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ABSTRACT

The results obtained by researchers interested in the speech-time relationship indicate that the sequential organization through time of speech sounds necessary for communication requires a universal "grammar" consisting of vowel and consonant sequences and an awareness of the duration experienced in that process, as well as the memory of its sequence. The elementary aspects of speech timing can only arise with infant babbling. A study of infant speech timing examined whether the perceived temporal characteristics of infant speech changed to reflect increased voluntary control of speech timing when the child achieved an unsupported, upright seated position. An analysis of tape recorded infant babblings obtained over several weeks revealed that (1) utterance durations decreased with time and became more uniform, or less variable; (2) the infants seemed to form a preference for consonant/vowel types, practice them, then use them often but more selectively; and (3) the infants began to use breath control to pattern sound with time. Thus, the changing skills observable in the speech data suggest voluntary control of speech series and an underlying emergence of cognitive functioning in segmented time, or temporality. (HOD)

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Infant Speech Timing:

The Temporal Aspects of Speech Praxis Toward Language

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The relat onship between a biologically evolved speech capacity and a culturally learned linguistic form of communication has been of interest to scholars from widely divergent fields including philosophy, neurology, linguistics, speech science and communication. The consequences of such a relationship appear to be numerous, but support for theoretical propositions concerning the relationship is sparse. Since speech communication scholars may, within disciplinary boundaries, focus on the phenomena arising from a speech-language relationship they may ultimately find it important to explore and explain the relationship itself.

The study of infant speech, or prelinguistic speech, has emerged as an acceptable and productive research focus for scholars interested in the speech-language relationship. The current research tends to be interdisciplinary, both in source and concept; that is, no one discipline can claim infant speech as its own, nor can one discuss it credibly without reference to disciplines other than one's own.[1] Speech communication scholars, until recently, have been conspicuously absent from bibliographies of infant speech. Even texts within the discipline cite largely authors writing from biological, psychological or linguistic perspectives.[2] Scholars from areas other than speech communication who are concerned with human behaviors are adopting an interest in in early speech processes because they appear to be related to the development of uniquely human capacities.

Within the domain of speech communication, "speech" may be claimed as a primitive, minimum term;[3] however, very little research of infant speech has been reported although developmental aspects of communication appear to be getting more attention.[4] A discipline which professes the study of human communication ultimately must address "why" as well as "how" and "what" questions. Along with the descriptions of what occurs in speech communication and how it is accomplished, consideration of why speech communication develops as it does will require pushing back the processes of interest to their origins. The relationship between speech and other human capacities may best be studied from a perspective grounded in speech communication and relatively unaffected by specialty biases arising from the study of an aspect of human behavior that is revealed by symbolic communication (e.g., anthropology, psychology).

The Problem

One of the uniquely human traits which appears to be inextricably tied to the speech-language relationship is a time sense, arising from the perception of time as duration and sequence. While the topic of time sense has been addressed by some communication scholars, the focus has been to study temporality as it affects communication,[5] or to examine time as a context for the generation of meaning.[6] While these are worthwhile projects, no attempt has been made in the field of speech communication to examine the foundations of temporality; to discover the clues which reveal the close relationship between temporality and human communication.

Temporality, or the perception of one's position in time, appears to assume an awareness of self as an agent in space. The perception of one's own speech seems to be the key to understanding this humanizing process of becoming self-aware in time. Ira Hirsh, working in psychoacoustics, provided much of the theoretical framework and support for the importance of auditory perception in communication. The belief that "the perception of speech depends . . . on the way in which things change in time,"[7] led him to look at the significance of the serial order of speech stimuli for human temporality.[8] He found that the rules which govern temporal pattern perception in the hearing process must be combined with different rules arising from the structural aspects of spoken language in order to perceive speech.[9] The use of speech as communication then, requires not only the types of pattern perception given by auditory mechanisms and available to some animals,[10] but also a generative set of rules which arise from the limitations of speech; phonological limitations of articulation in time sequences.

If, as some speech scientists suggest,[11] grammatical processes evolved as an interface to match the potentials of the brain to the limitations of the devices for producing and perceiving speech sounds, they were processes which brought with them an increasing control of time patterns and awareness of the time dimension. The connection between speech and temporality apparently provided by "grammar" (speech sound rules) prompted Hirsh to comment: "I am not sure that temporal and verbal are very different, in that I think original language learning is entirely auditory, is entirely processed in time."[12] Judging from the results obtained by researchers interested in the speech-time relationship,[13] one might synthesize that information as follows: the sequential organization of speech sounds in time necessary for communication appears to require a universal "grammar" consisting of vowel and consonant sequences, an awareness of the duration experienced in that process as well as the memory of its sequence.

Although speech sequences are not the only sequential patterns that humans have the capacity to produce, they may be the first to foster an awareness of the temporal characteristics of experience. Thus, the fact that one comes to speak in grammatical sequences is not trivial, nor is the fact trivial that one comes to think and act in cognizance of temporal context; indeed, these two characteristics of human communicative existence may be intimately related by means of their common precursor: speech.

Theoretical Framework

The study finds its foundations in a speech theory of human communication.[14] The developmental theory focuses on early speech growth in order to explain accompanying attributes of human communication. A projection of the theory may serve to comment on the role of speech in communication across the human life span.

The proposition which prompts the study has been explicated in the speech theory and expanded for purposes of this study to more clearly specify the nature of the oral/aural experience that is expected to foster the development of temporality. "The oral/aural experience forms and augments temporality for the individual" by means of the contrast between duration (of self throughout oral speech production) and succession (or aural sound sequences produced by self). Clarification of the proposed theoretical stance may be served by definitions of key terms and discussion of the variables of interest.

<u>Speech</u>: "The human genetically determined, species-specific individual activity consisting of the voluntary production of phonated, articulated sound through the interaction and coordination of peripheral effector organs as a group as well as the speech-specific neural structures and pathways."[15]

Although the scope of this work does not encompass a defense of definitions, support for "speech," as defined, may be found in Dance's treatise on the speech theory. The focus of the study is very early speech. Prior to the infant stage of babbling, simple vocalization is the norm. Speech in its normal development includes perception as well as production.[16]

<u>Language</u>: "The culturally determined syntactic systematization of signs and/or symbols."[17]

Language is the existing symbol system into which most humans are born. "When speech fuses with language the result is spoken language."[18] Babbling occurs prior to spoken language.

<u>Speech Timing</u>: The timing of articulatory movements and sequences in a controlled manner, such that the duration of speech sounds and their ordering are not completely determined by physiological constraints.[19]

The elementary aspects of speech timing can only arise with babbling; that is, upon achievement of "circular" or "secondary circular" reactions.[20] The child's own sounds, in a speech example of a secondary circular reaction, "stimulate the child to utter further sounds,[21] thus one "object" conditions the next such that a sequence is set up in which the individual is an active agent of speech.

Example: A string of babbling in which sounds are similar in articulation, but not necessarily regular (as in breathing). Some experimentation in the time element may occur.

Temporality: The perception of one's position in time as distinguished from space. Such a distinction fosters the development of an individual sense of time.

Time is a dimension of reality for humans that is constructed by the infant and requires the contrast between subject and object.[22] A sense of spatial position precedes temporality. Temporality, in the infant, may include anticipatory activity; action in expectation of an event.

Example: a greeting cry in anticipation of mother's presence.

Babbling: "Sequential combinations of two or more non-crying, non-reflexive infant sounds made with the vocal apparatus plus all prosodic and suprasegmental features of these sounds."[23]

Babbling as timed speech. With the emergence of babbling, the characteristics of speech (phonated, articulated sound) appear. In order to shape sounds in sequence, some control of the articulators is implied. In particular, instances of consonant/vowel syllables are clearly examples of speech.

In an integrated approach that stresses the cooperation of linguistic and behavioral skills, Lar found that early babbling and motor behaviors are related in preverbal skills. The rhythms of speech and other motor skills coincide, at least at the very early ages studied (the first eight weeks of life).[24] When the infant is able to control babbling sequences in later months, the rhythms may diverge; in fact, must diverge to some extent so that speech may serve meaningful language without extraneous movement.

As babbling sequences move away from correspondence with motor rhythms, toward independent control, the possibility for other correspondences emerges. Ferguson suggests that this stage between babbling and language is a link, not a leap, in which meaning and sound may become related.[25]

Delack concurs that babbled speech permits the construction of meaning,[26] by mapping patterned situations onto patterns of sound. The most likely candidates for the sound patterns are those which may be repeated and distinguished from one another. Ferguson described four phonetic types which may serve to "map" reality with sound.[27] Locke concludes from recent research data that speech is continuous from babbling to phonology. He implies a babbling "projection" to language.[28]

Lewis and Cherry claim a unified model in which social, cognitive and linguistic aspects interact in the individual.[29] They view social behavior as grammar, citing chains of behavior between the infant and mother that are rule governed, much as language is. Their example concerns the approach of the mother as a prototype of future tense in the sense of anticipation.[30] While they propose that language development is best studied as part of the socialization process, they fail to address the underlying structure that might trigger a grammar of any sort. Sequences organized for communicative or perceptual purposes appear to be set up synthetically, as opposed to being innate, and imply a uniquely human set of structures or process or both. The interaction of speech processes and the adaptive brain, cited by Lenneberg as peculiar to man,[31] may offer the necessary structure.

A set of assumptions, supported by literature from speech and language behavior, psychology and physiology, forms the underlying logic for a research question.[32]

1. Physiological constraints of speech give rise to universal speech patterns. For the most part, these patterns emerge in consonant/vowel sequences.

2. Auditory feedback of speech plays a crucial role in the development of speech timing. When feedback of speech is established, the infant may alter the patterns heard so as to produce different patterns from those which are based in reflex responses.

3. Articulation in speech plays a role in providing the necessary contrast for pattern recognition. The articulation found in babbling allows the perception of speech as a series of sounds in linear sequence; that is, a pattern.

4. Articulation and subglottal pressure maintenance are facilitated by an upright posture. Certain vowels appear with the developing twin-tube structre and the production of consonant/

vowel syllables increases. To what degree these abilities are due to simple maturation rather than postural change is unclear, but facilitation of articulate speech production by upright posture seems likely.

5. Sequential patterning of phonemes accompanies the increasing ability to produce longer breath-groups. The ability to maintain subglottal pressure permits the production of longer breath-groups. The infant's "practice-play" with speech patterns may then become more complex, specifically involving series of sound variations.

6. Physiological speech processes induce speech patterning which, at a critical point in development, comes under the infant's voluntary control. Using posture as a "marker" babbling patterns might be mapped across time to demonstrate a critical point, or visible change stage, in temporal characteristics of speech.

The Study

The research interest. One may reasonably ask of infant speech data: how and when does an infant begin to exercise voluntary control in time? Although the proposition will be neither supported nor denied with the results of the study, a step will have been taken toward the understanding of human communication effects.

The research question. The study seeks to describe a transition period in infancy, from temporal speech characteristics that may be accounted for by developing reflex processes to speech patterns that appear to be under increasing voluntary control. Will the perceived temporal characteristics of infant speech change upon achievement of an unsupported, upright seated position to reflect increased voluntary control of speech timing?

A postural milestone: control for development rather than age. In order to explore the genesis of timing skills for language, one might look for a milestone of physiological maturation for speech that could accelerate those skills in the individual possessing normal oral/aural functioning. The babbling stage of infancy will suit the data requirements in terms of availability of contrasting phonetic types and increasing non-cry vocalizations, but a maturational "event" in that stage would provide a focal point in the speech process moving toward language.

The changes fostered by the postural watershed in speech development may include shifts in speech patterns which demonstrate increasing timing control of speech. The timing control necessary for meaningful spoken language may begin at the described stage of motor development. "The sequential arrangement of muscular events" necessary for spoken language may begin with the patterning of speech sounds in babbling. The fact that this sequencing activity requires "anticipation of later events"[33] reveals the role of speech in individual temporality.

Subject selection. The postural milestone behavior that may foster speech production often occurs in the sixth month. In order to obtain speech samples prior to the postural achievement as well as following it, data was collected for the first time about a month before unsupported sitting was expected. Five and one half months following birth was chosen as an optimal age, on the average, to begin collecting data in the expectation of obtaining two samples (every two weeks) before the infant achieved the watershed in postural control which presumably paralled achievements in speech control.

The child study laboratory at the University of Denver maintains an infant subject pool selected for the following characteristics: 1) born in a Denver hospital, 2) resides in the Denver metropolitan area, 3) birth weight of 2500 grams or more, 4) APGAR score of 7 or better, 5) parents with a high school education or better, and 6) mother married. The selection reflects an attempt to obtain normal, healthy subjects with parents willing and able to participate.

Field procedures. Visits, scheduled at two week intervals prior to the milestone event and again following it for two sessions, consisted of setting up the recorder, completing a parents' questionnaire and giving instructions for recording speech and observing postural behavior.

The recorder was set up in an optimal location chosen by the parent in consideration of these criteria: 1) where the baby is most likely to vocalize in a prone or supine position, 2) where environmental noise is minimal, and 3) where there is an electrical outlet nearby. A page for describing the infant's sitting-up attempts was provided and the importance of this observation to the study was stressed. The behavior was defined, questions answered and methods of contacting the researcher suggested.

Each subsequent visit consisted of setting up the recorder and checking the progress of postural control. If the parent reported achievement of the milestone behavior, the researcher verified by timing the infant's maintenance of upright sitting. If the child could hold him/herself in a seated position for at least five minutes, the milestone was verified and a taping appointment scheduled for approximately two weeks from the observed event on the assumption that the child could, by that time, remain seated throughout the fifteen minute taping. After the milestone event, subjects were taped only in the seated position for the last two sessions.

Data reduction. Upon completion of data collection, each tape was submitted to careful analysis for selection of five speech segments per session, or twenty per subject, which met the following criteria: 1) demonstrates characteristics of an early vocable or phonetic type;[34] that is, a repeated consonant/ vowel syllable, syllabic vowel, syllabic nasal or syllabic fricative; 2) consists of a lalling sequence; that is, at least two repetitions of a vocable type in one breath-group, or several in succession;[35] and 3) is not perceived as a reflex response; i.e., crying, laughing, coughing. While the number of segments per session which met the criteria were noted for each subject, only five were submitted to spectrographic analysis. If selected segments totalled more than five per session, every other qualifying segment, starting with the first, was transferred to the master tape. If necessary, the process was repeated with the remaining segments until five were obtained.

Each tape was checked for time constancy.[36] The master tape, holding twenty segments per subject, produced spectrograms describing the segments visually. Each spectrogram was coded for 1) subject, 2) date and session number, and 3) phonetic types and broad descriptive catagories.[37]

Utterances and pauses were measured in millimeters and recorded on the spectrogram. Measurements of the duration of the first formant frequency regions during regular cycles were performed for utterances, while pauses defined the space between repetitive utterances (including "irregular" noise)

---figure 1---

From the analyzed data, the following descriptive techniques were applied:[38]

1. Each subject's speech was charted for utterance duration, pause duration and breath-groups (utterances per breath-group), per session and across sessions.

2. Frequency distributions of qualifying segments were charted over time, per subject.

3. Durations of phonetic types were charted on scattergrams.

4. Each phonetic type was graphed for duration scores, number of utterances per breath-group, and number of utterances lalled in sequence across breath-groups.

Descriptions of speech patterns per subject across time were thus obtained, as well as trends for phonetic types across subjects.

A check on reliability of researcher segment selection and coding was provided by repeating segment selection and the coding of those segments for two sets of data which were eliminated from the study proper by reason of incomplete sessions. Two judges (speech science graduate students) treated the data using the same criteria set forth for selection, measurement and coding.[39] The researcher used the instructions first in reducing the data, then repeated the procedures six weeks following the original reductions. Measures were thus obtained, on the basis of two eliminated subjects' data, for interjudge reliability as well as test-retest reliability. The coefficient of concordance, Kendall's W, was chosen to measure significant agreement between judges,[40] and a correlation coefficient, Spearman's rho, to demonstrate test-retest reliability.

Limitations. The primary precaution suggested throughout the study is to beware of assuming that the motoric milestone of unsupported sitting is of the same stature as an independent variable in an experimental study. While it is expected to foster speech development under normal conditions, upright posture is not to be considered causal in any sense. Rather, the developmental watershed provides an observeable behavior that may parallel the behavior of interest: speech timing. The milestone provides some control over maturation as a variable by pinpointing that postural event in the speech process.

As is often the case in infant studies, generalizability is severely limited to the characteristics selected for the subject pool. Random selection was impossible in attempting to obtain a number of subjects of approximately the same age. Even randomization of speech samples was also limited by the logistics of data collection by one individual with one set of recording equipment. Samples were obtained every two weeks; however, the sample obtained was often limited to the parents' available time or the infant's mood or state of health.

The sound spectrograph validly describes time, frequency and intensity of speech within a fixed frequency band. Because the recorded tapes were checked for time constancy and were all analyzed through the same filter, the resulting descriptions are consistent and reliable for frequency, intensity and duration.[41]

Results

The preliminary analysis included reliability tests, measures for sample representativeness, time reliability of equipment and analysis of subject data. Reliability of coding and data reduction procedures was highly satisfactory for purposes of this study. The test-retest correlations were highest (.62-.99), then interjudge (.38-.99). An exceptionally low score on phonetic type coding (.38) revealed low agreement between judges in this area. One explanation may have to do with the unfamiliarity of the student scorers with infant speech.

TABLE A

Reliability Measures

	Test-Retest	Interjudge
Selection of Segments From Tapes	ρ = .99 = 98	ρ = .99 = 98*
Phonetic Type Coding	ρ = .96 = 18.7	W = .38 = 30.7
Breath-Groups Per Segment	ρ = .62 = 4.1	ρ = .55 = 3.4*
Duration Measurements		
Utterance	ρ = .97 = 30.9	W = .88 = 66.6
Pause	ρ = .98 = 33.1	W = .94 = 71.1

*Two judges out of three completed procedures, so rho was calculated as the appropriate statistic for agreement between two judges rather than concordance among three.

see next pg. for unreduced Table

The data sample proved representative of phonetic types in the total population within a 2.5 percent range. Sound transferred to a visual display required a time-to-space measurement equivalency. All tapes showed consistent transferral of 100 cycles per second (sound frequency) to 128 millimeters on the spectrogram.

Information from the coded spectrogram was transferred to charts and then graphed by individual subject and session. Subject data varied from one individual to the next, although durations appeared generally to decrease and utterances per breath-group to increase with age.

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*Two judges out of three completed procedures, so rho was calculated as the appropriate statistic for agreement between two judges rather than concordance among three.

---figure 2---

Subsequent analyses were performed to integrate the data for an overall picture of changes in infant speech patterns before and after the postural milestone. Across types and subjects, utterance durations decreased and became less variable and pause durations decreased, then increased. Specifically,

---figure 3---

---figure 4---

vowels tended to cluster toward lower durations. Consonant/vowel types decreased in duration, then increased in the last session.

---figure 5---

---figure 6---

All types increased in frequency of repeated utterances before the event and decreased after it. The strongest patterns were found in consonant/vowel types. The change in number of utterances per

---figure 7---

---figure 8---

breath-group appeared to be dependent upon phonetic type. Vowels per breath-group increased after the milestone while consonant/vowel types increased at the milestone, then decreased.

---figure 9---

---figure 10---

Supplementary analysis examined the relationship of utterance duration to the duration of the total segment consisting of utterance repetitions. Vowels tended to move to shorter utterances in slightly longer segments. Consonant/vowel types clustered, after the event, toward longer utterances within briefer segments.

---figure 11---

---figure 12---

---figure 13---

The answer to the research question then, is yes; infant speech timing does change in several ways in the period controlled by the postural achievement of upright sitting. Implications for voluntary control, as well as for other temporal behaviors, are explored by interpretation.

Discussion

Duration. Utterance durations decreased with time and became more uniform, or less variable. The results of the present study differ from the findings of researchers who described earlier infant speech. Delack found that duration of utterance became greater over the first year of life,[42] and Laufer and Horii reported an increase from the second to the fifth month.[43] The present study is not in disagreement with the Laufer and Horii findings, but may provide a continuation from their exploration of the first five months to a period in which the infant sits up (five and one half to eight months). However, the period described in this study does seem to contradict the Delack findings from the first year of life. Two individual subjects in the present study demonstrated a decrease in utterance duration, then a rise at the last session. Durations did show a decrease particularly around the event. But a wider range of data, such as was gathered for the Delack study, could be descriptive of an overall increase even if most subjects decreased durations for a period limited by the milestone of upright postural achievement.

The discontinuity observed in speech durations around the milestone event suggests a change in the way infants time speech during the period circumscribed by the postural behavior. If, as Hubbard's findings seem to imply, infants do operate on the basis of feedback of their own speech,[44] then infants from at least six months of age may alter their speech by modal feedback and control durations in a manner that may begin to approach preplanning of speech. Bruner's view of the construction of serially ordered acts informed Kent and Forner's study of children's motor control for spoken language. Their finding of reduced duration of segments with age was interpreted as one of the gradual modifications of serial acts toward "diminishing variability, increased anticipation, and improved economy."[45] The infants in the present study appeared to modify their speech patterns, in the period defined by postural achievement, such that similar modifications of speech serial acts (e.g., babbling) were accomplished.

The decrease in variability of durations agrees with the findings of Lane and Sheppard who studied infants up to the fifth month of life. The control of respiratory and laryngeal mechanisms that Sheppard and Lane concluded is a concomitant of age and maturation, appears to increase after the achievement of upright posture (see figures 5 and 6). Durations clustered at the lower end of the scale; that is, became more uniform.

In a comparison of individual utterances to the length of the total segment of repetitions of which it is a part, results of this study revealed no clear pattern within sessions; however, both utterances and segments decreased duration over time. Vowel utterances became shorter within longer segments of repetitions in the final session. Consonant/vowel utterances however, became longer within shorter segments of repetitions (see figures 12 and 13). Cooper's results demonstrated that three-year old children tend to preplan utterances much as adults do; that is, the longer the "segment" (sentence) the shorter the individual "utterance" (word).[46] Although infant data in the present study do not show a similar trend, there is evidence (movement to utterances of similar length for both consonant/vowel and single vowel utterances) to support a suggestion of experimentation with timing for language.

The number of utterances repeated over a segment increased after the milestone event, then decreased in the final session (see figures 7 and 8). Experimentation with long strings of utterances appear just around the event, then segments seem to become more uniform, more efficient. The patterns of speech acts move toward "diminishing variability" and "improved economy," that is, toward the control of serially ordered acts as Bruner described them in development.

Phonetic Types. Oller and his colleagues found that infants formulate phonetic preferences very early, by six months of age.[47] Some of these preferences emerged in the data collected for the present study. Generally, the frequency of vowels decreased, while consonant/vowel syllables and nasals increased in number of segments produced after the event. The Oller study also revealed trends including a reduction of consonant clusters to single consonants. The number of consonant/vowel repetitions per segment found by this researcher increased radically just following the event, then decreased even more drastically. The infants seemed to form the preference for consonant/vowel types, practice them, then use them often but more selectively (see figure 8).

Breath-groups. Lieberman's "pattern of articulatory activity," that forms patterns characteristic of those used to form sentences in adult speech,[48] is maturational in that the patterns of esophageal pressure and fundamental frequency contours are formed from birth. Increased control of respiration and phonation are necessary to the use of the breath-group as a "phonetic marker."

Lieberman suggest that the first evidence of the use of the breath-group referentially occurs in babbled sound patterns.

The use of the breath-group to pattern sound is supported by the data gathered in the study. Although the number of vowels produced per breath-group increases after the milestone event, the more dramatic changes occur in consonant/vowel syllables per breath-group. The number of consonant/vowel utterances increased to the session following the event, then decreased in the last session (see figure 10). Thus, while vowels were becoming shorter and more controlled; that is, several might be produced in one breath-group; consonant/vowel syllables went through a stage of multiple repetitions while becoming shorter, then leveled out in duration and decreased repetitions (see figures 6 and 8). Vowels became less drawn-out, more clipped per breath-group; and consonant/vowel syllables became more uniform and singular, less repetitions per breath-group. Mean durations for both types approached the same measurement in the last session (figures 5 and 6), while their frequencies per breath-group appeared to be inversely related after the event (figures 9 and 10). Both types appear to be moving toward controlled use in breath-groups, such that either type might replace the other in a breath-group, at least in terms of duration. The segmentation of a speech series for language use seems possible at this point.

Interpretation

Control and Volition. The study described a period of infant babbling limited in range by a milestone of postural achievement.

Although temporal characteristics of infant speech did change upon the postural achievement, often just after the event, whether those changes reflect increased voluntary control is a question of interpretation. Volition has been defined as "the will to act in the present; may be observed as behavior in which acts and perceptions are coordinated such that the actor is an element in a series." [49] The infants in the study produced speech acts coordinated in series, and moreover, appeared to coordinate those series in different patterns over the course of several months. Of particular interest is the sudden dip in durations within an overall increase - a variation of a trend in timing.

Although infants do seem to be aware of their power to produce sounds from the third month on,[50] patterned speech acts may become voluntary acts only "when the infant has had an opportunity to observe the results of his own acts."[51] The speech which emerges at approximately six months in babbling provides the raw material for distinct feedback cycles in which the patterned speech may by produced in variations with varying results. It is in the observation of these results that "phonetic preferences" emerge.[52] The preferences for certain types of sounds and for certain patterns of producing them, after trying other patterns, implies increasing choice rather than chance and increasing control as well.

<u>Temporality</u>. The expanding control of speech timing implies a developing sense of time, or individual temporality. Fraisse suggests that the birth of a notion of time is the result of "the experience of successions."[53] This researcher adds that the individual must be able to recall the experience in relation to him/herself. Series of speech patterns produced by self, in which

the self may effect change and choice, may be called up or recalled and repatterned as one's own. These series of rudimentarily timed speech sounds provide the necessary experience of successions that are controlled by the individual who experiences them. The fact that the individual endures, yet may produce changing, patterned acts that are held in memory, allows the segmentation of experience such that the speaker may begin to map perceptions to speech patterns. Situating oneself in time becomes possible when one is capable of recalling one's situation in past patterned acts; the controlled use of segmented speech serves such a capacity. The discontinuity demonstrated by the decrease in durations within a general trend to longer utterances suggests a novel use of speech timing control and points to some rudimentary temporal skills necessary for language use. (See figures 3, 5, and 6)

The number of utterances repeated in a series increased before the milestone then decreased substantially. The most illustrative of the phonetic types for this pattern is the consonant/vowel syllable (figure 10). This type provided the clearest contrast in sound for the individual perceiving and recalling them, and for much that reason, provide the raw material for words. The sounds are repeated in long series at first, for practice and variety. Then, the individual appears to become more selective in their use. Memory may come to serve the speaker so that long repetitions are unnecessary; the utterance may be recalled and produced by choice. The infant appears to begin functioning in the temporal ambient.

Theoretical Implications

The study serves to describe a period in infant development in which speech patterns begin to demonstrate variations that have been interpreted as evidence for the beginnings of individual temporal functioning. The argument made in the previous section provides interpretive support for the proposition that prompted the study. Adapted from Dance's speech theory of human communication,[54] the proposition has been stated: the oral/aural experience provided in speech forms and augments temporality for the individual, by means of the contrast between duration (of self throughout the oral experience) and succession (or aural sound sequences produced by self). Although the study does not directly support the proposition, it does define a period in development in which the temporal characteristics of speech change. The interpretation of those changes as supportive of the proposition may be accepted or denied, but does provide one rational explanation of the results.

Another proposition found in the speech theory may gain support from the results of the study: "the characteristics of human language derive from the characteristics of speech."[55] The period of speech development studied may be viewed as an important stage in the progression toward language from speech. Other speech theorists have also proposed babbling as a preparatory period of speech for language.[56]

The controlled patterning of stable speech forms; that is, the timing of sounds in recognition of past forms, is necessary for their referential use. The study data demonstrates an overall increase in the frequency of consonant/vowel syllables and decrease in the use of vowels alone. The choice of the more easily patternable type suggests that this developmental period includes the possibility of the referential use of speech prior to the acquisition of language. The consonant/vowel syllables decrease in duration, then become quite uniform; from erratic instances before the event, they begin to cluster after the event. The more selective use of consonant/vowel types hints at more deliberate production based upon recall. Infants ceased to draw out vowel production over the length of an expiration, and began to produce a more clipped vowel that could be interpreted as more deliberate. Both vowel and consonant/vowel syllables approached comparable durations in clusters of utterances after the event mark. Some movement toward uniformity or interchangeability of speech sounds is apparent. The possibility for strings of referential utterances that are preplanned for timing emerges in this pattern.

Overview

The results of the study describe a period of infant babbling limited by postural achievement. The patterns which emerged from the data may be interpreted to imply a progression toward the requirements of referential language. The patterns pointing to that progression are formed by changes in the speech timing skills of infants. The changing skills observeable in the speech data suggest voluntary control of speech series and an underlying emergence of cognitive functioning in segmented time, or temporality.

Notes

1 See Margaret Bullowa, Before Speech (Cambridge: Cambridge University Press, 1979), pp. 2-5 for a discussion of the interdisciplinary nature of prelinguistic communication studies; and pp. 51-61 for vitae of contributors. Those representative of the interdisciplinary trend range from linguists through scholars of animal behavior, anthropology and education to philosophers.

2 Refer to notes in Barbara S. Wood, Children and Communication: Verbal and Nonverbal Language Development (New Jersey: Prentice-Hall, Inc., 1981).

3 Frank E.X. Dance, "A Speech Theory of Human Communication," Human Communication Theory: Comparative Essays, ed. Frank E.X. Dance (New York: Harper and Row, in press).

4 See the constructivist literature on development, for example: Jesse G. Delia and Barbara J. O'Keefe, "Constructivism: The Development of Communication in Children," Children Communicating, ed. E. Wartella (Beverly Hills: Sage Press, 1979).

5 For example: T.J. Bruneau, "Silence, Mind-Time Relativity and Interpersonal Communication," a paper presented at the Third Conference of the International Society for the Study of Time, Alpbach, Austria, 1976.

6 Joseph J. Pilotta, "Presentational Thinking: A Contemporary Hermeneutic of Communicative Action," Western Journal of Speech Communication, 48 (Fall 1979), 288-300.

7 Ira J. Hirsh, "Information Processing in Input Channels for Speech and Language: The Significance of the Serial Order of Stimuli," Brain Mechanisms Underlying Speech and Language, eds. Clark H.

Millikan and Frederic L. Darley (New York: Grune and Stratton, 1967), p. 140.

[8] Bela Julesz and Ira J. Hirsh, "Visual and Auditory Perception - An Essay of Comparison," Human Communication: A Unified View, eds. Edward E. David, Jr. and Peter B. Denes (New York: McGraw-Hill Book Company, 1972).

[9] Hirsh, p. 140.

[10] Richard M. Warren, "Auditory Perception and Speech Evolution," Origins and Evolution of Language and Speech, eds. S.R. Harnad, H.D. Steklis and J. Lancaster (New York: New York Academy of Sciences, 1976).

[11] Alvin M. Liberman, "Introduction to the Conference," The Role of Speech in Language, eds. James F. Kavanagh and James E. Cutting (Cambridge: The M.I.T. Press, 1975).

[12] Hirsh, p. 140.

[13] A representative list might include: George D. Allen, Donald Broadbent and Peter Ladefoged, Jacob Bronowski, John B. Delack, Ira Hirsh, Alvin M. Liberman, S.G. Nooteboom and Michael Studdert-Kennedy.

[14] Frank E.X. Dance, "A Speech Theory of Human Communication," in Human Communication Theory: Comparative Essays (New York: Harper and Row, in press).

[15] Dance.

[16] Jerry Fodor, "Open Discussion of the Papers of Studdert-Kennedy, Cutting and Eimas, Palermo and Jenkins and Shaw," in The Role of Speech in Language, eds. Kavanagh and Cutting (Cambridge: The M.I.T. Press, 1975), p. 166.

[17] Dance.

[18] Dance.

[19] Ilse Lehiste, Suprasegmentals (Cambridge: The M.I.T. Press, 1970). This definition arises from a discussion of "quantity" in suprasegmental aspects of speech, found in Chapter II, p. 6.

[20] Jean Piaget, The Construction of Reality in the Child (New York: Basic Books, Inc., 1954), pp. 229-234.

[21] Sei Nakazima, "Phonemicization and Symbolization in Language Development," in Foundations of Language Development, Volume 1, eds. Eric H. Lenneberg and Elizabeth Lenneberg (New York: Academic Press, 1975), p. 183.

[22] Piaget, pp. 321, 330, 348.

[23] Rede Lar, "Movement Behaviour and Preverbalization of Five Infants in a Cross-Cultural Setting," Neurolinguistics 5 (1976), 138-144.

[24] Lar, p. 142.

[25] Charles A. Ferguson, "Learning to Pronounce: The Earliest Stages of Phonological Development in the Child," in Communicative and Cognitive Abilities - Early Behavioral Assessment, eds. Fred D. Minifie and Lyle L. Lloyd (Baltimore: University Park Press, 1978), p. 278.

[26] John B. Delack, "Prosodic Analysis of Infant Vocalization and the Ontogenesis of Sound-Meaning Correlations," Papers and Reports on Child Language Development 8 (June 1974), 16-18.

[27] Ferguson, p. 280. The phonetic types are listed under "Data Reduction" in this paper.

[28] John L. Locke, "Mechanisms of Phonological Development in Children: Maintenance, Learning and Loss," paper presented to the

General Session of the 16th Regional Meeting of the Chicago Linguistic Society, April 17-19, 1980.

29 Michael Lewis and Louise Cherry, "Social Behavior and Language Acquisition," in Interaction, Conversation and the Development of Language, eds. Lewis and Rosenblum (New York: John Wiley and Sons, 1977), p. 230.

30 Lewis and Cherry, p. 241.

31 Eric H. Lenneberg, Biological Foundations of Language (New York: John Wiley and Sons, Inc., 1967), p. 374.

32 Julia M. Yingling, "Temporal Features of Infant Speech: A Description of Babbling Patterns Cricumscribed by Postural Achievement," Diss. University of Denver 1981, chapter II, pp. 20-98.

33 Lenneberg, p. 120.

34 Ferguson, p. 280.

35 The breath-group has been found to be a more reliable segment for analysis than a time sample. See John Locke, "Mechanisms of Phonological Development," p. 2, citing O.C. Irwin and T. Curry, "Vowel Elements in the Crying Vocalization of Infants Under Ten Days of Age," Child Development 12 (1941), 99-109.

36 For a more detailed explanation of the procedure, see Yingling, p. 110.

37 The coding was accomplished by a preliminary I.P.A. transcription, then broadened to phonetic types further defined by catagory. See William R. Tiffany and James Carrell, Phonetics: Theory and Application (New York: McGraw-Hill Company, 1977) as well as Ferguson's early vocable types.

38 Information concerning descriptive statistics and graphing procedures are from: Oystein Ore, Graphs and Their Uses (New York:

Random House, 1963) and Frederick Williams, Reasoning With Statistics (New York: Holt, Rinehart and Winston, 1979).

39 For a detailed description of the criteria, refer to Yingling, Appendix E, pp. 194-196.

40 W.S. Robinson, "The Statistical Measurement of Agreement," American Sociological Review 22 (1957), 17-25.

41 W. Koenig, H.K. Dunn and L.Y. Lacy, "The Sound Spectograph," Journal of the Acoustic Society of America 17 (1946), 19-49; and Egan A. Ringwall, Hayne W. Reese and Norman N. Markel, "A Distinctive Features Analysis of Pre-Linguistic Infant Vocalizations," in The Development of Language Functions, ed. K.R. Riegel (Ann Arbor: Center for Human Growth and Development, 1965), pp. 69-78.

42 Delack.

43 Marsha Zlatin Laufer and Yoshiyuki Horii, "Fundamental Frequency Characteristics of Infant Non-Distress Vocalization During the First Twenty-Four Weeks," Journal of Child Language 4 (1977), 179.

44 Patricia Bell Hubbard, "The Effect of Auditory Delay, Age and Sex on the Total Length of Infants' Vocalizations," Diss. Ohio State University 1971.

45 R.D. Kent and L.L. Forner, "Speech Segment Durations in Sentence Recitations by Children and Adults," Journal of Phonetics 8 (1980), 157-68.

46 William E. Cooper, "The Development of Speech Timing," in Language Development and Neurological Theory, eds. Sidney J. Segalowitz and Frederic A. Gruber (New York: Academic Press, 1977), p. 368.

[47] D. Kimbrough Oller, Leslie A. Wieman, William J. Doyle and Carol Ross, "Infant Babbling and Speech," Child Language 3 (1976), 1-11.

[48] Philip Lieberman, Intonation, Perception and Language (Cambridge: The M.I.T. Press, 1967), p. 27.

[49] The definition is more fully explicated in Yingling, p. 18, as an adaptation of the Piagetian concept of voluntary acts. See Piaget, pp. 231-235.

[50] Rene A. Spitz, The First Year of Life: A Psychoanalytic Study of Normal and Deviant Development of Object Relations (New York: International Universities Press, Inc., 1965), pp. 97-98.

[51] Jerome S. Bruner, "Organization of Early Skilled Action," Child Development 44 (1973), 2.

[52] Oller et al.

[53] Paul Fraisse, The Psychology of Time, trans. Jennifer Leith (New York: Harper and Row, 1963), p. 1.

[54] Dance.

[55] Dance.

[56] For example, John Dore, M.B. Franklin, Rboert T. Miller and A.L.H. Ramer, "Transitional Phenomena in Early Language Acquisition," Journal of Child Language 3 (1976), 26-27; as well as Locke and Delack, cited here.

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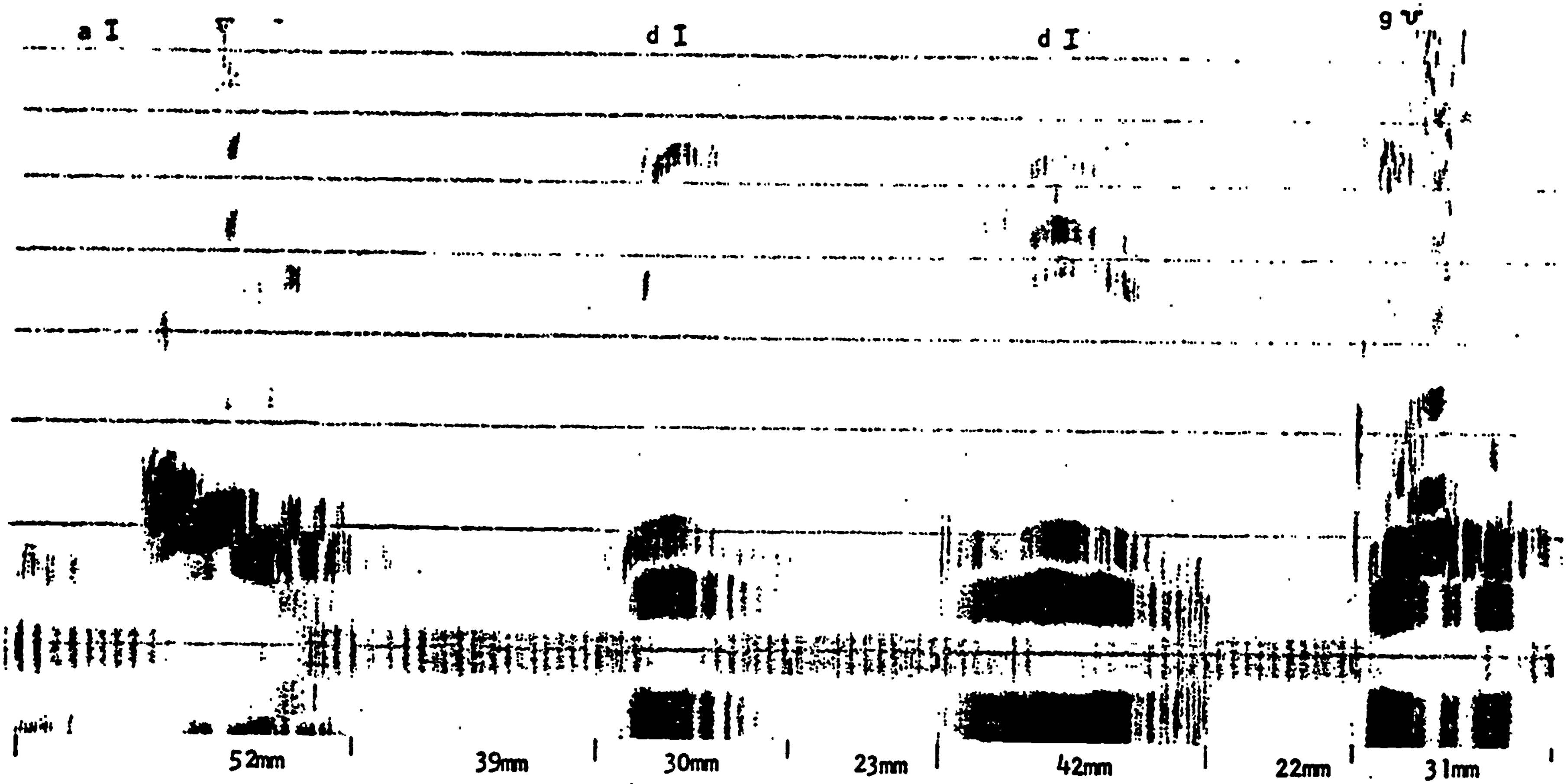

C/V syllable:
(stop with front vowel)
(stop with back vowel)
1 breath-group
4 segments per breath-group

Figure 1 Coded Spectrogram: Example

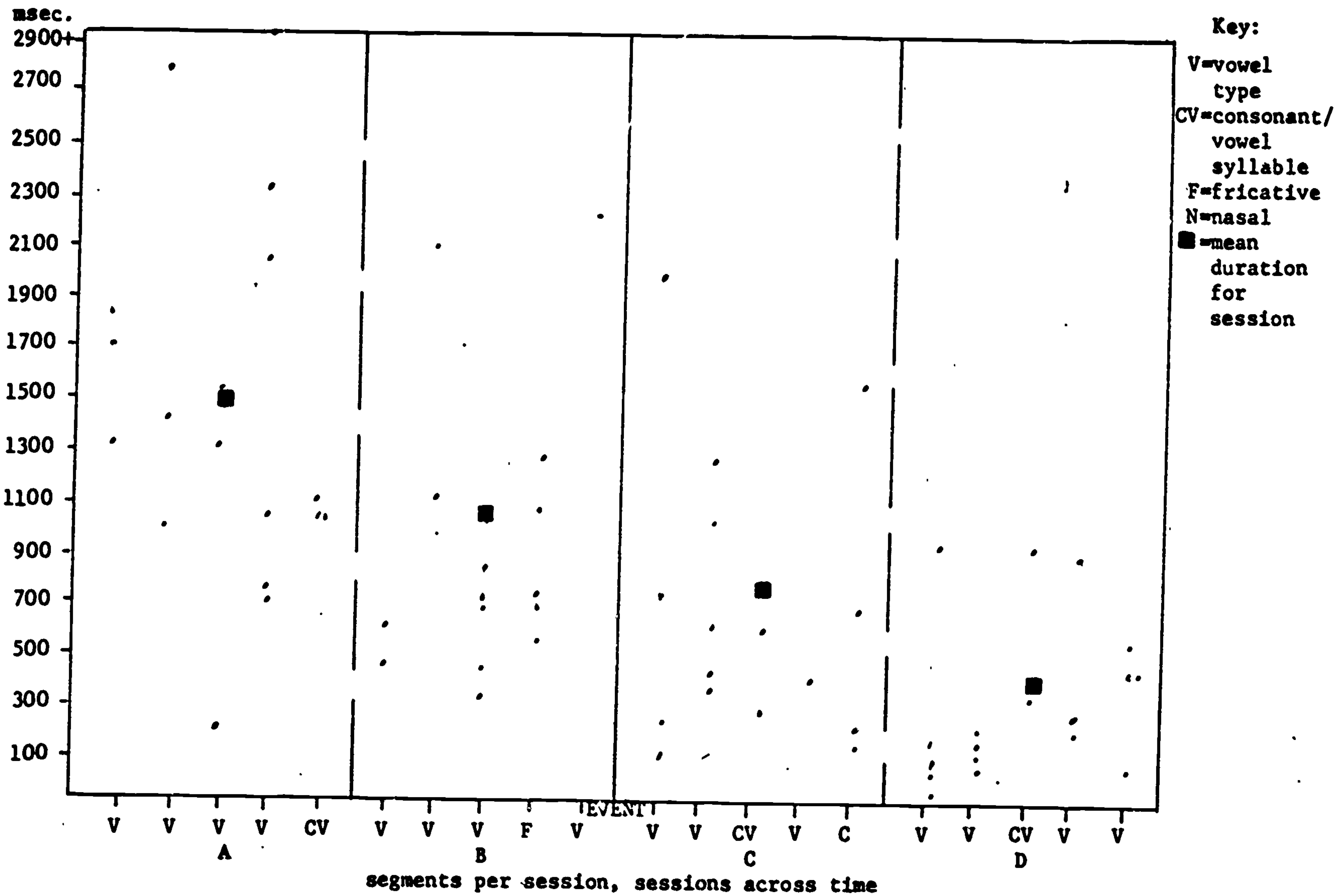

Figure 2 Utterance Duration--Subject I
Example: Preliminary Analysis

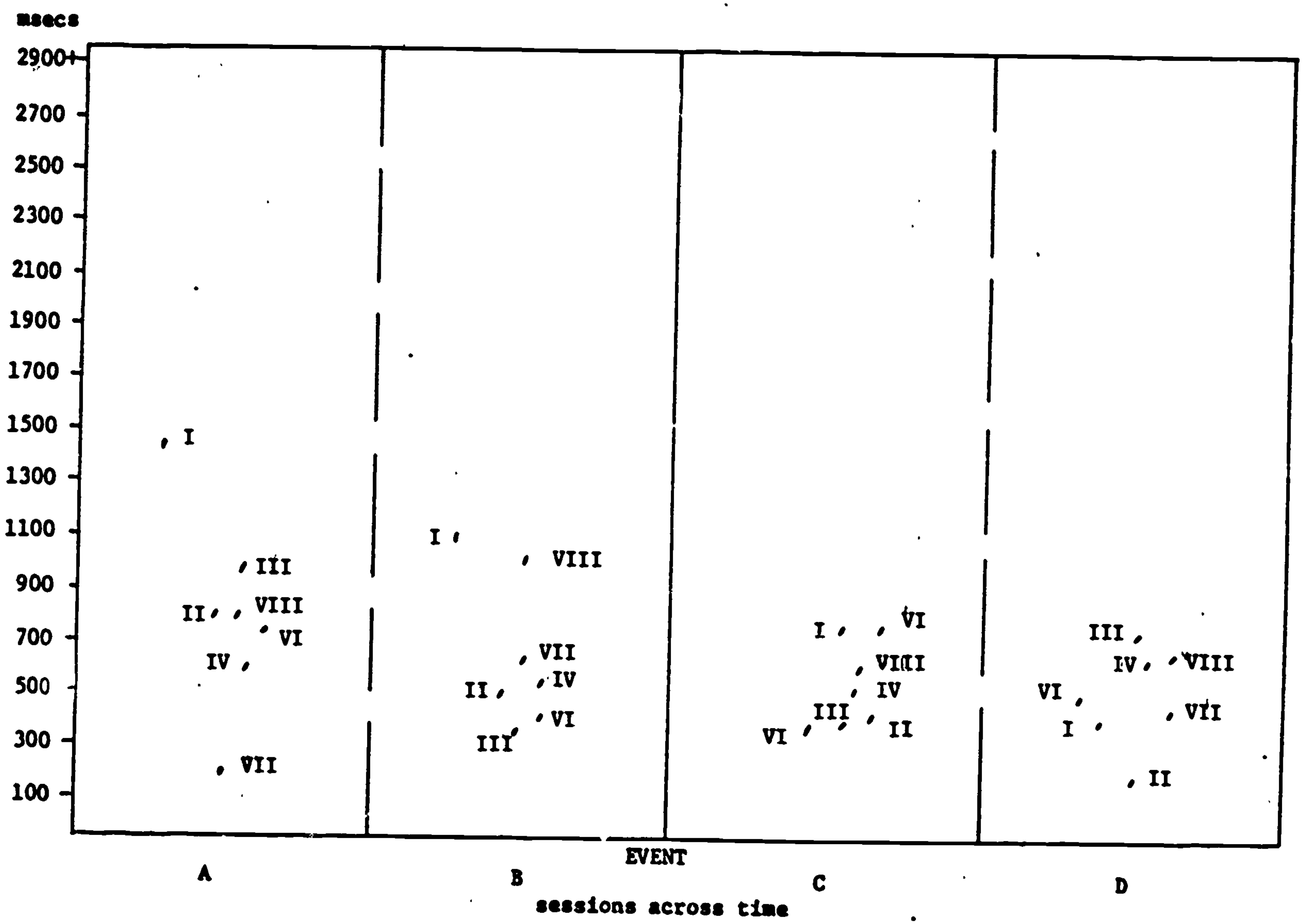

Figure 3 Mean Utterance Duration--All Subjects

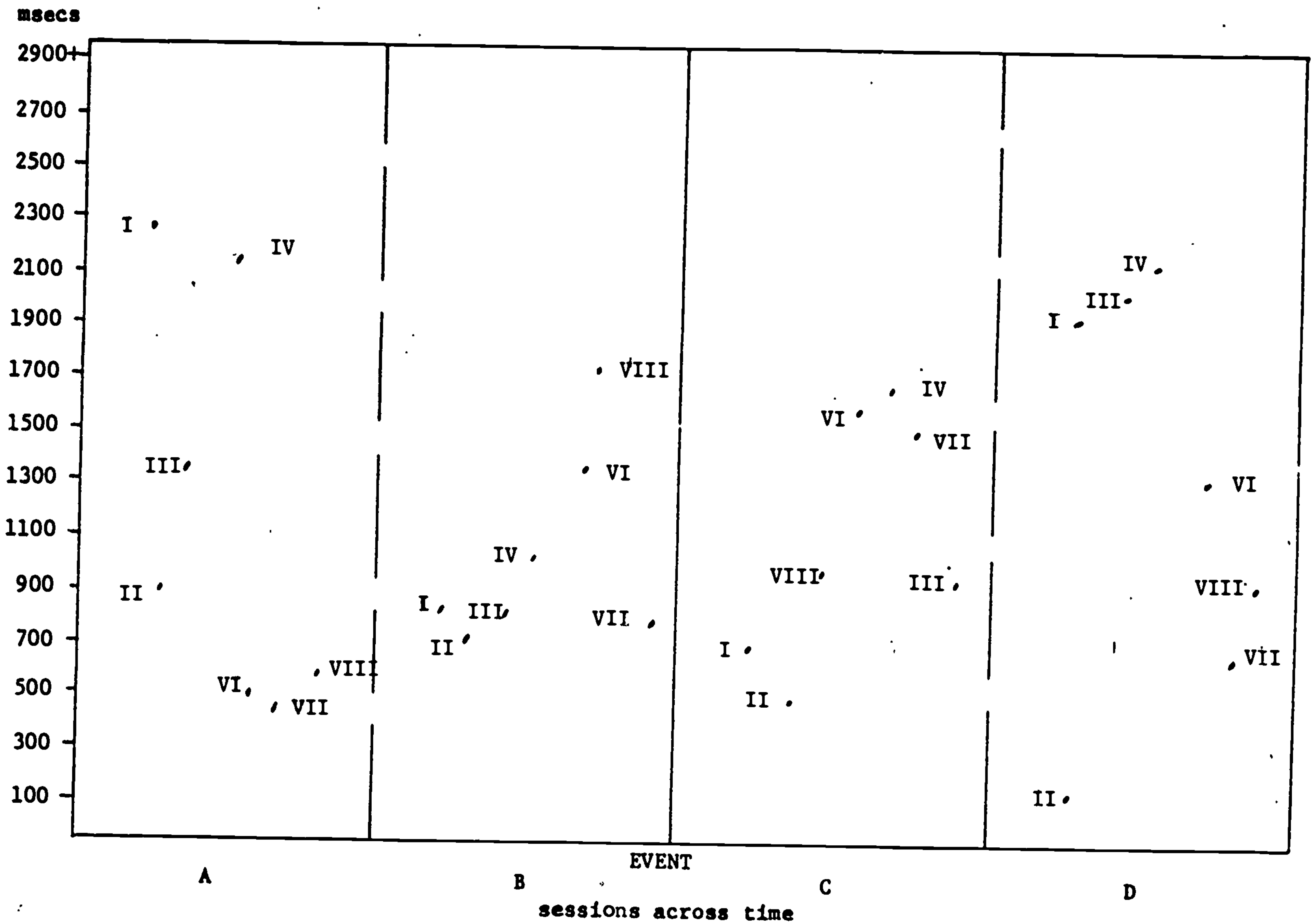

Figure 4 Mean Pause Duration--All Subjects

41

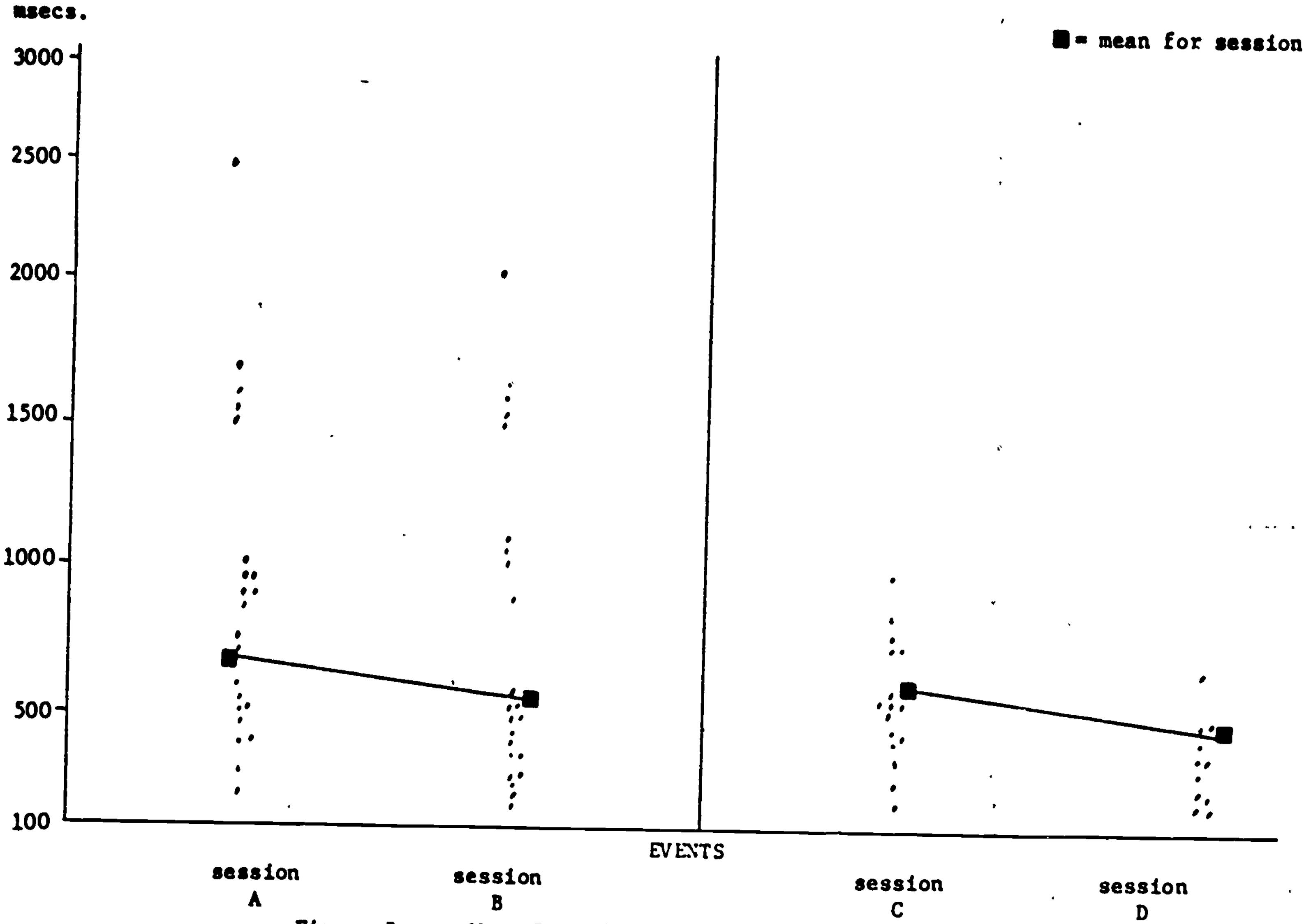

Figure 5 Mean Duration Per Segment of Phone Types--Vowels

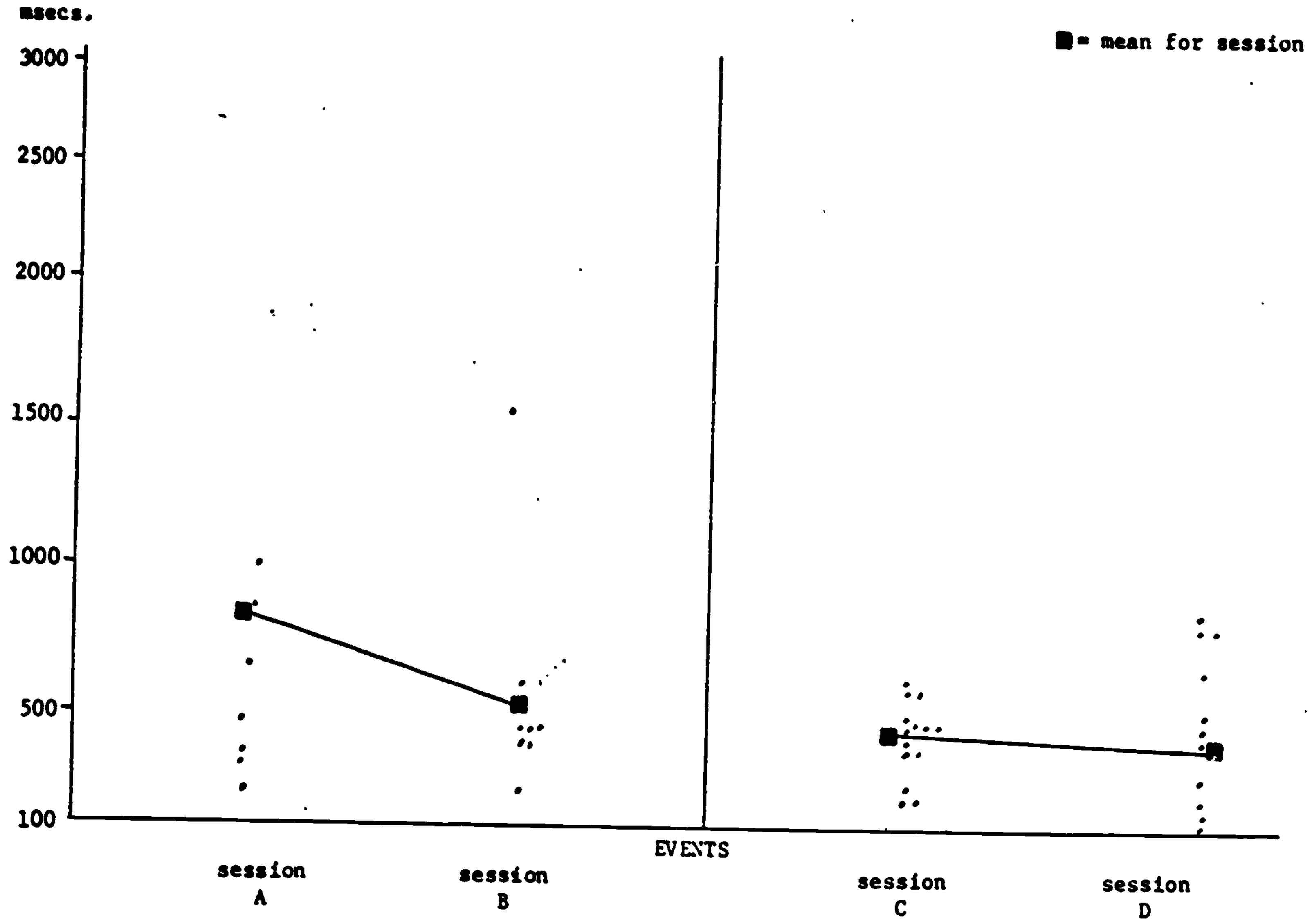

Figure 6 . Mean Duration Per Segment of Phone Types--Consonant/Vowel Syllables

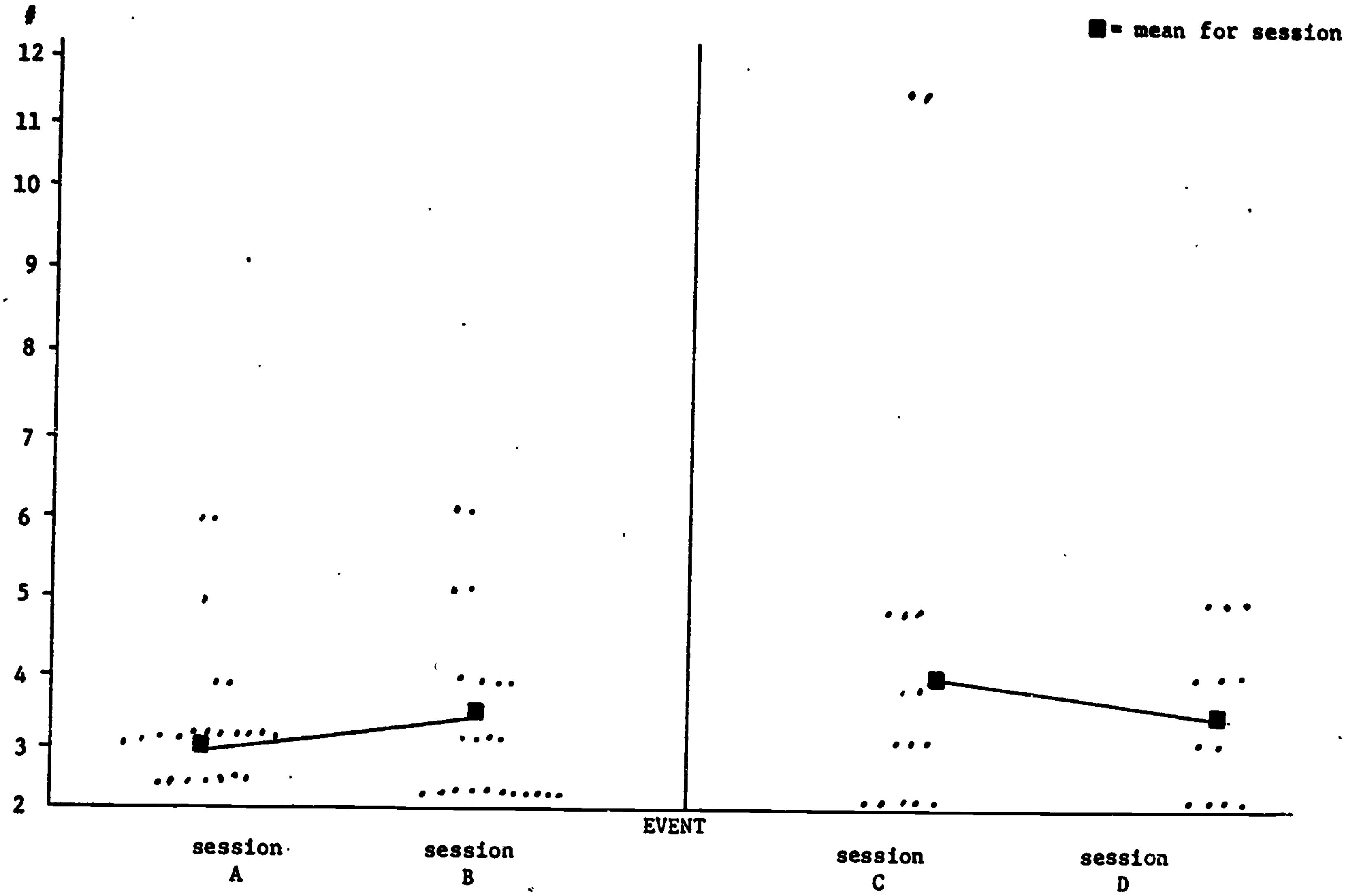

Figure 7 Number of Utterances Repeated in Succession Per Segment (across breath-groups)--Vowels

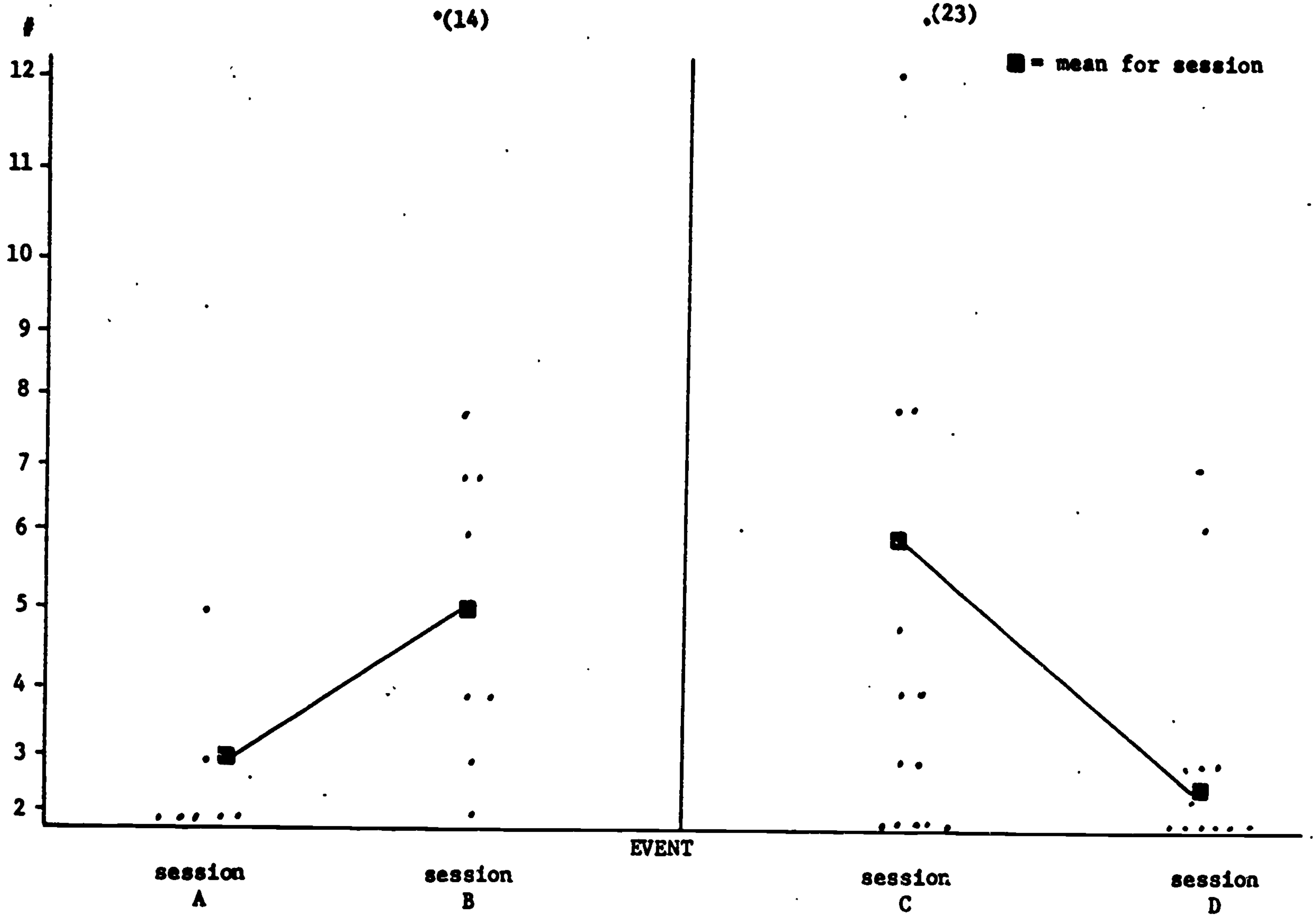

Figure 8 Number of Utterances Repeated in Succession Per Segment (across breath-groups)--Consonant/ Vowel Syllables

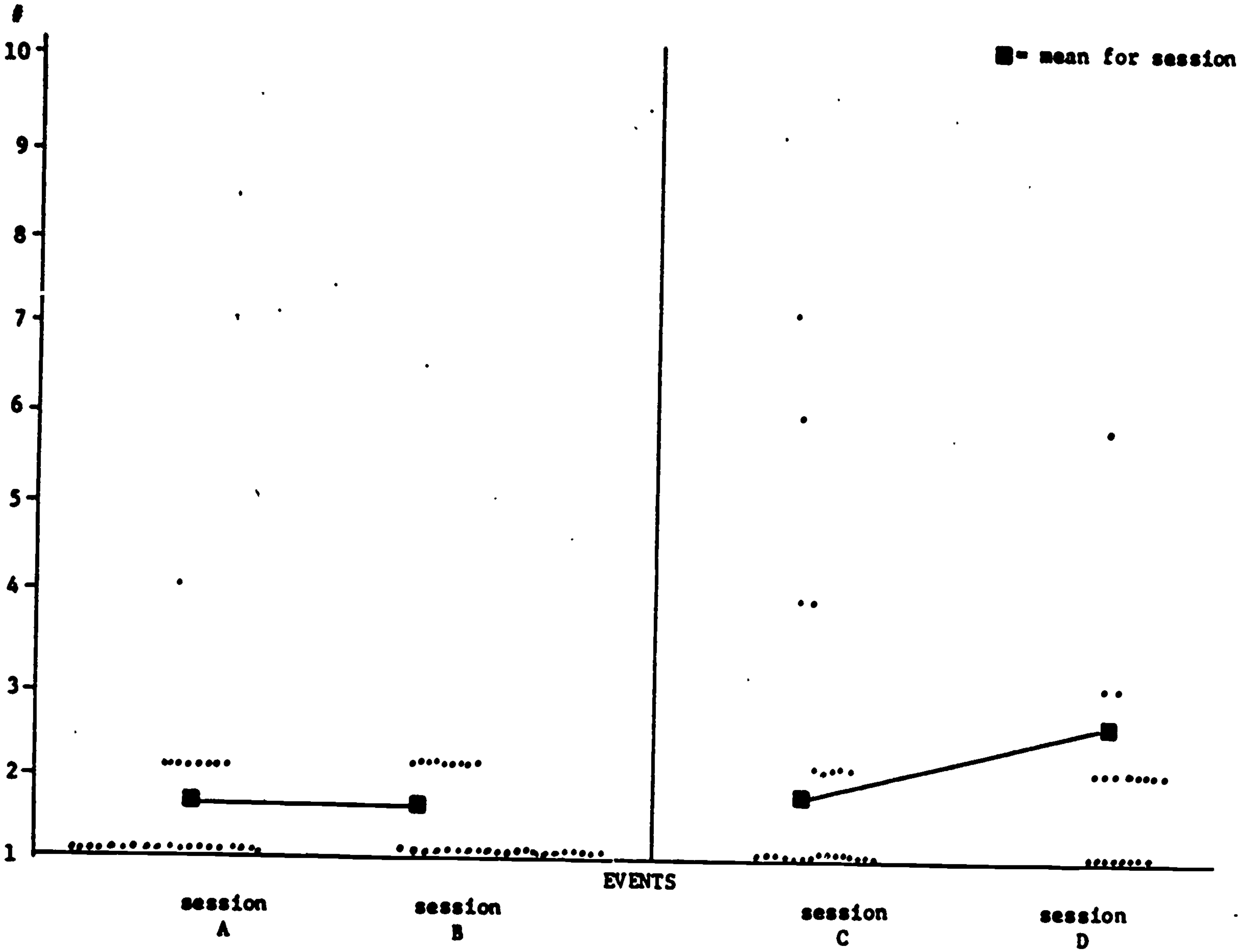

Figure 9 Number of Utterances Per Breath-Group--Vowels

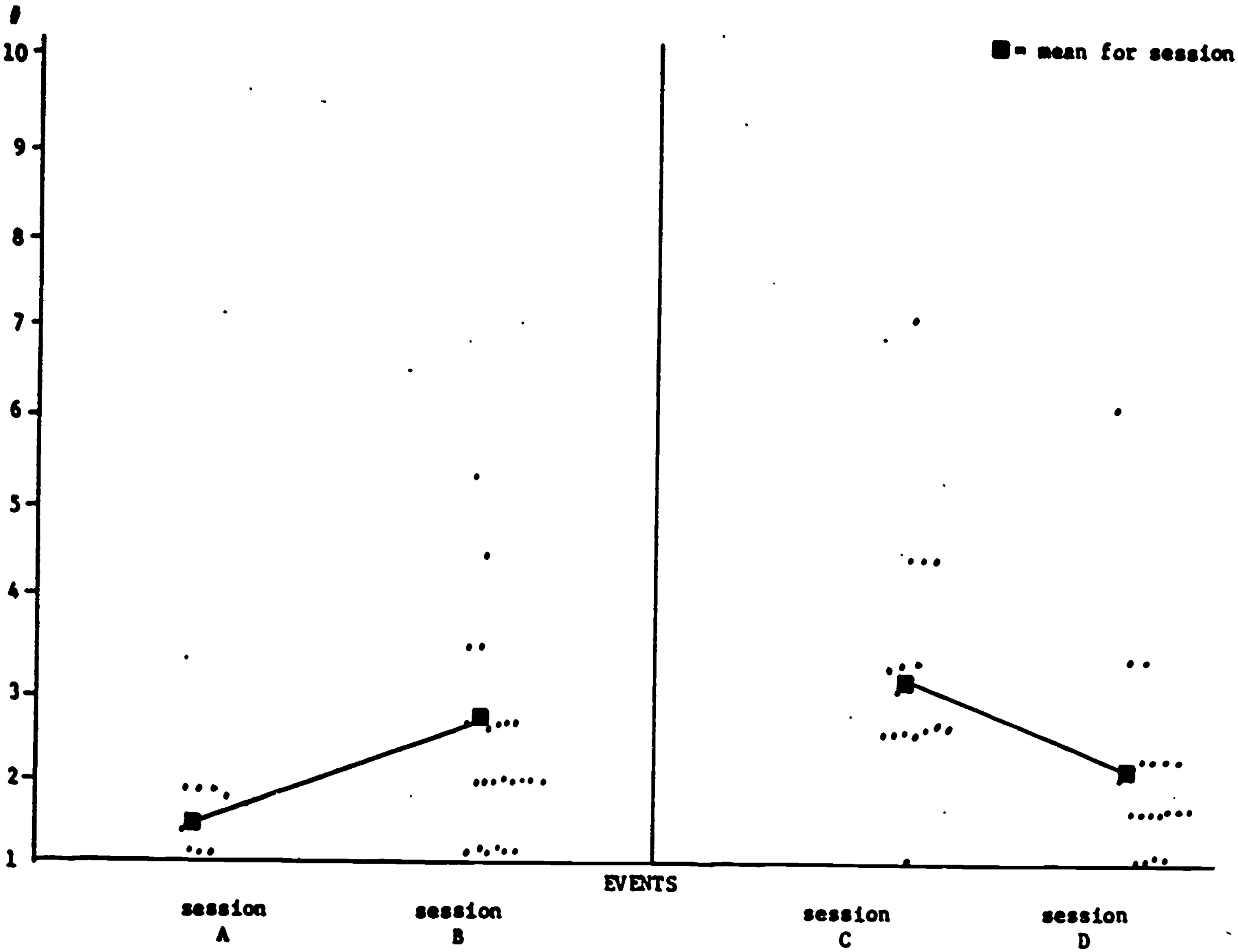

Figure 10 Number of Utterances Per Breath-Group--Consonant/Vowel Syllables

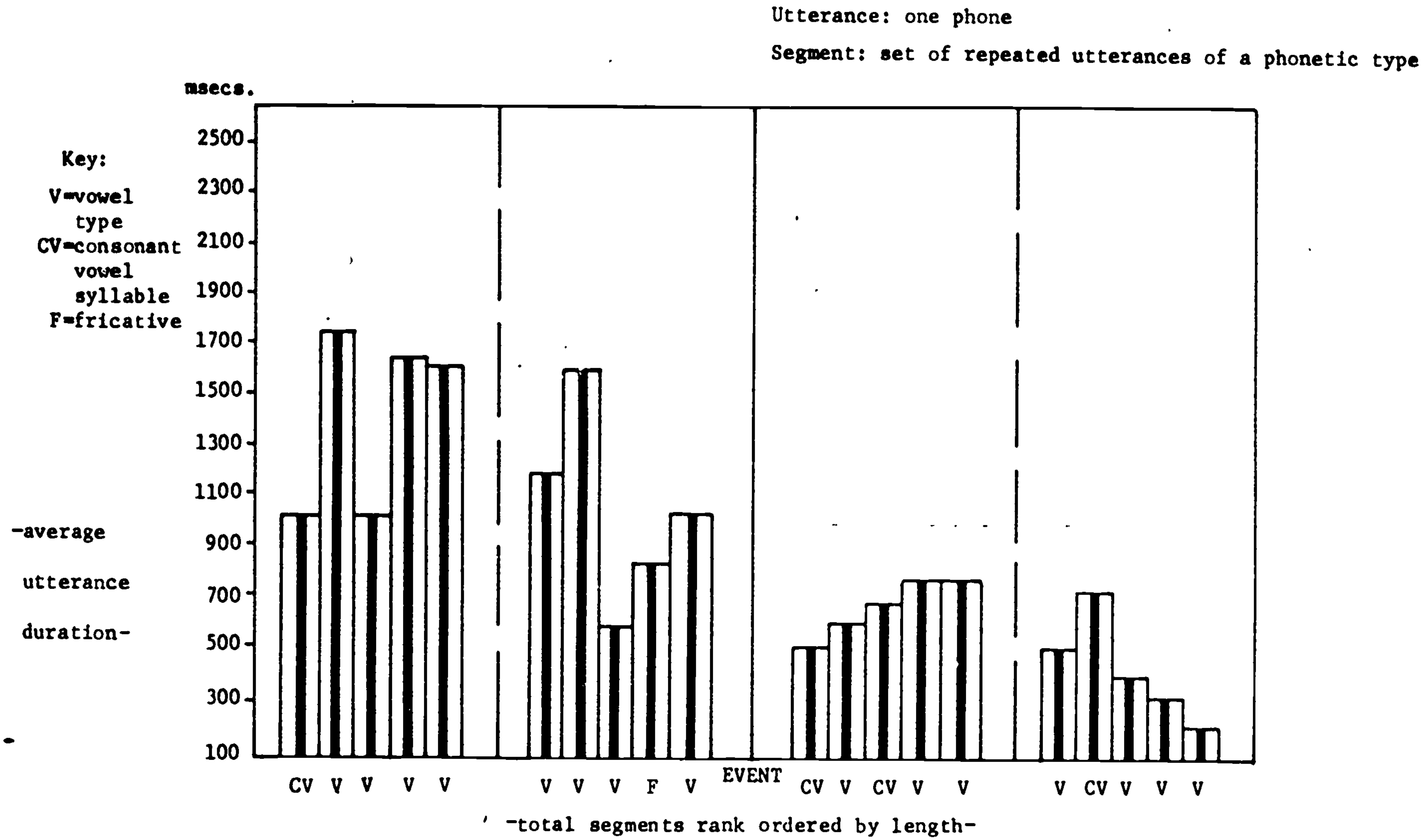

Figure 11 Average Utterance Duration Compared to Total Segment Duration--Subject I

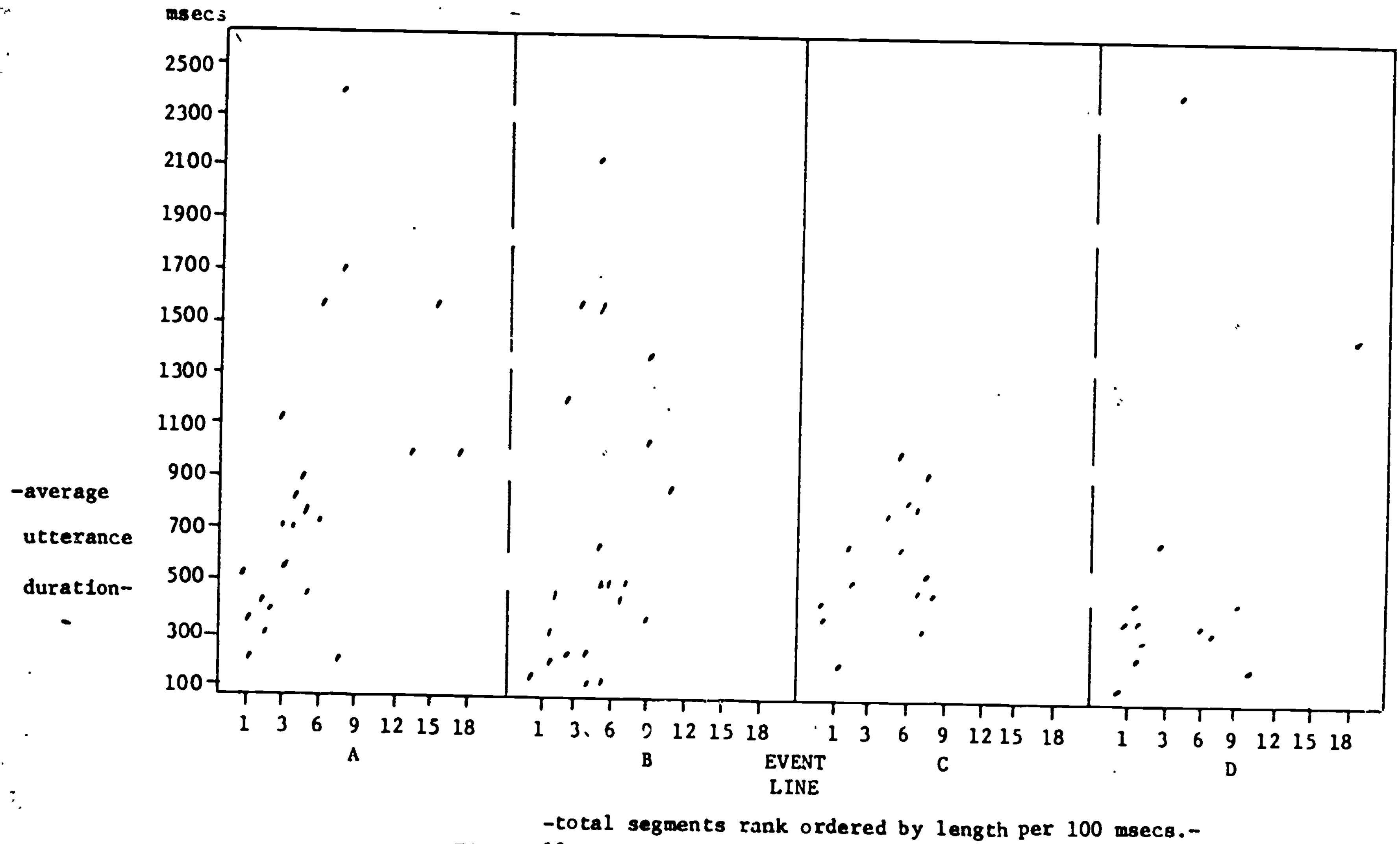

Figure 12 Average Utterance Duration Compared to Total Segment Duration--Vowels--All Subjects

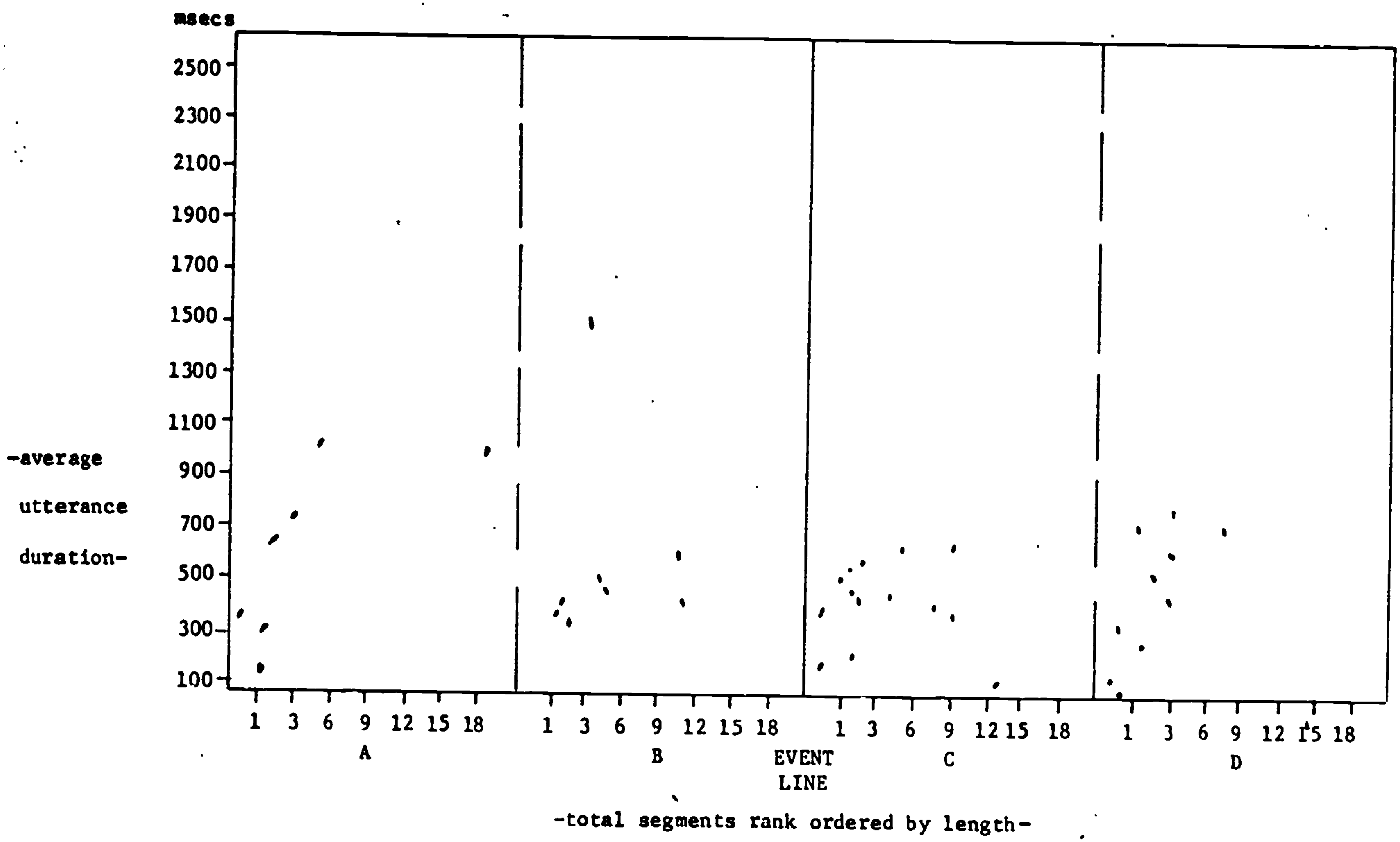

Figure 13 Average Utterance Duration Compared to Total Segment Duration--Consonant/Vowel Syllables--All Subjects