significant decreases in heart rate variability were obtained. While it would not be at all surprising to have found four month old infants capable of discriminating between the rising and falling stressed contours, it is unlikely that these decreases in heart rate variability reflect discrimination. This conclusion seems justified from a comparison of (1) the relationship of the observed decreases in heart rate variability to change and non-change points within sequences presented to all groups, and (2) the concomitant patterns of cardiac and orienting behavior found at change points in group 8B and in groups examined during pilot investigations (Kaplan, 1969). First, the heart rate decreases observed in 4B, 8A and 8B are not systematically related to any particular point in the stimulus sequence. Since these patterns occurred at different points within the sequence across the three groups, they cannot be directly attributed to any particular aspect in the stimulus sequence such as a change in stimulation. Second, these points bear no relation to increases or decreases in the frequency of orienting responses, as was true at contour change points for group 8B. The preliminary data collected on the discrimination between a male and female voice repeating the experimental triplet, "See the cat, see the cat, see the cat", further substantiates this claim (Kaplan, 1969). The design employed in these investigations was identical in all important respects to the one followed in the main experiment; and, the results followed a pattern similar to that found in 8B. Whenever marked increases in heart rate variability occurred at a stimulus change point, impressive increases in the incidence of orienting responses were also observed. Large increases in heart rate variability as well as orienting responses were not noted at any other non-change point in the presented sequences. Moreover, a decrease in heart rate was never accompanied by a concomitant increase in orienting behavior. In sum, these preliminary data suggest that discrimination is reflected by a combined pattern of increased cardiac and orienting behavior such as observed only in group 8B.

3.0 Discussion. The data suggest that normal falling and rising intonation contours, including the stress marker, can be discriminated by at least eight months. The failure of the other group of eight month old Ss to discriminate the unstressed falling and rising contours may reflect the importance of concomitant stress and pitch patterns which characterize terminal contour in normal American-English speech.

The data indicate that neither group of four month old infants was able to distinguish between the presented forms. Simple procedural artifacts can be ruled out since extensive pretesting with a set of stimuli known to be highly discriminable to four month old infants proved the procedures to be most satisfactory (Kaplan, 1969). A male and female voice repeating the utterance "See the cat↑" were presented for discrimination under the same experimental conditions employed in the study here reported. The results matched those found for the 8B group. Variability in heart rate increased when the voice changed from male to female and vice versa; the number of observed orienting responses varied in a similar fashion. Exactly when the ability to discriminate between these features appears is not clear from this study. The study only indicates that it develops somewhere between four and eight months. There is reason for expecting this distinction somewhat earlier, perhaps as early as at five months. A recent study suggests this possibility. Using a similar habituation-dishabituation design, Moffitt (1968) was able to demonstrate discrimination between the two phonemes /b/ and /g/ when paired with a vowel in five month old infants.

At first glance Moffitt's results might seem to contradict the original hypothesis that there is an overwhelming priority given to supra-segmental as opposed to segmental information. However, before accepting this conclusion, there are several points to consider. First, Moffitt's subjects were slightly older than the youngest group examined in this study. Second, there were several critical differences in the procedures followed in both studies. For example, the number of stimulus repetitions presented differed considerably as did the length of the inter-stimulus intervals used (a variable known to be important in this kind of design); but most importantly, Moffitt maximized the critical differences between his stimuli by embedding them within a smaller context. That is, the contrast was embedded in the two short syllables bah and gah in Moffitt's study, whereas the contrast in this study was embedded in the longer utterances "See the cat" ↓ and "See the cat" ↑. Perhaps a contrast between bah ↓ and bah ↑ would have provided a more appropriate test of the present hypotheses.

A more interesting explanation for the difference between the two studies lies in the nature of the particular supra-segmental feature--terminal contour--originally selected for study. Although there were good reasons for examining direction of terminal contour, there is now reason for suspecting that distinctions among other supra-segmental features might precede the distinction between direction of terminal contours. Specifically, the distinction between the features presence or absence of terminal contour (+ or - terminal contour) may be more basic than the features falling and rising terminal (↓ and ↑ terminal contour). It follows from the definition of terminal contour that the ability to distinguish between + and - terminal contour logically must precede the ability to distinguish between ↓ and ↑ terminal contour. After all, ↓ and ↑ terminal contour are examples of + terminal contour. The difference between ↓ terminal contour and ↑ terminal contour should require the prior ability to discriminate between the features + and - terminal contour. Consequently, the detection of the feature contrast + vs. - terminal contour would be expected to developmentally precede the distinction between the features ↓ and ↑ terminal contour.

There are other considerations which lend additional confirmation to this interpretation. It can be demonstrated that the kind of information carried by these two features (+ and - terminal contour and ↓ and ↑ terminal contour)is of a different nature. The features + and - terminal contour are normally more informative than the particular + terminal contour features ↓ and ↑. The correspondence between either of the latter two features and language structure is more complex than the correspondence between the + and - terminal contour normally specify boundary information only; although the + terminal contour features, ↓ and ↑ terminal contour also specify boundary information, there is in addition a partial correlation between these features and a variety of related linguistic forms--the statement, question and incomplete phrase. Most yes/no questions end in ↑ terminal contour, but there are many questions as well as statements which take the feature ↓ terminal contour. Also, the feature ↑ terminal contour as well as the feature |* terminal contour are often associated with non-finality, i.e., they indicate the sentence is not over yet. Both points, (1) the difference in the kinds of dimensions separating the two sets of features, and (2) the difference in the relative informativeness of the two features, would argue for the prior detection of the features + and - terminal contour.

There is one final point to consider. Do the ↓ and ↑ distinctions made by the young infants in this study and the /b/ and /g/ distinctions made by Moffitt's Ss, represent phonetic or phonemic perception? For adults speech perception appears to be categorical (Liberman, 1957). That is, for at least some classes of sounds, including the stop consonants [b] and [g], speech perception is discrete. It is thus important to ask whether the infants (in both studies) were discriminating on the basis of continuous differences along the sound spectrum rather than classifying the two sounds as categorically different. Stating it somewhat differently, do these represent language specific distinctions, universal distinctions, or distinctions not specific to language? Future research involving cross-linguistic comparisons is in part directed towards answering these particular questions. Additional studies now in progress using more sensitive habituation and conditioning procedures are directed towards answering some additional questions raised in this paper (Bower, 1966). For example, is plus vs. minus terminal contour distinguished prior to direction of terminal contour? Is priority shown to supra-segmental as opposed to segmental features during the early stages of language acquisition? Specifically, does a young child perceive (a) [bah]↓ as more similar to (b) [bah]↑, (c) [gah]↓ or (d) [gah]↑ If the main hypothesis is correct, a child should initially perceive (a) and (c) as more similar than (a) and (b) with (a) and (d) being perceived as the most distant comparison.

* Level

FOOTNOTES

1 Citing Lieberman's (1965) study as support, several investigators (McNeill, 1966; Bever, Fodor & Weksel, 1965) have suggested that correct appreciation of supra-segmental features is restricted to speakers with fully realized language systems; thus, the possibility of a young child utilizing such information to discover other language patterning is eliminated. This assertion is based on an unfortunate misunderstanding of Lieberman's study. The Lieberman study only shows the inadequacy of the rather complex, Trager-Smith transcription system; it does demonstrate the inability of naive listeners to correctly perceive intonation patterns.

2 The procedures described in this section are based on a series of preliminary investigations reported in Kaplan (1969).

3 Data from an additional 24 Ss were discarded for the following reasons: 10 Ss equipment failure; 9 Ss cried and fussed during the session; and 5 Ss were overly active. All decisions to discard Ss were made prior to data analysis.

Table 1

Stimulus Presentation Orders

Six sets of alternating triplets

Group	Order	1	2	*3	*4	*5	*6
4A & 8A	I	↓↓↓ .... ↓↓↓	↑↑↑ .... ↑↑↑	↓↓↓ .... ↓↓↓	↑↑↑ .... ↑↑↑	↓↓↓ .... ↓↓↓	↑↑↑ ....↑↑↑
	II	↑↑↑ .... ↑↑↑	↓↓↓ .... ↓↓↓	↑↑↑ .... ↑↑↑	↓↓↓ .... ↓↓↓	↑↑↑ .... ↑↑↑	↓↓↓ ....↓↓↓
4B & 8B	I	↓/↓/↓/...↓/↓/↓/	↑/↑/↑/...↑/↑/↑/	Etc.			
	II	↑/↑/↑/...↑/↑/↑/	↓/↓/↓/...↓/↓/↓/	Etc.			

*Contrast points

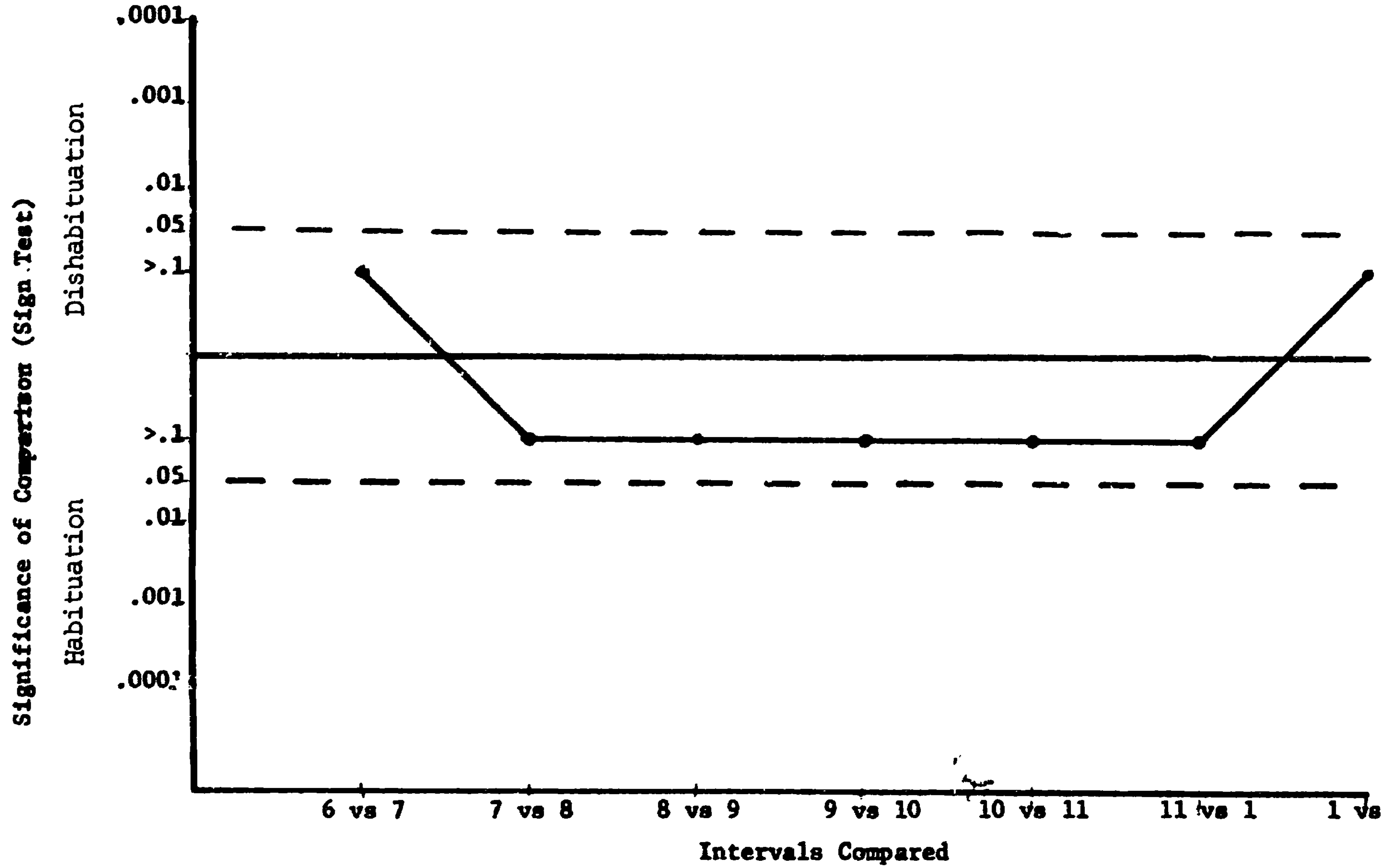

Figure 1-A Comparison of Heart Rate Range
in Adjacent Intervals: 4A

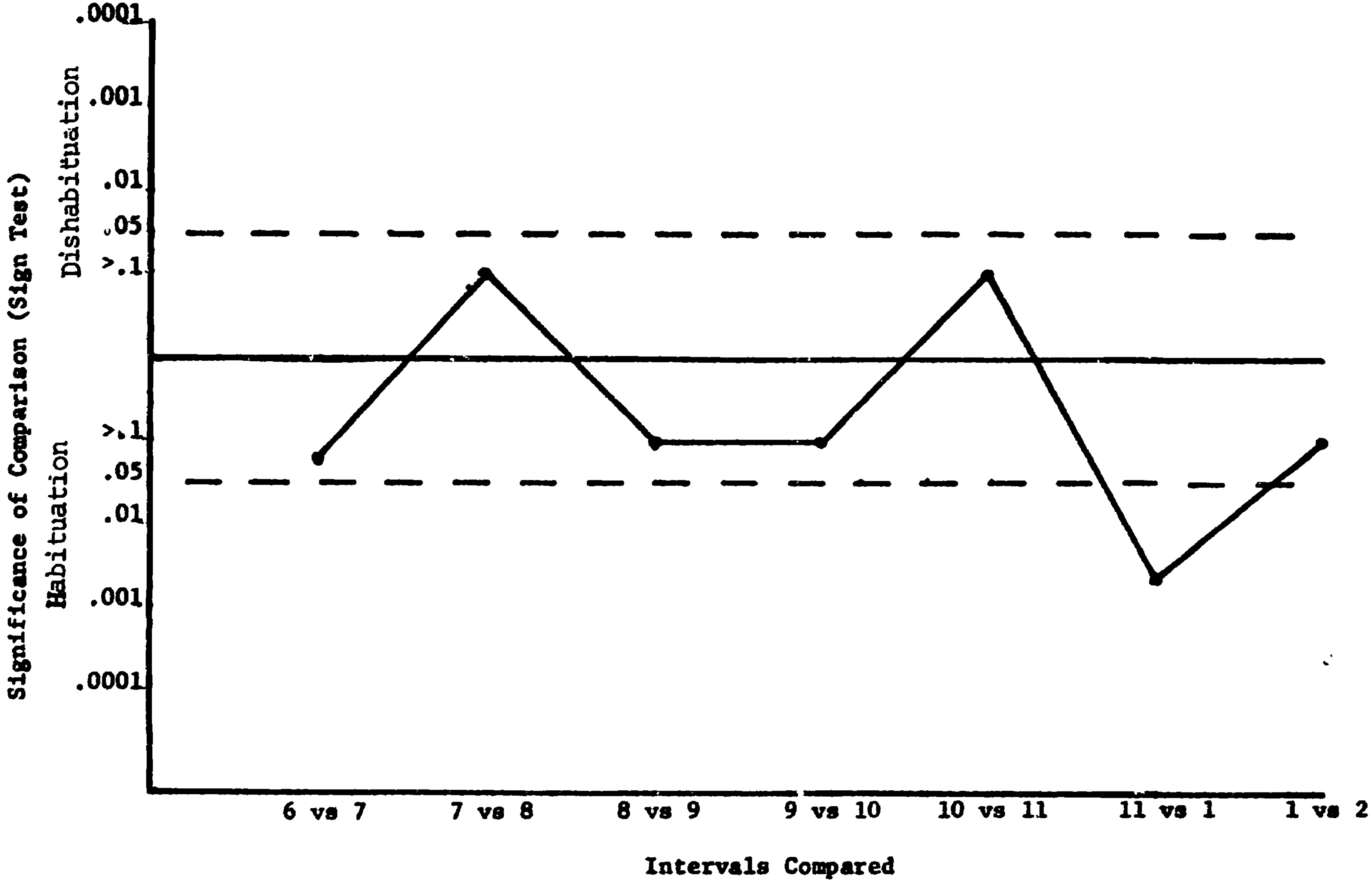

Figure 1-B Comparison of Heart Rate Range
in Adjacent Intervals: 4B

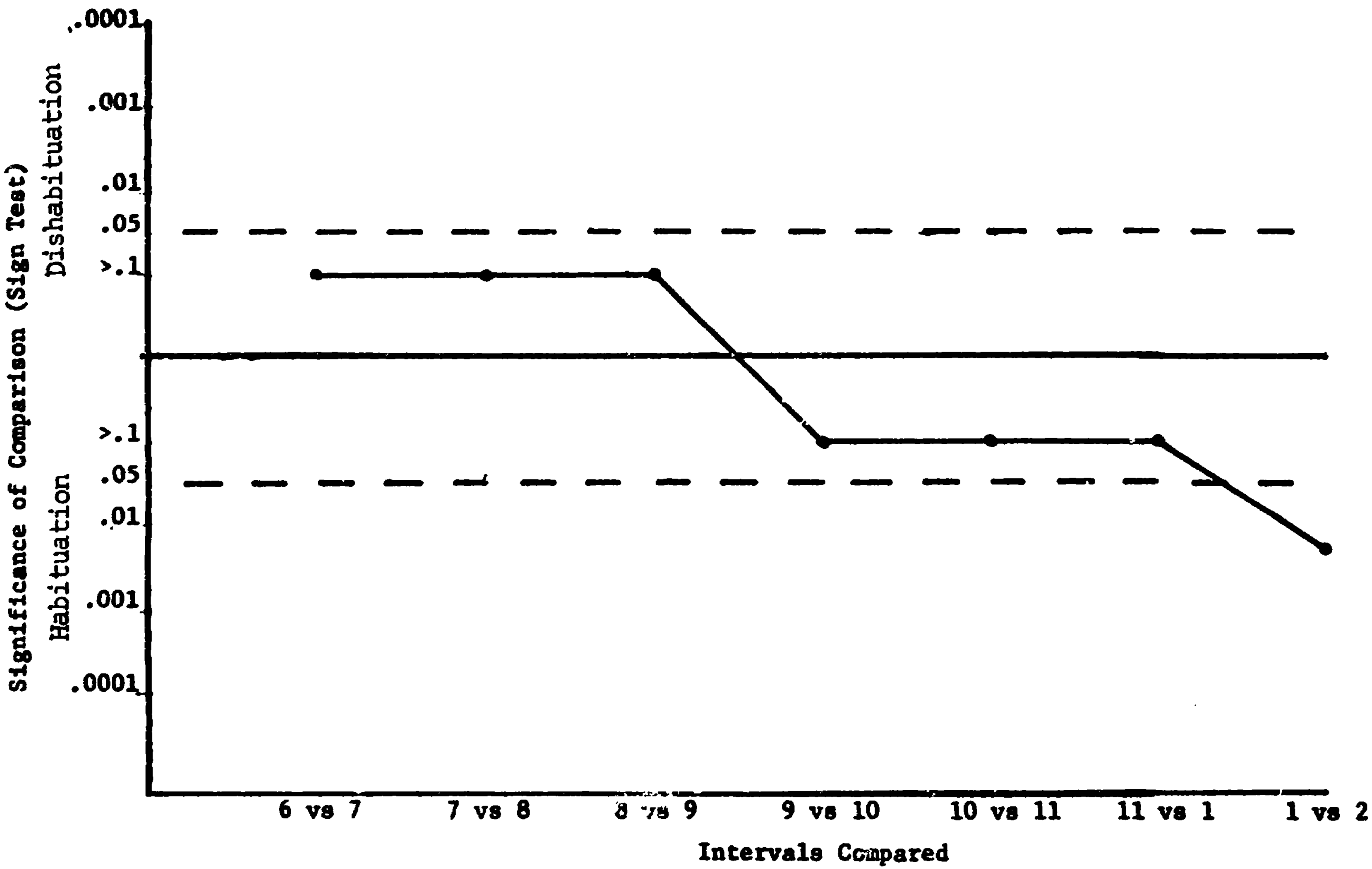

Figure 1-C Comparison of Heart Rate Range
in Adjacent Intervals: 8A

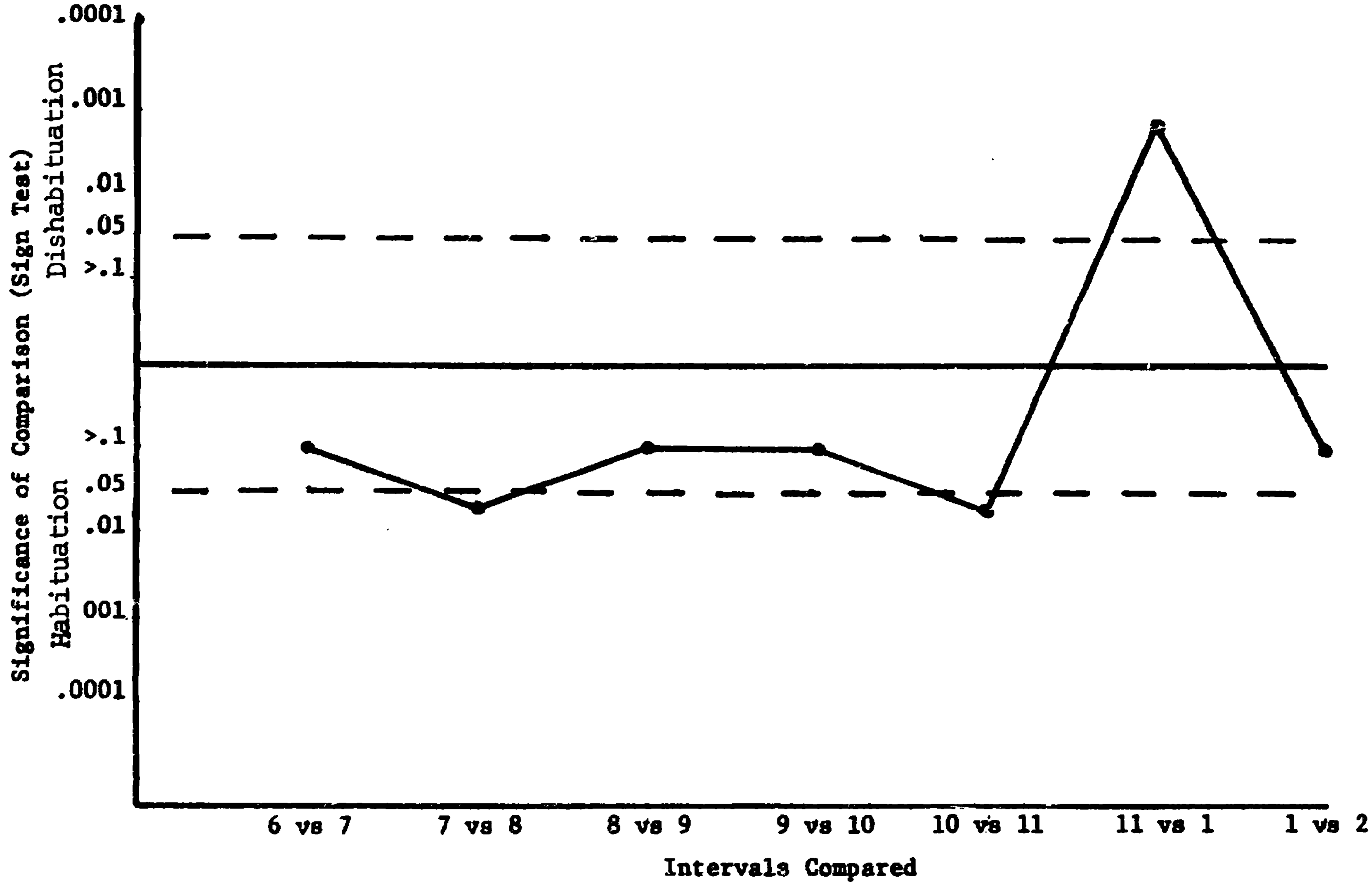

Figure 1-D Comparison of Heart Rate Range
in Adjacent Intervals: 8B

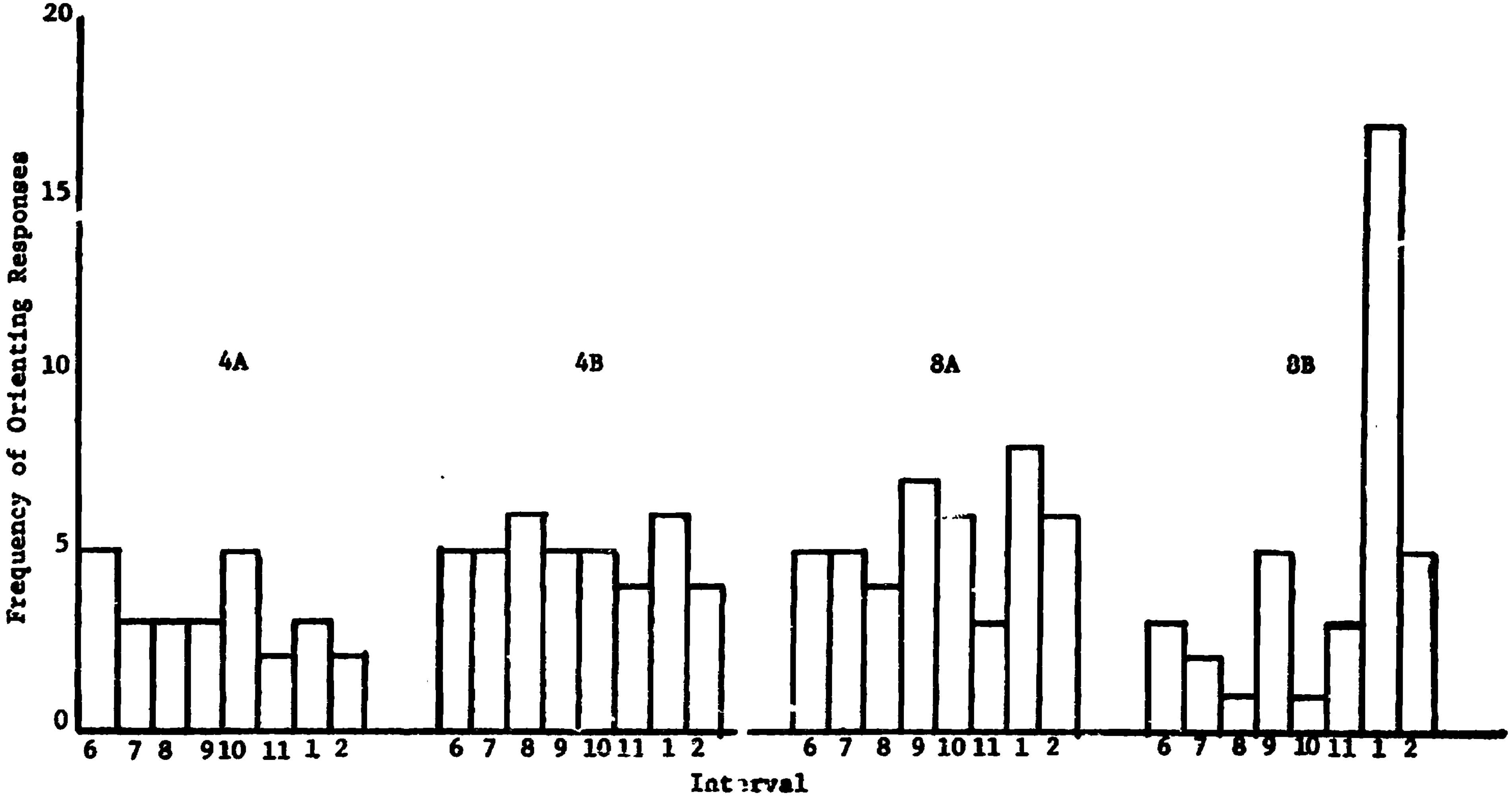

Figure 2. Distribution of Orienting Responses

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