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Phonetic and Temporal Titration of the Dichotic Right Ear Effect.

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PHONETIC AND TEMPORAL TITRATION OF THE DICHOTIC RIGHT EAR EFFECT

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ABSTRACT

Twenty-four female subjects were used to study the effect of alignment on dichotic listening. The alignment was accomplished by using the microstructure landmarks of: onset, transition, V-O-T, boundary, and their combinations in the 12 CV's chosen. The synthetic CV syllables were two representations each of ba, pa, da, ta, ga, and ka. The two representations differed only in V-O-T. Voiced items had V-O-T's of +30 and 0 msecs while V-O-T's of voiceless items were -60 and -90 msecs.

Results showed:

1. Right ear identification was always more accurate; differences between ears were greatest with simultaneous onset alignments.
2. Intelligibility was depressed when transitions were aligned.
3. Laterality effects and intelligibility were not correlated.
4. Items whose "boundaries"* trailed were more intelligible than any other trailing items.

*Release for voiced items, V-O-T for voiceless items.

5. Unvoiced items were dominant in voiced/ unvoiced pairings for most conditions.

CHAPTER I

INTRODUCTION

A recent psychophysical technique (Broadbent, 1954) has made assessment of hemispheric dominance for speech and language possible with normals. The technique identifies the dominant hemisphere, using the intra-carotid amytal test as the criterion (Kimura, 1961a), and can be taken as a valid measure of hemispheric language dominance.

Dichotic listening studies show right ear preference for speech materials and left ear preference for non-speech materials. In addition to right ear preference, speech material is more correctly identified in a trailing position relative to its competition. Unvoiced items in a voiced-versus-unvoiced pairing also predominate.

The dichotic simultaneous stimulation of the two ears has been used to study:

1. Difference between ears.
2. Effect of stimulus delay in one ear relative to the other ear.

3. The handling of voiced-versus-unvoiced consonants.

At present no study has systematically evaluated whether ear, trail, and unvoiced-over-voiced preference for dichotically presented speech is a function of speech wave envelope or speech wave microstructure. Recent electronic developments allowing computer synthesis of speech signals provide the precision needed to assess the importance of acoustical microstructure.

Terminology And Definitions

1. Dichotic stimulation occurs when a different message is simultaneously presented to each ear. All listening in this experiment was dichotic with a different consonant-vowel (CV) going to each ear.
2. Laterality effects refer to ear differences in intelligibility under the same dichotic listening conditions. Lateralization refers to the preferred ear when differences occur.
3. Intelligibility is the number of correct identifications of the dichotic stimulus.
4. Voiced speech sounds utilized in this study are those whose onset occurs with periodic vibrations.

5. Unvoiced speech sounds utilized in this study have their onset occurring with noise.
6. Speech wave microstructure encompasses those identifiable aspects of the oscillographic and spectrographic tracings such as:
   a) Onset of the stimulus.
   b) Voice-onset-time (V-O-T): the onset of periodicity of the stimulus.
   c) Boundary: the beginning point of large amplitude periodicity.
   d) Transition: formant movement pattern into steady-state vowel.
7. The speech wave envelope is the total sound pattern without reference to its micro-structure.
8. Alignment in dichotic listening is the time relation between selected stimulus parameters across the two channels. For example, a boundary alignment would have simultaneous occurrence of the large amplitude periodic portions of the two CV speech waves.

General Research Aims

This study is an investigation of the effects of speech wave microstructure on dichotic listening. Precise

simultaneous alignment on the speech wave microstructure was made for the following:

1. Boundary (beginning point of large amplitude periodicity).
2. Onset (beginning point of signal).
3. Transition (beginning of signal release, i.e., start of formant transition as seen on spectrographic tracings).
4. V-O-T (beginning fundamental frequency excitation).
5. V-O-T-plus-boundary (1 and 4 alignments coincide).
6. Transition-plus-boundary (1 and 3 alignments coincide).
7. Onset-plus-transition (2 and 3 alignments coincide).
8. Onset-plus-V-O-T (2 and 4 alignments coincide).
9. V-O-T-plus-onset-plus-transition-plus-boundary (all alignments coincide).

Examples of the above alignments are given in Appendix D.

Specific Questions

1. Are there response differences between the two channels utilized in dichotic listening tasks?
2. Does laterality change with differing alignment conditions?
3. Does intelligibility change with differing alignment conditions?
4. Are laterality and intelligibility correlated?
5. Do the two ears share common ways of responding to the dichotic listening task?
6. Do responses show change corresponding to "place" of articulation?
7. Do voiced items differ from unvoiced items in voiced-versus-unvoiced identification?
8. Does voiced-versus-voiced identification differ from unvoiced-versus-unvoiced identification?
9. Are there differences attributed to lead versus trail in relation to the four basic alignments (boundary, onset, transition, and V-O-T)?

10. Do correct responses (double, single, or none) vary with different alignment conditions?

CHAPTER II

REVIEW OF THE LITERATURE

The human brain shows a dramatic difference from that of other vertebrates in the appearance of hemispheric dominance for language specialization. Not only is laterality observed in language functioning but in handedness and to a lesser extent for eye, ear, and foot usage. Apes and monkeys also express individual preferences for one side of the extremity in a given behavior, but the distribution between right and left preference throughout the species appears random (Lenneberg, 1967). Additionally, Bonin (1962) notes that most quantitative measurements of structural size in humans yield small but higher values for the left hemisphere. Geschwind and Levitsky (1968) note similar results in their postmortem examination of 100 adult human brains. The area behind Heschl's gyrus was larger for the left hemisphere in 65 percent of the brains and for the right hemisphere in only 11 percent.

Efforts to describe hemispheric areas related to language processing have encompassed:

1. Dichotic and Other Behavioral Studies with Normal Subjects.
2. Dichotic and Other Behavioral Studies with Abnormal Subjects.
3. Related Literature on Laterality of the Brain for Speech and Language Functions.

Dichotic and Other Behavioral Studies with Normal Subjects

There have been a number of dichotic listening studies comparing performance of normal subjects on both verbal and non-verbal material (Kimura, 1964; Dirks, 1964; Curry, 1966; Chaney and Webster, 1966). These studies have consistently shown a differential identification for the ears depending upon whether the stimulus is perceived as a speech or as a non-speech sound. The right ear shows an advantage for verbal identification, whereas the left ear shows an advantage for non-verbal identification.

Evidence also indicated a differential perception for the two ears between continuous and discontinuous speech sounds. Shankweiler and Studdert-Kennedy (1967) compared vowel to vowel (V to V) and consonant-vowel to consonant-vowel (CV to CV) identification in the dichotic

listening mode. Their results show a dominant right ear effect with CV to CV contrasts and a neutral or slight left ear advantage with the V to V contrasts.

Broadbent (1954) originally devised the dichotic digits task to test his hypothesis on memory systems. Competing spans of digits were presented to each ear and the subject's task was to recall one ear series before recalling the other series. The first series of reports were more error-free and Broadbent concluded that information passes successively rather than simultaneously. He proposed two different mental storage mechanisms to explain the results: a P-system which passes information instantaneously and an S-system which stores information. Information in the S-system is therefore subject to greater error.

Inglis (1965; 1962) reasoned that storage rather than perceptual differences between the ears is responsible for the results obtained on dichotic listening tasks; therefore, he stressed order of recall rather than laterality. Inglis's hypothesis was strengthened by the findings of Wilson et al. (1968) on the effect of ear biasing on recall. Neutral recall showed a slight right ear advantage, whereas attending to either the left or right ear increased the number of correct identifications for that particular ear.

A number of dichotic listening studies at the Kresge Hearing Research Laboratory of the South are particularly germane to the present study. In these studies, stimulus materials for dichotic presentation were aligned within ± 2.5 msecs on a specially fabricated delay line so that critical control of onset was achieved. In the first study, Berlin et al. (1968) utilized real words and nonsense syllables with competing English stops. The right ear responses were better for both real words and nonsense syllables and unvoiced consonants were more intelligible than voiced consonants when they competed against each other.

A second study was designed to further explore the unvoiced-over-voiced consonant identification. In this study (Berlin et al., 1969; Willett, 1969; and Lowe et al., 1970), both real and synthetic CV nonsense syllables competed dichotically (a different message to each ear) and monotically (the competing messages to the same ear). The dichotic mode showed a significant right ear laterality effect with the synthetic CV's while no such effect was seen for the monotic condition. The unvoiced-over-voiced effect was seen again, thus ruling out acoustic idiosyncrasies of natural speech as a cause.

The third study in the series (Lowe, 1970; Lowe et al., 1969) extended the dichotic and monotic listening task to several temporal offset lead/trail conditions. Real speech competing CV's were systematically separated by 15, 30, 60, and 90 msecs. While right ear scores were higher for comparable lead/trail conditions, the trailing syllable rather than the lead syllable tended to be more accurately identified. This "trail effect" and the right ear laterality effect appeared to attenuate at 90 msec separation. Monotic results showed no ear differences, with the lead stimulus being more correctly identified in all time-staggered conditions.

When the time separation between real speech CV pairs was extended to 500 msecs, right ear scores were once again higher than comparable left ear scores, and the voiceless onset words were more easily identified except for the "boundary" condition. This "boundary" condition was one in which onset times were ignored and the competing signals were simultaneously aligned on the boundaries between aperiodicity and periodicity. With boundary alignment during dichotic presentation, unvoiced-over-voiced preponderance was attenuated while right versus left laterality was enhanced. Therefore,

"voicing-onset-time" was implicated as a possible critical feature in dichotic listening and analysis for normals (Berlin and Lowe, 1970). Results of the monotic task showed an orderly advantage for the lead ear through 250 msecs. At 500 msecs, equal intelligibility was seen between lead and lag reception since the signals (460 msecs overall duration) no longer competed.

The above time-titration studies agreed closely with the results of Studdert-Kennedy et al. (1970a; 1970b), and Kirstein (1970). All authors believed the "trail effect" is of central origin and is tied to components of the speech stream which are necessary in complex decoding.

Dichotic and Other Behavioral Studies with Abnormal Subjects

Kimura (1961b) used dichotic testing to study epileptic patients with known lesions. Of 65 patients, 30 exhibited left temporal lobe lesions, 16 right temporal lobe lesions, 9 frontal lesions, and 10 sub-cortical lesions. Simultaneous presentation of three digits to each ear showed a marked reduction in the total score for the group with the left temporal lobe lesions. Katz (1962) confirmed the findings of Kimura utilizing Staggered

Spondee Word Tests (SSW). Perceptions of the overlapping or dichotic signals were markedly reduced with subjects having temporal lobe lesions. Other studies (Milner et al., 1968; Sparks and Geschwind, 1968) showed virtually no left ear responses on dichotic listening tasks when there is complete section of the neocortical commissures. This is interpreted as evidence that the callosal pathway from the right to left temporal lobe is more important for competing signal separation than an intact ipsilateral pathway.

A major difficulty for persons with temporal lobe lesions is auditory sequencing. Efron (1967; 1963a; 1963b; 1963c) studied the time required to identify the correct order of auditory and visual signals with subjects having temporal lobe lesions. Average time separation for this task was reported by Hirsh and Sherrick (1961) as 20 msec; Efron's subjects required as much as 1 sec separation to identify the correct temporal order.

Basser (1962) gathered data on two groups of children, one with brain lesions sustained before speech onset and one group with brain lesions sustained after speech onset. No essential difference was seen in the course of speech development between the first group and normals. However, the group whose lesions occurred

after speech onset were quite different. Eighty-five percent of the group with left hemispheric lesions and only 45 percent of the group with right hemispheric lesions showed speech disturbance. Basser (1962) also gathered data which showed that the sequelae of left hemispherectomy were a function of the age of occurrence of the original insult. With early childhood lesions, speech functioning was eventually confined to the healthy side and caused no aphasia. Patients with lesions acquired in later life exhibited aphasia following left hemispherectomy and minimal or no aphasia with right hemispherectomy.

Related Literature on Laterality of the Brain for Speech and Language Functions

Sodium amytal, a chemical blocking agent of neural impulses, was used by Wada and Rassmussen (1960) to determine hemispheric dominance for language. Patients were asked to maintain a speech task while they received unilateral injection of this agent into the carotid artery; the injection always caused right and left hemiplegia, alternately. In most patients, the performance of the speech task was interrupted concurrently with a left

cerebral dominance for language. It is important for this study to note that results with dichotic listening and intra-carotid amytal injection have been shown to be in very close agreement (Kimura, 1961a).

Traumatic lesions to the head have often been used as a basis for mapping language areas of the brain. The data of Conrad (1954) and Russell and Espir (1961) were obtained on World War II veterans. Conrad (1954) showed that aphasic tendencies occurred in motor speech when there were left side lesions on the margin of the central sulcus and frontally; amnesia and sensory sound organization difficulties predominated with lesions in the parieto-occipital areas. Aphasic difficulties also occurred in these areas in the Russell and Espir data. Russell and Espir (1961) further indicated that the majority of individual were left hemispheric dominant regardless of hand preference. Early observations (Dax, 1836; Broca, 1861) also noted the close relationship between left temporal lobe lesions and aphasia with dextrals. The corollary belief of right hemispheric dominance with sinistrals was widely held for many years, but has since been questioned by Penfield and Roberts (1959), Geschwind (1968), and many others.

Milner (1962) used the Seashore Test of Musical Talents to assess differences between lesions in the right and left temporal lobes. Subjects with right temporal lobe lesions showed a significant error increase in tonal memory and rhythm pattern errors, post-operatively for the subjects with left temporal lobe lesions. This indicated greater activity by the right hemisphere in response to non-linguistic acoustic stimulation.

Summary

The human brain shows:

1. Left hemispheric dominance for language processing.
2. Right hemispheric dominance for non-language acoustic processing.
3. Larger left hemispheres.

Dichotic listening with competing speech signals:

1. Assesses hemispheric dominance for language functioning.
2. Shows right ear preponderance.
3. Shows an advantage for the trailing item within a competing pair.

4. Generates unvoiced consonant identification preponderance when voiced and unvoiced compete.
5. Has not studied the effects of speech wave microstructure on laterality.

The present study plans to dissect the nature of the dichotic right ear laterality effect by systematically varying the reference points on which the competing CV's are aligned. Previous studies aligned speech material either with little thought to phonetic and especially temporal alignment (e.g., Katz, 1962; Broadbent, 1954; Kimura, 1961a, 1961b, 1967) or with a criterion related primarily to onset (Shankweiler and Studdert-Kennedy, 1967; Studdert-Kennedy and Shankweiler, 1970a; Lowe, 1970; Kirstein, 1970).

CHAPTER III

METHODOLOGY

Stimulus Material

Stimulus material consisted of computer-generated nonsense CV syllables aligned so that "boundary," onset, transition, and V-O-T were simultaneous. "Boundary" was defined as the beginning point of large amplitude periodicity, onset as the beginning point of the acoustic stimulus, transition as the beginning point for movement of formants, and V-O-T as the beginning point for excitation by the fundamental frequency.

The consonants used in this study were /p/, /t/, /k/, /b/, /d/, and /g/ which were always combined with the vowel nucleus /a/. The consonants /p/, /t/, and /k/ are voiceless and /b/, /d/, and /g/ are voiced. With regard to place of articulation, /p/ and /b/ are labial, /t/ and /d/ are alveolar, and /k/ and /g/ are velar. Two representations varying only by V-O-T were chosen for each consonant. Consonants identified by listeners as being voiced had 30 msec and 0 msec prevoicing while those identified as voiceless consonants had 60 and 90 msec

voice lag (see Appendix C for spectrographs). All CV's were extracted from the Lisker and Abramson Continua (Appendix A) after judgments as to their categorization were made by 16 listeners at the Kresge Laboratory (See Appendix B).

In addition to being identified "correctly" 100% of the time by our panel, the consonants with the critical V-O-T's were chosen for their relationship to spoken English and distribution around the average crossover point for the continua obtained independently by Lisker and Abramson (1964). For these continua, phonemic crossover was defined as the V-O-T which separated those items responded to as voiced from those responded to as unvoiced. The usual crossover from perception of voiced to unvoiced CV's occurred around 30 msecs voicing trail relative to release. Therefore, 0 msec prevoicing and 60 msecs voice lag were 30 msecs removed from the average crossover point, while 30 msecs prevoicing and 90 msecs voice lag were 60 msecs removed from the average crossover point. Two representations of each consonant were selected to permit the proper manipulation of stimulus alignments.

Construction Of The Tests

Each of 30, 0, -60, and -90 msec V-O-T stimuli was systematically recorded onto a single channel of a two-

channel tape loop recording system with movable playback and record heads. The instrument, fabricated by the Audio Instrument Company, was modified to allow independent recording on either channel. Thus a given stimulus was recorded on one channel and then a second selection was recorded on the other channel. The resulting pair was then monitored on a storage oscilloscope while the distance between the playback heads was varied to achieve the desired alignments (Appendix E). The alignments could be made from the oscillographic display since the temporal relationship between the spectrographic, oscillographic, and computer control parameters for generating the synthetic speech were known. The position of the transition was obtained from spectrographs, while onsets and boundaries were obtained from oscillographs. Knowledge of the computer control parameters permitted cross-validation of the relative positions of each landmark. The aligned pair was then rerecorded onto an Ampex AG 440. The Channel I and Channel II leads into the Ampex AG 440 were then switched to achieve balance between channels. Other alignment conditions for the pair on the tape loop were then rerecorded in the same manner.

All single criterion alignments were within ± 1 msec, and conditions requiring that multiple criteria be met were accurate within ± 4 msecs. Each of the 12 CV syllables was aligned with every other syllable except itself and its perceptual counterpart, i.e., 30/ba and 0/ba, were never aligned. The perceptual counterparts were not aligned because the experimental design required that two different consonants always compete, one to each ear.

The peak intensities of the vowels were monitored and equalized throughout the recording. Competing pairs were within ± 1/2 dB of one another; between stimulus pairs there was only ± 1 dB difference. The signal-to-noise ratios exceeded 30 dB. All signal-to-noise and amplitude measures were obtained with a Bruel and Kjaer 2305 Sound Level Recorder.

After appropriate balancing procedures (see next section), 6 randomizations, distributing a total of 288 stimulus items, were available. Each 48-item tape had CV's which were simultaneous with respect to boundary, onset, transition, and V-O-T. Items in these alignment conditions were not mutually exclusive and have been divided into nine subcategories:

1. Boundary.
2. Onset.

3. Transition.
4. V-O-T.
5. V-O-T with Boundary.
6. Transition with Boundary.
7. Onset with Transition.
8. Onset with V-O-T.
9. Onset with V-O-T with Transition with Boundary, the "all" condition.

A complete randomization of the test items was restricted to a single occurrence of a particular alignment condition for each pairing. A listing for each alignment condition is presented in Appendix F.

Following the stimulus recording, three individual items were spliced out for each pair under every condition (two items for each randomization and one back-up item). Splice-outs were taken between the first and last recorded item and individually attached to five second timed white leader tape. The individual item pairs were then spliced together in proper order to form 12 test tapes, the 6 basic tapes plus another 6 randomizations, so that no subject pair received the same item order.

Randomization

A basic list of individual item pairs for each of the nine proposed alignment conditions was used to

prepare six lists of 48 items each. Each list developed in this manner was balanced to achieve:

1. Equal number of voiced-voiceless items.
2. Equal occurrence of 12 CV items in both Channel I and Channel II within and across all tests.
3. Equal number of pairs for each condition across all lists.

Two sets of 48 non-repeating random numbers were generated for each basic list from a table of random numbers. The items in each basic list were then ordered according to these random numbers so that each list had an equal number of voiced CV's, unvoiced CV's, alignment conditions, and an equal representation of each of the 12 possible CV's available.

Test Administration

Equipment.--The subjects were seated in arm desk chairs in an IAC sound room for the tests. The stimuli were presented over two sets of Telephonics TDH-49 earphones mounted in MX 41/AR cushions and matched within $\pm$ 1 dB from 100-6000 Hz. These headsets were checked for calibration immediately prior to and after each testing session (Appendix H). The test tapes were played on an Ampex AG 440 stereo tape recorder into a Dynaco 120 A

stereo amplifier which drove a listening buss and the attached earphones. Hewlett Packard 350-D attenuators were placed between the Ampex tape recorder and Dynaco power amplifier to control the intensity of the input signal to the Dynaco. The experimenter monitored all stimuli with his own set of TDH-39 earphones in parallel with the subjects' phones. Two Bruel and Kjaer microphone amplifiers (one for each channel) monitored the voltages.

Subjects.--The subjects for this study consisted of 24 young females who met the following criteria:

1. Right-handed.
2. No reported head trauma, neurological or hearing disorder.
3. No observed or reported speech problem.
4. Native English speakers and essentially monolingual.
5. Eighteen to thirty years of age.
6. Minimal training in phonetics.
7. No exposure to experimental competing messages or similar listening tasks (Appendix I).
8. Correctly identified the 12 items used in this study when presented from the Lisker and Abramson Continua.

The hearing criteria for this study were met when the subject exhibited:

1. Békésy tracings for each ear better than 15 dB ISO and with a difference between the ears of less than 10 dB for the frequency range of 300-4000 Hz.
2. Speech discrimination of 96% or better for half list PB-50's when presented at 40 dB above the speech reception threshold.

The subjects, who received $2.00 per hour for their participation in the experiment, were selected from Catholic teaching nuns, secretaries, college students, housewives, and department store clerks. Only two potential subjects failed to meet the test criteria.

Test procedure.--The 24 subjects were tested in groups of two. The subjects were yoked so that while one subject received Channel I in his left ear, the other subject received Channel I in his right ear. The order of presentation of the 12 lists, the ear, and channel selection were balanced and rotated according to Appendix J.

An instruction and training tape was played immediately prior to the test presentation (Appendix K). In this tape, 4 representations of each of the 12 CV items were presented monaurally every five seconds. Subjects

were asked to write down their responses on the answer sheet as BA, PA, DA, TA, GA, and KA, and were not permitted to go on until their perceptions of all the synthetic items were correct. Occasional repetitions were required for some subjects; however, no subject needed more than 2 repetitions to meet criteria. A cover sheet was utilized throughout the testing to minimize response set and to maintain position on the answer sheet.

Testing began following the training tape. Rest sessions were given after completion of the fourth and eighth test lists, and none of the subjects complained of fatigue.

Analysis

All responses were coded, card punched, and verified by two independent teams. Data were then computer-processed to obtain response matrices for each condition pooled across subjects. Correct responses were further analyzed within each condition to investigate possible differences due to:

1. Channel.
2. Laterality.
3. Intelligibility.
4. Voiced-versus-unvoiced intelligibility.

5. Place of speech production.
6. Lead and trail relative to boundary, onset, transition, and V-O-T.
7. Response errors by condition.

Because certain pairings were unlawful, there were large differences in N's between conditions. Furthermore, the same 12 items with different alignments were used repeatedly for all the conditions and, therefore, independence of conditions could not be established. These idiosyncrasies in this experiment precluded the use of common analyses of variance.

CHAPTER IV

RESULTS AND DISCUSSION

The Right Ear Was Always Superior To The Left Ear

All conditions showed a right ear advantage ranging from 5.0 to 16.3 percent. Differences between ears are summarized in Table 1. Correlated z values (Dixon and Massey, 1969), were at $p<.01$ for all alignment conditions. Thus, right ear scores were independent of left ear scores. The conditions which showed the largest and smallest ear differences, Conditions 2 and 6 respectively, were subjected to t tests. Correlated t values between left and right ears were 5.35 for the onset condition ($p<.001$) and 1.60 ($p<.10$) for the boundary-plus-transition conditions (see Appendix N).

Laterality and Intelligibility Were Not Related

Intelligibility scores (Table 2) were lowest with transition alignments. Onset alignments elicited moderate intelligibility, while boundary and V-O-T alignments elicited high overall intelligibility.

TABLE 1.--Rank-Order of Right Ear Preponderance by Alignment Condition. (In Percent Correct)

Condition	Rank	Number Given	Correct		Difference	Z Values of R:L* (Correlated Proportions)
			R	L	R-L	
Onset	1	3456	69.8	53.5	16.3	10.57
Onset + V-O-T	2	1152	70.1	57.3	12.8	7.05
Onset + Transition	3	4608	62.2	49.7	12.5	6.10
Transition	4	3456	63.1	52.4	10.7	6.80
Boundary V-O-T	5	4608	78.0	67.4	10.6	23.05
All Aligned	6.5	2304	64.7	55.7	9.0	7.26
V-O-T	6.5	3456	86.6	77.6	9.0	27.96
Boundary	8	3456	74.1	77.9	7.6	24.13
Boundary + Transition	9	1152	62.8	57.8	5.0	5.09

*Dixon and Massey (1969)

TABLE 2.--Rank-Order of Correct CV Identification by Ear and Alignment Condition.

Condition	Rank	Number Given	Number and Percent Correct		
			R	L	Total
Voice-Onset-Time	1	3456	1496 (86.6)	1341 (77.6)	2837 (82.1)
Boundary	2	3456	1412 (81.7)	1280 (74.1)	2692 (77.9)
Voice-Onset-Time + Boundary	3	4608	1797 (78.0)	1552 (67.4)	3349 (72.7)
Voice-Onset-Time + Onset	4	1152	404 (70.1)	330 (57.3)	734 (63.7)
Onset	5	3456	1206 (69.8)	924 (53.5)	2130 (61.6)
Transition + Boundary	6	1152	362 (62.8)	333 (57.8)	695 (60.3)
All Aligned	7	2304	745 (64.7)	642 (55.7)	1387 (60.2)
Transition	8	3456	1091 (63.1)	906 (52.4)	1997 (57.8)
Onset + Transition	9	4608	1434 (62.2)	1144 (49.7)	2578 (55.9)

If the dichotic listening tasks were too easy, one might expect so many correct responses that a laterality effect would be obscured. However, no task in this experiment was that simple. A rank-order correlation coefficient, (rho) value of -.09, indicated that separate cues affected laterality and intelligibility. Laterality was largest when onsets were aligned and intelligibility was poorest when transitions were aligned.

Kimura (1961a) and Shankweiler and Studdert-Kennedy (1967) proposed a negative correlation between laterality and intelligibility; however, the present data did not support their tenet.

Phonetically, Right Ears Out-Performed Left Ears At A Constant Ratio

While right ear scores were always higher, the left ear generated parallel but less accurate identifications with respect to voiced-versus-unvoiced, place of articulation, and alignment conditions. Inspection of responses in Table 3, and the resulting ratios in Table 4, confirmed this parallelism. The parallelism suggested that information from both ears is processed similarly but with a greater loss of information from the left ear. In comparing Tables 3 and 4, however, it should be noted that the conditions with asterisks compete consonants

TABLE 3.--Place and Manner Identification by Ear and Condition.

Condition	Front				Mid				Back				Correlated Z for V:U**
	Left Ear		Right Ear		Left Ear		Right Ear		Left Ear		Right Ear		
	V	U	V	U	V	U	V	U	V	U	V	U	
1. Boundary	224	220	248	238	244	185	260	203	232	175	255	208	23.19
2. Onset	123	189	143	238	147	156	196	197	119	187	189	243	8.87
3. Transition	102	201	125	241	135	158	159	201	96	214	129	236	5.69
4. V-O-T	227	238	260	255	244	207	265	211	228	197	270	235	27.93
5. Onset + Transition*	75	306	122	370	111	235	145	306	96	323	138	353	2.37
6. Boundary + Transition*	59	--	77	--	104	--	110	--	170	--	175	--	--
7. Boundary + V-O-T*	212	320	229	375	222	304	248	344	220	274	268	333	22.33
8. Onset + V-O-T	84	--	116	--	96	--	116	--	150	--	172	--	--
9. All Aligned	71	136	92	150	78	90	112	95	158	109	173	123	--

* Unequal V:U presentation.

**Correlated Z values for proportions between V and U when there is V:U competition (Dixon and Massey, 1969).

TABLE 4.--Ratios for V:U Pairings*.

Condition	Front		Mid		Back		Total		
	L	R	L	R	L	R	L	R	L+R
1. Boundary	1.02	1.04	1.32	1.28	1.33	1.28	1.22	1.18	1.20
2. Onset	.65	.60	.92	.99	.64	.78	.74	.79	.76
3. Transition	.51	.52	.85	.79	.45	.55	.60	.62	.61
4. V-O-T	.95	1.01	1.18	1.26	1.16	1.15	1.10	1.14	1.12
5. Onset + Transition*	.42	.55	.80	.70	.48	.61	.54	.64	.60
6. Boundary + Transition									**
7. Boundary + V-O-T	1.02	.98	1.17	1.25	1.29	1.27	1.16	1.16	1.16
8. Onset + V-O-T									**
9. All Aligned									**

* Calculated only when voiced and unvoiced consonants competed in the same pair.
**No V:U pairings possible.

against each other from the same manner class, e.g., voiced-versus-voiced and unvoiced-versus-unvoiced. The figures given in Table 4 reflected only the voiced-versus-unvoiced ratios (V:U) and therefore direct comparisons between Tables 3 and 4 should be made with care.

Magnitude of the Right Ear Effect Varied with Alignment Points

Rank-order ear differences (Table 4) showed that alignment on stimulus onset elicited the largest laterality effects; the three conditions showing greatest laterality all involved onset alignments. A Friedman two-way analysis of variance (Siegel, 1956) was used to determine if a significant difference existed between the nine conditions; the resultant Chi Square value of 71 was highly significant (Chi Square for 8 d.f. at .01 level = 20.06).

V:U Ratios as a Function of Place

The place response pattern (Tables 3 and 4) showed two general trends. Alignment Conditions 1, 4, and 7 elicited the lowest values for V:U identifications in the front-position and higher V:U ratios in the mid- and back-positions. Common features of these conditions were high intelligibility scores, and non-competing boundary and/or V-O-T. In each condition, V:U ratios for the front

position were near 1.00. Mid- and back-position ratios were approximately 1.25.

Conditions 2, 3, and 5 showed a second pattern: low intelligibility, highest V:U ratios with the mid-position, and similar ratios for the front- and back-positions. However, Condition 2 had consistently larger V:U values. The higher ratios observed in Condition 2 may be the result of 2 factors. First of all, transitions trailed in Condition 2, while they competed in Conditions 3 and 5. Secondly, the voiced item may have had a trail advantage if the subject had ignored prevoicing information. Inspection of Conditions 3 and 5 indicated prevoicing of the voiced item did not alter identification.

Unvoiced CV's Were Generally, But Not Always, More Intelligible Than Voiced CV's

Voiced-to-unvoiced ratios (Table 4) formed two distinct groupings: high unvoiced-over-voiced and low voiced-over-unvoiced. Voiced items were most intelligible when either V-O-T or boundary were simultaneous and onsets trailed. The highest V:U values were seen at boundary alignments in Conditions 1, 4, and 7. Correlated proportion z scores (Dixon and Massey, 1969) showed significant independence of voiced-unvoiced differences at the .01 level of confidence for all conditions except

onset-plus-transition. Onset-plus-transition voiced-unvoiced differences were significant at the .05 level of confidence.

Boundary and V-O-T alignment of V-U pairs required that the onsets of unvoiced items lead. The favored lag position may have enhanced voiced item identification.

When CV's of the same class competed, i.e., V-V or U-U, a simple "trail advantage" occurred. The microstructure introduced some variables which will be discussed later.

When Boundaries of CV's Trailed, Intelligibility was Generally Enhanced

Earlier studies had shown a "trail effect" using onset as the reference for whether a signal led or trailed (Lowe, 1970; Kirstein, 1970; Shankweiler and Studdert-Kennedy, 1967). This design permitted an analysis of "trail effect" using other microstructure references in addition to onset.

Table 5 showed that trail advantages were very large when boundary was taken as a reference for simultaneity. The trail-to-lead ratio was 1.35. It should also be noted that unvoiced consonants in V-U pairs were no longer more intelligible than voiced consonants. This reversal is in contrast to the findings of Table 6. Here we see that the unvoiced items in V-U pairs are more

TABLE 5.--Responses to Lead and Trail Stimuli with Boundary as the Reference for Simultaneity.

Microstructure Reference	Lead	Simultaneous	Trail
Boundary			
Voiced	*	1463	*
Unvoiced	*	1229	*
Boundary + Transition			
Voiced	*	*	*
Unvoiced	*	*	*
Boundary + V-O-T			
Voiced	*	1339	*
Unvoiced	*	1203	*
Onset			
Voiced	917	*	*
Unvoiced	*	*	1213
Transition			
Voiced	746	*	*
Unvoiced	*	*	1251
V-O-T			
Voiced	*	*	1494
Unvoiced	1343	*	*
Onset + Transition			
Voiced:Voiced	369	*	370
Voiced	687	*	*
Unvoiced	*	*	1152
Onset + V-O-T			
Voiced	309	*	425
Unvoiced	*	*	*

*Not Applicable

TABLE 6.--Responses to Lead and Trail Stimuli with Onset as Reference for Simultaneity

Microstructure Reference	Lead	Simultaneous	Trail
Onset			
Voiced	*	917	*
Unvoiced	*	1213	*
Onset + Transition			
Voiced	*	687	*
Unvoiced	*	1152	*
Onset + V-O-T			
Voiced	*	*	*
Unvoiced	*	*	*
Boundary			
Voiced	*	*	1463
Unvoiced	1229	*	*
Transition			
Voiced	746	*	*
Unvoiced	*	*	1251
V-O-T			
Voiced	*	*	1494
Unvoiced	1343	*	*
Boundary + Transition			
Voiced	341	*	354
Unvoiced	*	*	*
Boundary + V-O-T			
Unvoiced:			
Unvoiced	317	*	430
Voiced	*	*	1399
Unvoiced	1203	*	*

*Not Applicable

intelligible than their voiced counterparts. The trail-to-lead ratio was 1.23.

When onset was used as the reference point for simultaneity (Table 6), we again found the unvoiced consonants to be more intelligible than the voiced consonants. The trail-to-lead ratio was also 1.23.

Table 7, showing the effects of using transition as the reference for simultaneity, also showed the largest unvoiced-over-voiced preponderance in the simultaneous condition. In contrast, the trail-to-lead ratios here were only 1.09.

Table 8, showing the effects of using V-O-T as the reference for simultaneity, generated a 1.23 trail-to-lead ratio. In this condition the voiced items of V-U pairs were more intelligible than the unvoiced items.

These tables suggest that when transitions are aligned, the item with the trailing boundary was most likely to be heard. This finding may explain why the unvoiced items dominated voiced items in previous natural speech experiments (Lowe et al, 1970; Lowe, 1970). It will be recalled that these studies used <u>onset</u> as the criterion for simultaneity. Oscillographic tracings of V-U pairings, aligned on onset, revealed the boundaries

TABLE 7.--Responses to Lead and Trail Stimuli with Transition as the Reference for Simultaneity.

Microstructure Reference	Lead	Simultaneous	Trail
Transition			
Voiced	*	746	*
Unvoiced	*	1251	*
Onset + Transition			
Voiced	*	687	*
Unvoiced	*	1152	*
Boundary + Transition			
Voiced	*	341	*
Unvoiced	*	354	*
Boundary			
Voiced	*	*	1463
Unvoiced	1229	*	*
Onset			
Voiced	*	*	917
Unvoiced	1213	*	*
V-O-T			
Voiced	*	*	1494
Unvoiced	1343	*	*
Boundary + V-O-T			
Unvoiced: Unvoiced	317	*	430
Voiced	*	*	1399
Unvoiced	1203	*	*
Onset + V-O-T			
Voiced:Voiced	309	*	425
Voiced	*	*	*
Unvoiced	*	*	*

*Not Applicable

TABLE 8.--Responses to Lead and Trail Stimuli with V-O-T as the Reference for Simultaneity

Microstructure Reference	Lead	Simultaneous	Trail
V-O-T			
Voiced	*	1494	*
Unvoiced	*	1343	*
Boundary + V-O-T			
Voiced	*	1399	*
Unvoiced	*	1203	*
Onset + V-O-T			
Voiced	*	*	*
Unvoiced	*	*	*
Boundary			
Voiced	1463	*	*
Unvoiced	*	*	1229
Onset			
Voiced	917	*	*
Unvoiced	*	*	1213
Transition			
Voiced	746	*	*
Unvoiced	*	*	1251
Onset + Transition			
Unvoiced: Unvoiced	369	*	370
Voiced	687	*	*
Unvoiced	*	*	1152
Boundary + Transition			
Voiced	341	*	354
Unvoiced	*	*	*

*Not Applicable

of the unvoiced consonants always trailed those of the voiced consonant.

Scores for the trail items varied independently of scores for the lead items. The z scores for independence of these measures were as follows:

1. Boundary- - - - - - - - z = 7.2
2. Onset - - - - - - - - - z = 42.35
3. V-O-T - - - - - - - - - z = 24.21
4. Transition - - - - - z = 57.80

Differences larger than 2.58 are significant beyond the .01 level of confidence.

Single Versus Double Correct Responses Vary With Alignment Conditions

The three conditions which were easiest for the subjects, as evidenced by their high double correct scores, were V-O-T, boundary, and boundary + V-O-T. The three conditions which were most difficult, as evidenced by their high double error scores, were transition, onset + transition, and onset. The three conditions which elicited the highest numbers of single correct responses were the "all" condition, the boundary + transition condition, and the onset + transition condition. Table 9 shows these figures for raw data, and Table 10 shows the rank-orders of the conditions as a function of percent correct.

TABLE 9.--Summary of Response Pair Identification by Alignment Condition.

Alignment Condition	Double Correct	Single Correct	None Correct	Pairs Presented
Boundary	1050	592	86	1728
Onset	616	898	214	1728
Transition	504	989	235	1728
V-O-T	1169	499	60	1728
Onset + Transition	569	1440	295	2304
Boundary + Transition	156	383	37	576
Boundary + V-O-T	1156	1037	111	2304
Onset + V-O-T	200	334	42	576
All Aligned	301	785	66	1152
Total	5721	6957	1146	13824

TABLE 10.--Percent Correct and Rank-Order of Pair Identification for Each Alignment Condition.

Rank	Double Correct	Single Correct	None Correct	Total Correct
1	V-O-T (67.7)	All Aligned (68.1)	Transition (13.6)	V-O-T (82.2)
2	Boundary (60.8)	Boundary + Transition (66.5)	Onset + Transition (12.8)	Boundary (78.0)
3	Boundary + V-O-T (50.2)	Onset + Transition (62.5)	Onset (12.4)	Boundary + V-O-T (72.7)
4	Onset (35.6)	Onset + V-O-T (58.0)	Onset + V-O-T (7.3)	Onset + V-O-T (63.7)
5	Onset + V-O-T (34.7)	Transition (57.2)	Boundary + Transition (6.4)	Onset (61.6)
6	Transition (29.2)	Onset (52.0)	All Aligned (5.7)	Boundary + Transition (60.4)
7	Boundary + Transition (27.1)	Boundary + V-O-T (45.0)	Boundary (5.0)	All Aligned (60.2)
8	All Aligned (26.1)	Boundary (34.3)	Boundary + V-O-T (4.8)	Transition (57.8)
9	Onset + Transition (24.7)	V-O-T (28.9)	V-O-T (3.5)	Onset + Transition (56.0)

Kimura (1967) and the Haskins group (Studdert-Kennedy and Shankweiler, 1970a) have routinely analyzed only the first response from their subjects. In the present study, single responses did not accurately reflect the difficulty of the listening task. Task difficulty was best revealed by comparing these conditions which elicited many double correct responses, to those conditions eliciting many double errors.

A Comment on Subject Variability

Correlation coefficients were calculated by ear, across subjects, for the onset and the boundary + transition conditions. These conditions were chosen because they generated the highest and lowest laterality effects, respectively. Our computer program was not designed to generate individual subject plots, and therefore, these analyses were done by hand.

While differences between subjects were large in each condition, individual subject scores were correlated. Correlation coefficients were .45 for the left ear and .51 for the right ear. See Appendix O for individual subject performance.

A Final Note on Channel Equality

Inspection of the conditions listed in Table 11 revealed no overall channel difference, nor any differences as a function of whether a given channel went to the left or right ear. Channel I differed from Channel II by only 5 of 18,399 counts. The agreement ratios of Channel I to II were .999 total, .986 left ear, and 1.010 right ear. This final observation assured that there were no appreciable electronic or acoustic differences between channels.

TABLE 11.--Channel Comparison of Number Correct by Ear and Condition.

Condition	Total		Left Ear		Right Ear	
	Channel I	Channel II	Channel I	Channel II	Channel I	Channel II
Boundary	1349	1343	638	642	711	701
Onset	1065	1065	452	472	613	593
Transition	1007	990	445	461	562	529
V-O-T	1414	1423	665	676	749	747
Onset + Transition	1297	1281	583	561	714	720
Transition + Boundary	337	358	161	172	176	186
V-O-T + Boundary	1672	1677	768	784	904	893
V-O-T + Onset	368	366	164	166	204	200
All Aligned	688	699	321	321	367	378
Total	9197	9202	4197	4255	5000	4947
Channel Difference	5		58		53	
Ratio (Ch.1/Ch.2)	.999		.986		.989	

CHAPTER V

SUMMARY

Alignment on speech wave microstructure of dichotically presented synthetic speech resulted in the following response patterns:

1. The right ear was always superior to the left ear.
2. Magnitude of right ear superiority varied with alignment conditions as follows:

a.	Onset	16.3%
b.	Voice-onset-time-plus-onset	12.8%
c.	Onset-plus-transition	12.5%
d.	Transition	10.7%
e.	Voice-onset-time-plus-boundary	10.6%
f.	All	9.0%
g.	Voice-onset-time	9.0%
h.	Boundary	7.6%
i.	Transition-plus-boundary	5.0%

3. Laterality effects were uncorrelated with intelligibility. In dichotic listening laterality was enhanced by onset alignments while intelligibility was reduced by transition alignments. The rank order correlation (rho) between laterality and intelligibility was -.09.
4. Phonetically, right-ears out-performed left-ears at a constant ratio suggesting a common mode of processing.
5. Unvoiced are generally, but not always, more intelligible than voiced. Intelligibility of voiced items was maximum when boundaries were aligned.
6. Response by place showed either high scores at mid-place or low scores at front-place. In alignments with high voiced-to-unvoiced ratios, lower ratios were seen at the front position. In alignments with low voiced-to-unvoiced ratios, higher voiced-to-unvoiced ratios occurred at the mid-position.
7. When voiced competed against voiced and voiceless competed against voiceless, we still saw both a right ear laterality effect

and a trail effect.

8. Syllables whose boundaries were in the trailing position were most readily identified. Other alignments also enhanced the trailing items, but maximum intelligibility still occurred for trailing items relative to boundary.

9. Single-versus-double correct responses varied with the alignment condition. Double correct responses occurred often with boundary and voice-onset-time alignment. Few double correct responses occurred with transition and "all" alignments.

Complete response matrices for each condition and channel appear in Appendix M.

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APPENDICES

APPENDIX A

SYNTHETIC CONTINUA FOR THE CONSONANT - VOWEL PAIRS /BA-PA, DA-TA, GA-KA/

The b-p, d-t, and g-k continua are a second generation of the Haskin's Laboratories' voiced/voiceless continuum used by Lisker and Abramson (1964) in their study of stop consonant perception as a function of linguistic background. The continua were generated by means of a parallel-formant-synthesizer controlled by a DDP-224 computer. This system was assembled by Dr. Franklin Cooper and the Haskin's Laboratory staff.

Each of the three separate continua consists of 37 individual items varied by voice onset from +150 msecs to -150 msecs relative to the point of release. The general characteristics of the stimuli are:

1. Total duration of 400 msecs following release (prevoicing or + voicing creates 400 msecs plus their respective duration).
2. Fundamental frequency of approximately 130 Hz.
3. Steady state synthetic vowel /a/ with formant values correspond to the centroid values given by Peterson (1959). The formant band widths are: F--120 Hz; F_2--90 Hz; F_3--120 Hz. The

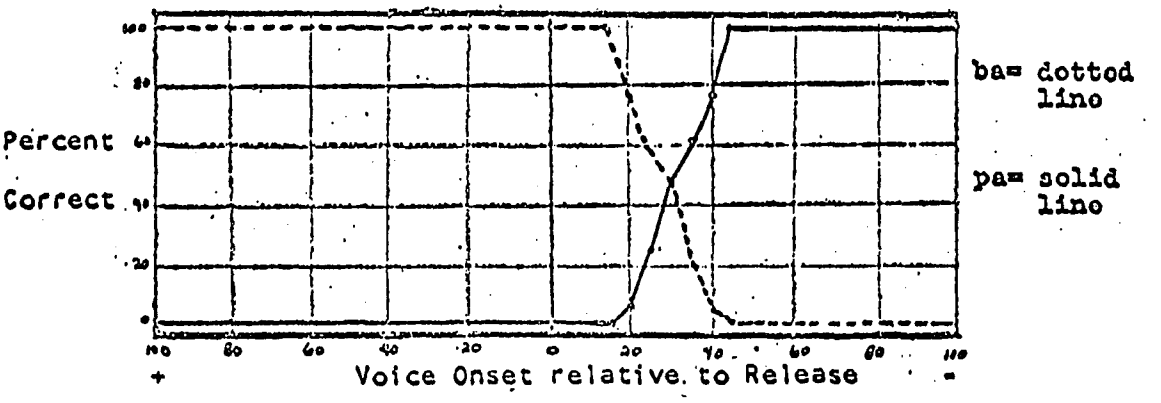
APPENDIX A (Continued)

formant bandwidths are employed in most terminal synthesizers and correspond well to the data of Dunn (1958) and House (1958).

4. The rates of formant loci transition correspond to the values given in previous Haskins Laboratories work.
5. A slight downward shift in frequency has been provided at the terminal border of the CV to improve the "naturalness" of the synthetic samples.

APPENDIX B
CROSSOVER POINTS FOR PHONEME IDENTIFICATION
AS A FUNCTION OF V-O-T* N=16**

/ba-pa/



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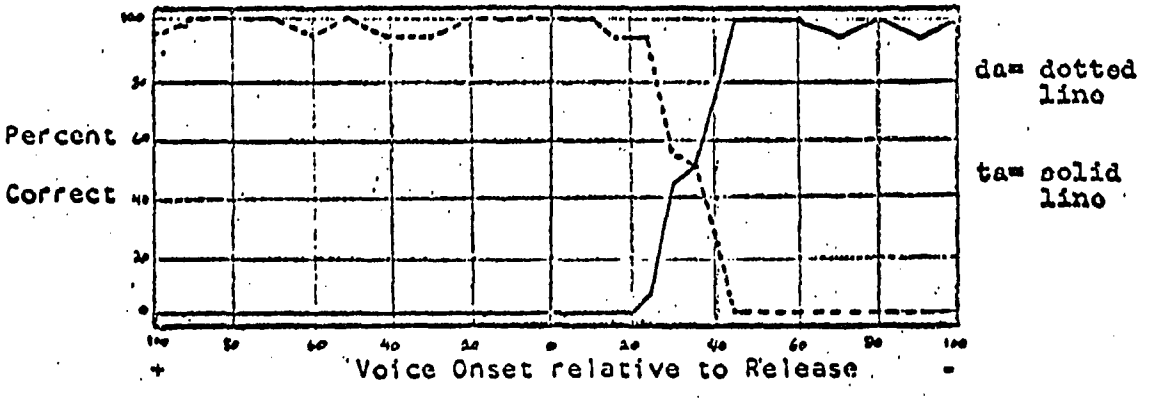

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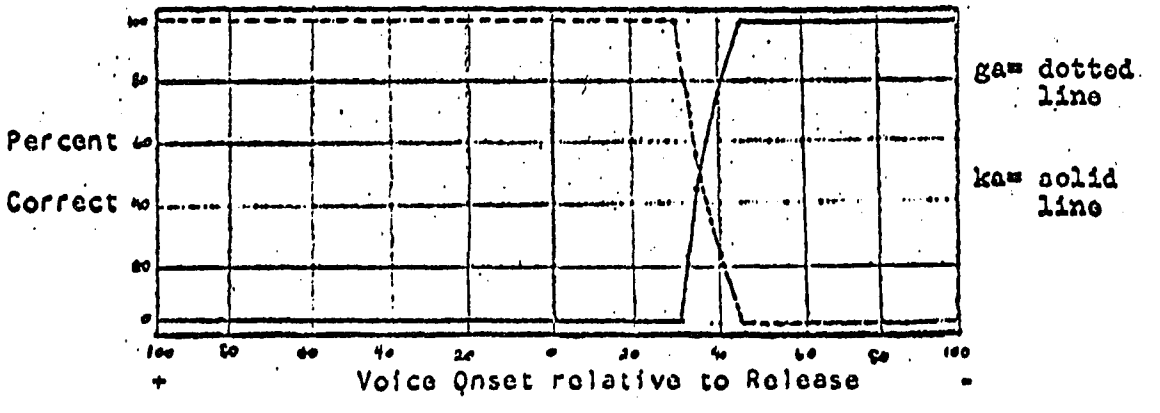
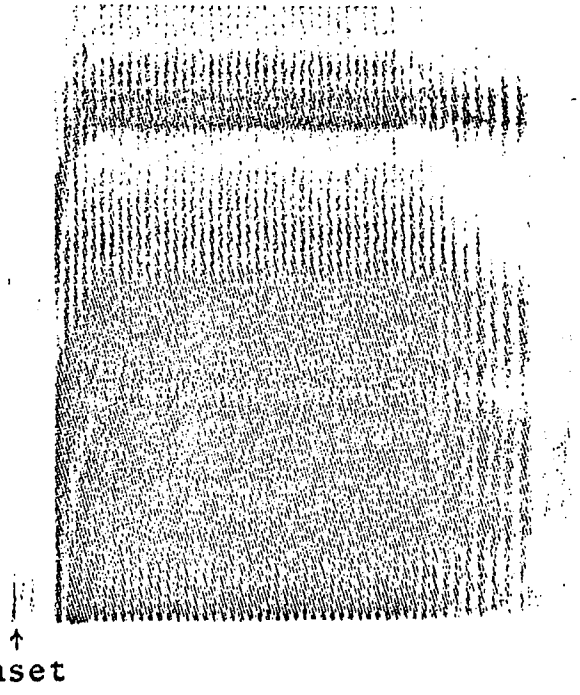


*Continua made available courtesy of Lisker and Abramson (1964).
**Tested at the Kresge Hearing Research Laboratory of the South, New Orleans, Louisiana.

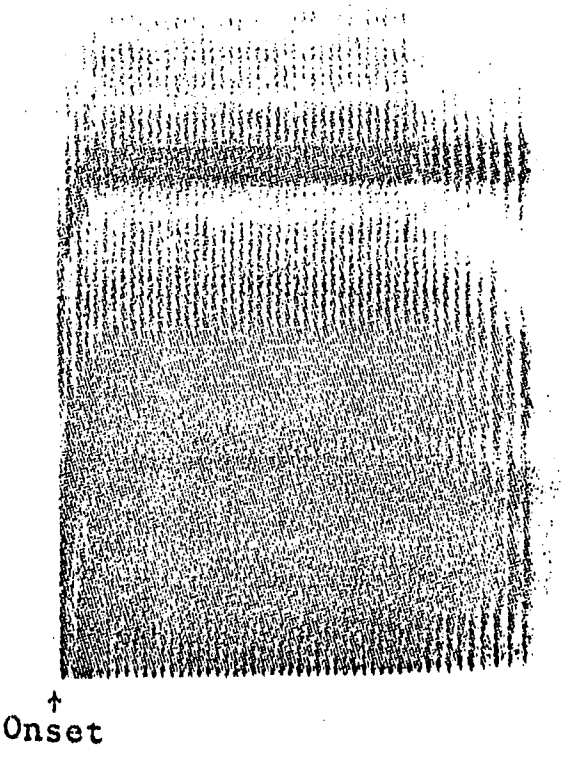
APPENDIX C

SPECTROGRAPHS OF INDIVIDUAL CV SYLLABLES

BA with 30 msec prevoicing



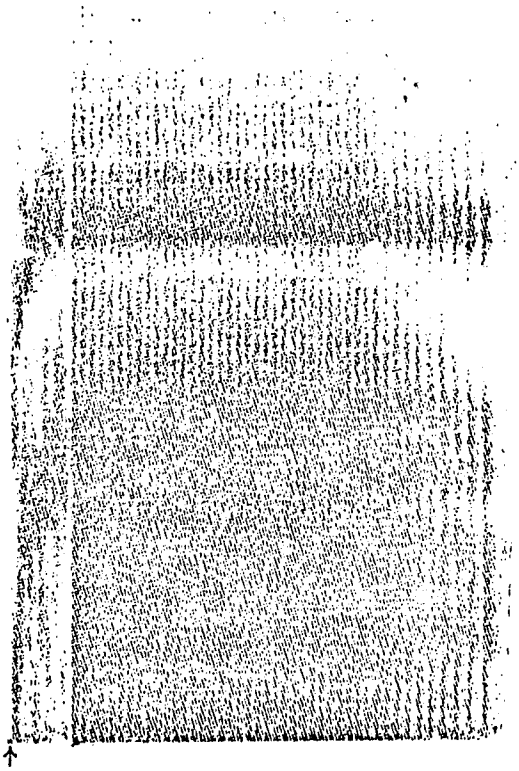
BA with 0 msec prevoicing



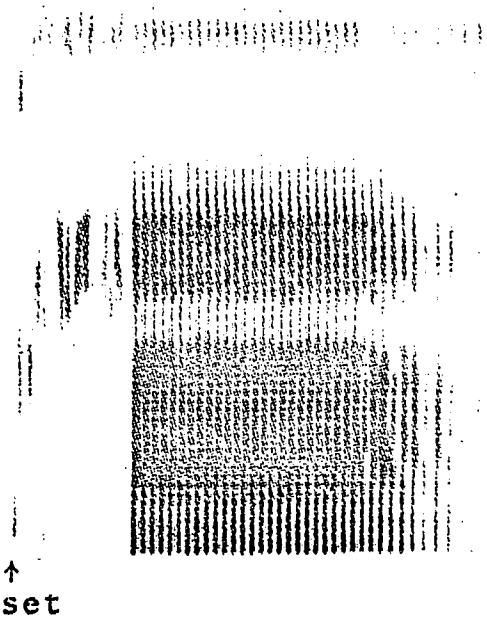
APPENDIX C (Continued)

SPECTROGRAPHS OF INDIVIDUAL CV SYLLABLES

PA with 60 msec voice trail



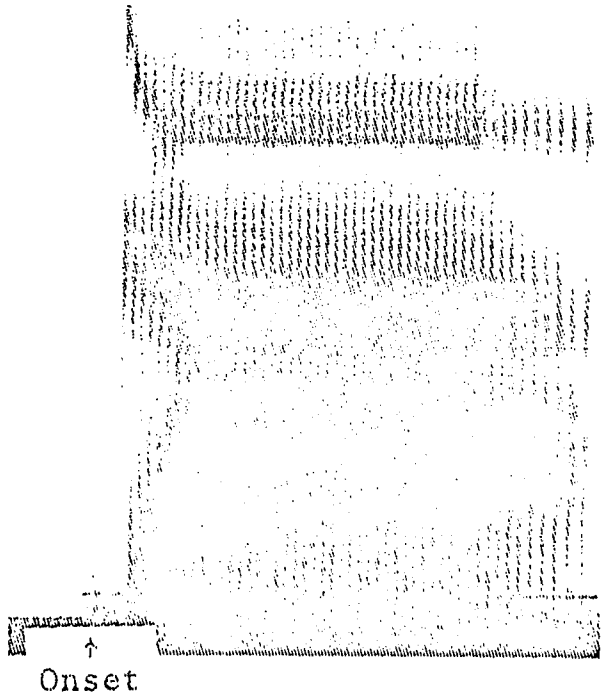
PA with 90 msec voice trail



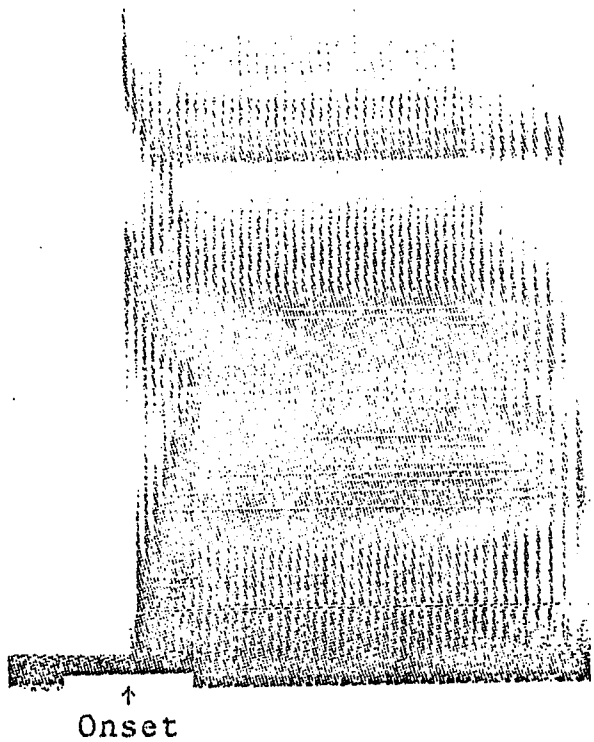
APPENDIX C

SPECTROGRAPHS OF INDIVIDUAL CV SYLLABLES

DA with 30 msec prevoicing



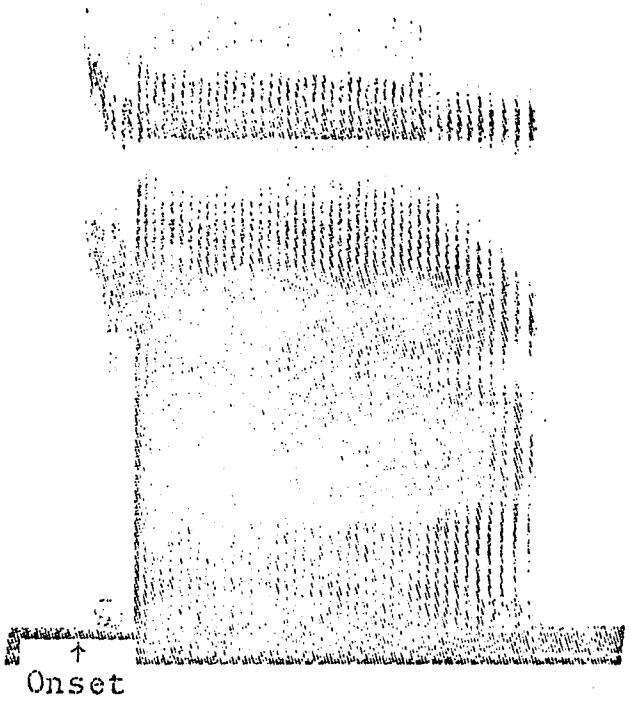
DA with 0 msec prevoicing



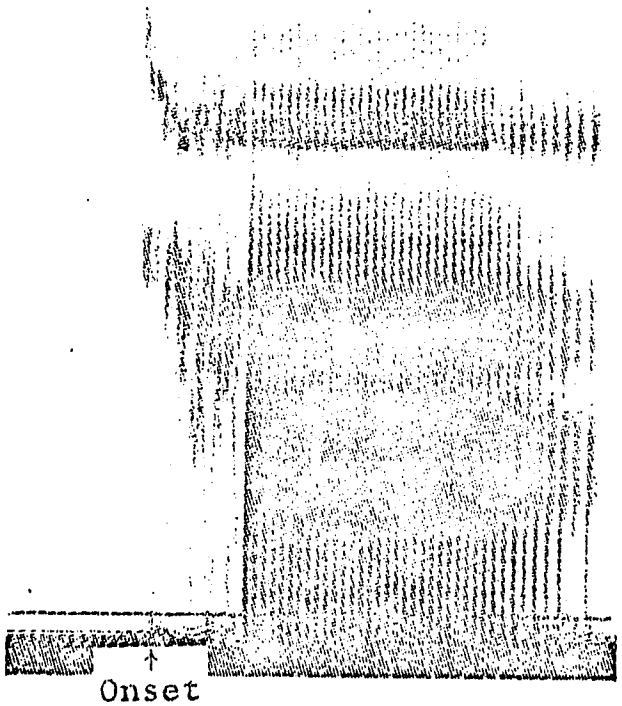
APPENDIX C

SPECTROGRAPHS OF INDIVIDUAL CV SYLLABLES

TA with 60 msec voice trail



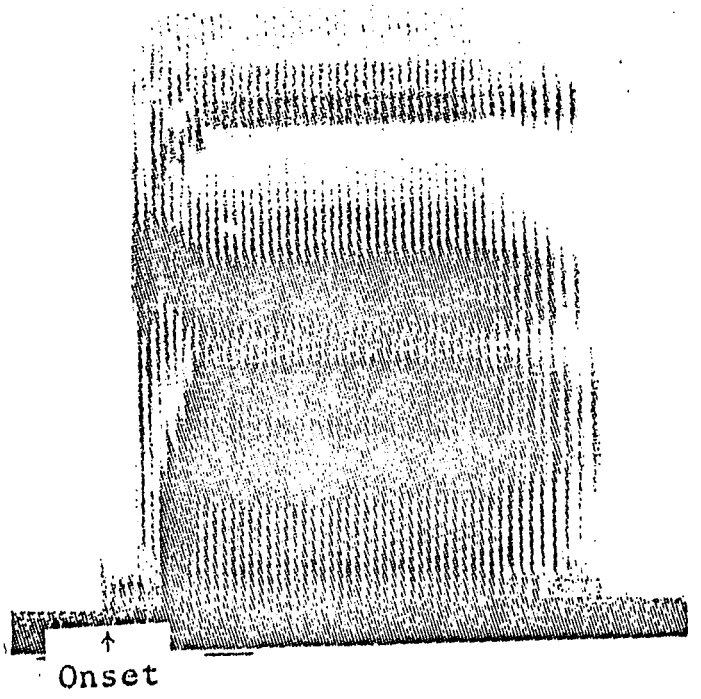
TA with 90 msec voice trail



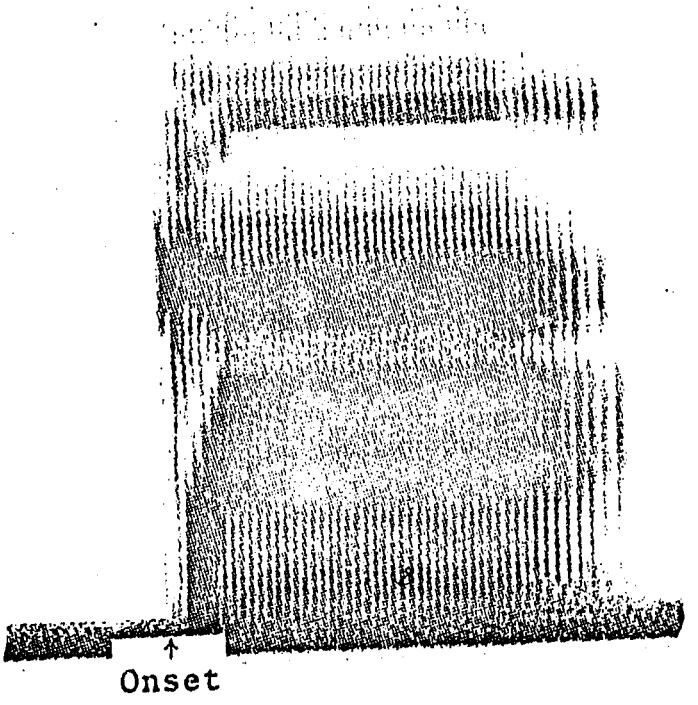
APPENDIX C (Continued)

SPECTROGRAPHS OF INDIVIDUAL CV SYLLABLES

GA with 30 msec prevoicing



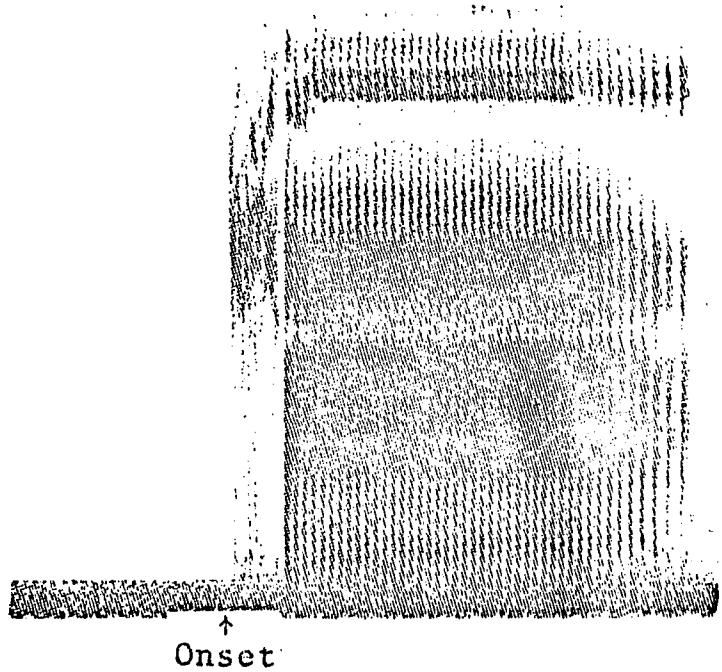
GA with 0 msec prevoicing



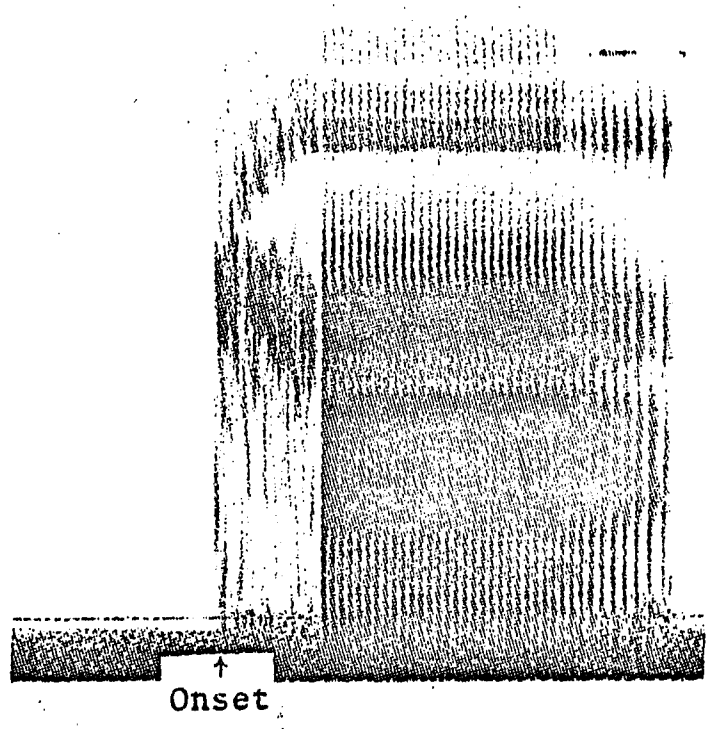
APPENDIX C (Continued)

SPECTROGRAPHS OF INDIVIDUAL CV SYLLABLES

KA with 60 msec voice trail



KA with 90 msec voice trail

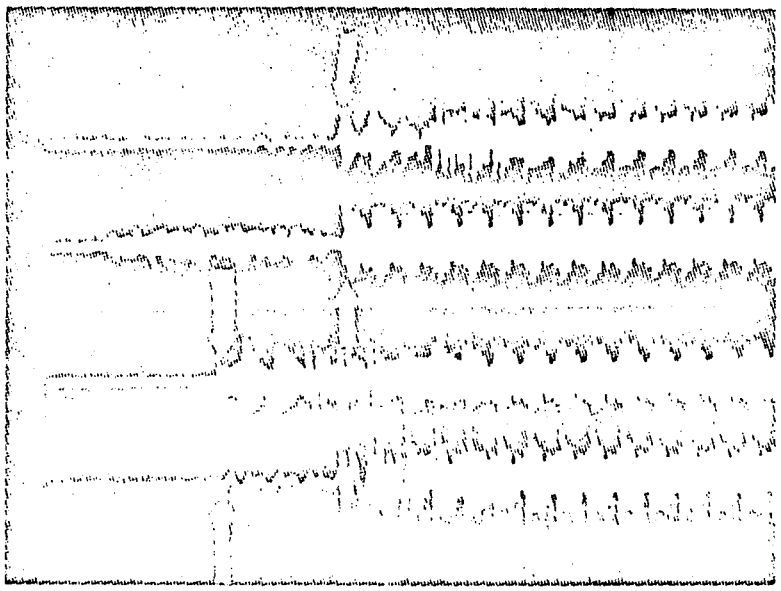


APPENDIX D

OSCILLOGRAPHIC TRACINGS OF REPRESENTATIVE ALIGNMENTS

Horizontal = 20 msec/ division

Vertical = 2 volts/ division

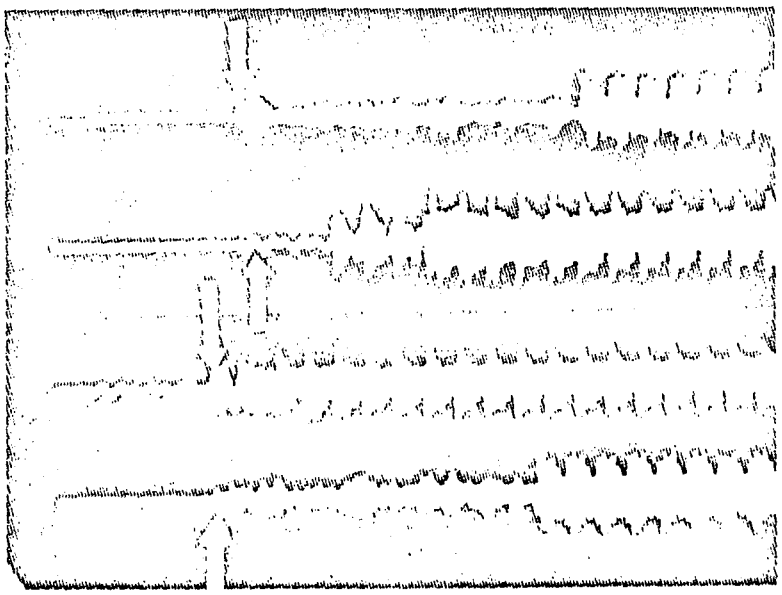


Upper: 30GA&60PA, Boundary.

Lower: 0GA&30BA, Onset+Voice-Onset-Time.

Horizontal = 20 msec/ division

Vertical = 2 volts/ division



Upper: 90TA&30GA, Onset.

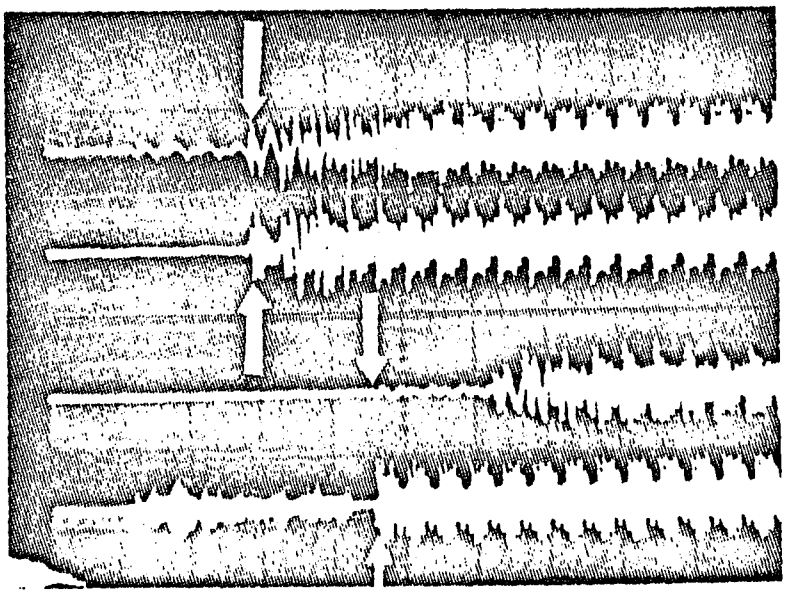
Lower: 30BA&90KA, Transition.

APPENDIX D (Continued)

OSCILLOGRAPHIC TRACINGS OF REPRESENTATIVE ALIGNMENTS

Horizontal = 20 msec/ division

Vertical = 2 volts/ division

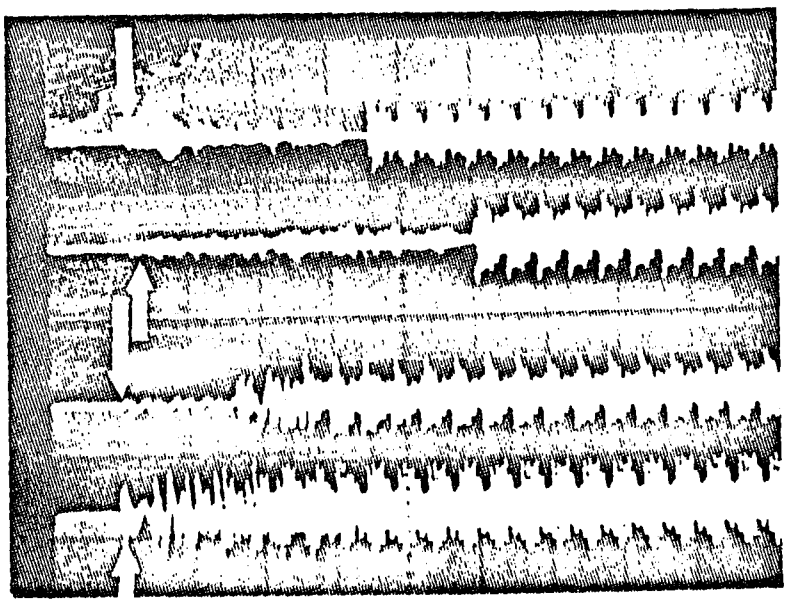


Upper: 30DA&0BA, Transition+Boundary.

Lower: 30DA&60KA, V-O-T.

Horizontal = 20 msec/ division

Vertical = 2 volts/ division



Upper: 60KA&90TA, Onset+Transition.

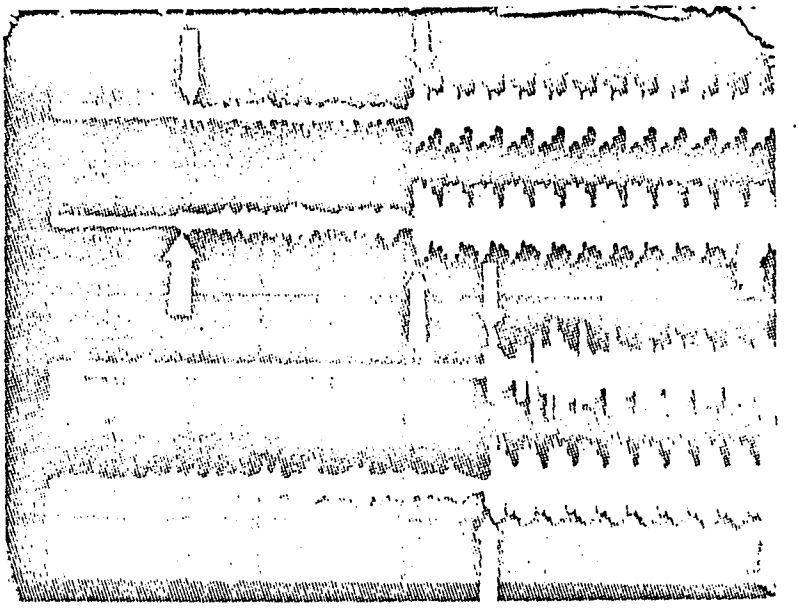
Lower: 30BA&0DA, Onset+V-O-T.

APPENDIX D (Continued)

OSCILLOGRAPHIC TRACINGS OF REPRESENTATIVE ALIGNMENTS

Horizontal = 20 msec/ division

Vertical = 2 volts/ division

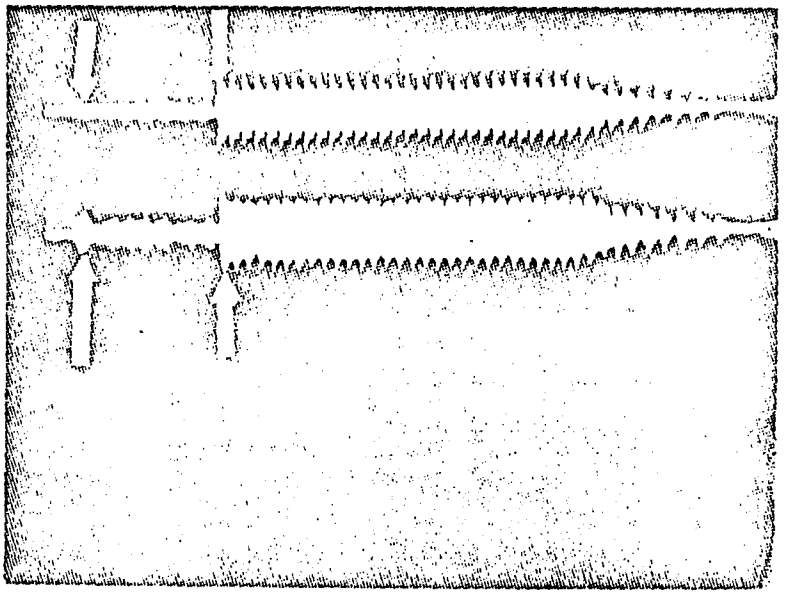


Upper: 60PA&60TA, Boundary+Onset+Transition+V-O-T.

Lower: 0BA&90TA, Boundary+V-O-T.

Horizontal = 20 msec/ division

Vertical = 2 volts/ division



Upper: 90TA&90KA, Boundary+Onset+Transition+V-O-T.

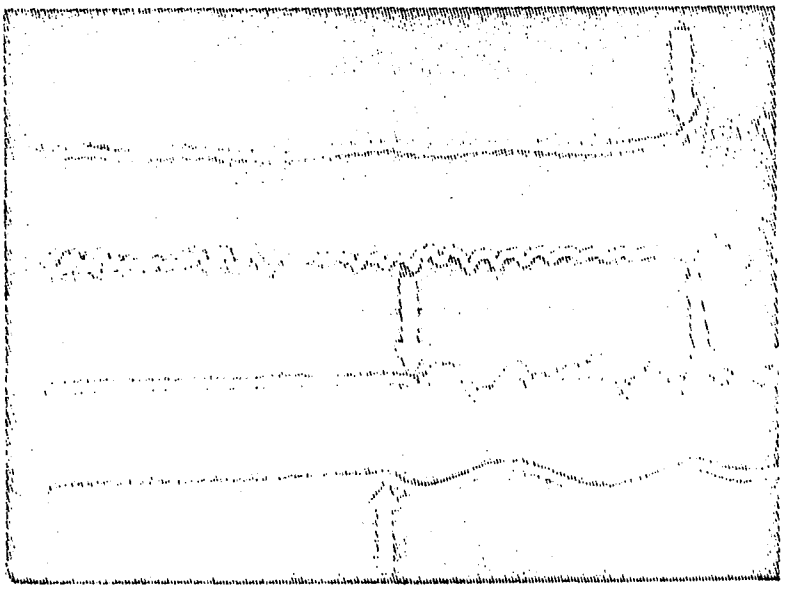
APPENDIX D (Continued)

OSCILLOGRAPHIC TRACINGS OF REPRESENTATIVE ALIGNMENTS

Horizontal = 2 msec/ division

Upper Vertical = 2 volts/ division

Lower Vertical = 1 volt/ division

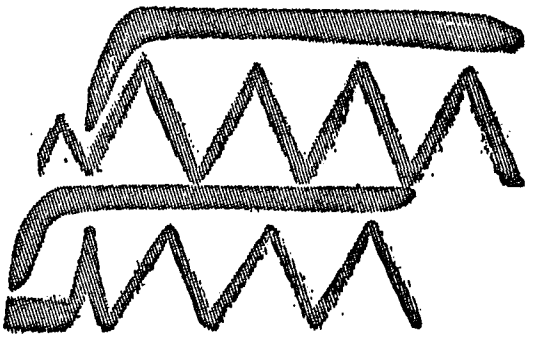


Upper: 30GA&90PA, Boundary.

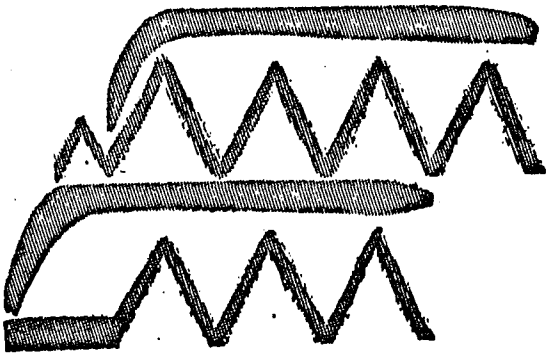
Lower: 90PA&30BA, Onset.

APPENDIX E

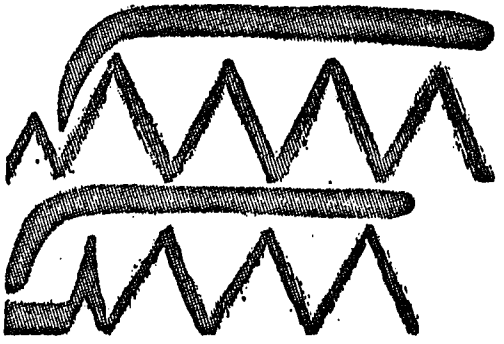
SCHEMATIC REPRESENTATION OF EACH ALIGNMENT CONDITION



BOUNDARY, +30 msec V-O-T and -60 msec V-O-T.



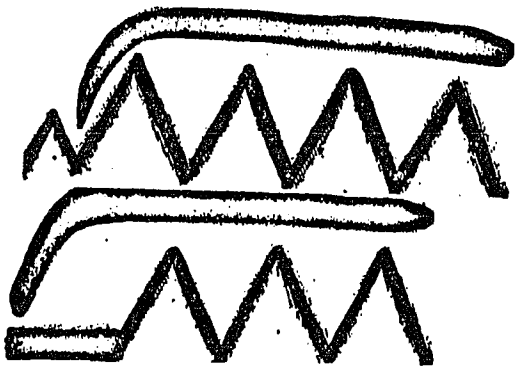
BOUNDARY, +30 msec V-O-T and -90 msec V-O-T.



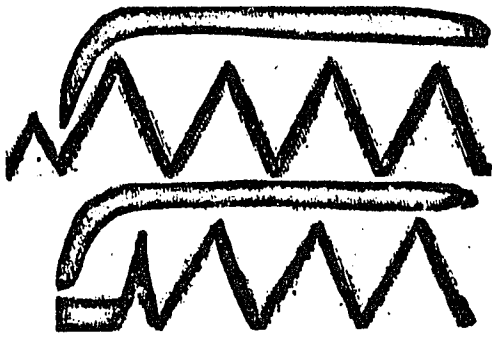
ONSET, +30 msec V-O-T and -60 msec V-O-T.

APPENDIX E (Continued)

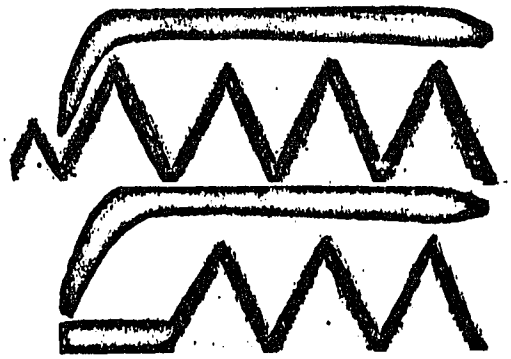
SCHEMATIC REPRESENTATION OF EACH ALIGNMENT CONDITION



ONSET, +30 msec V-O-T and -90 msec V-O-T.



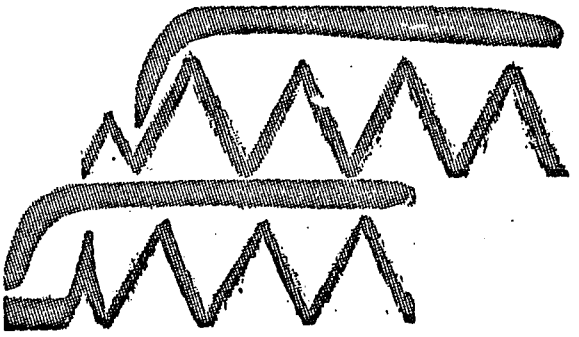
TRANSITION, +30 msec V-O-T and -60 msec V-O-T.



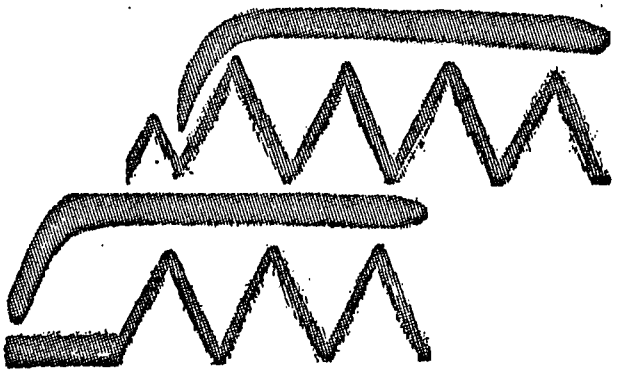
TRANSITION, +30 msec V-O-T and -90 msec V-O-T.

APPENDIX E (Continued)

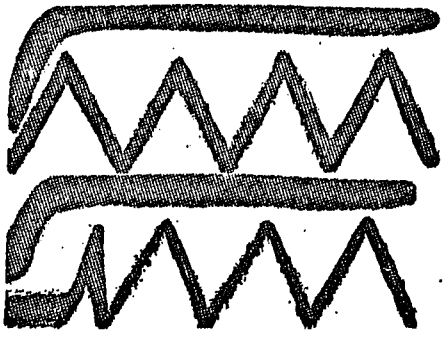
SCHEMATIC REPRESENTATION OF EACH ALIGNMENT CONDITION



VOICE-ONSET-TIME, +30 msec V-O-T and -60 msec V-O-T.



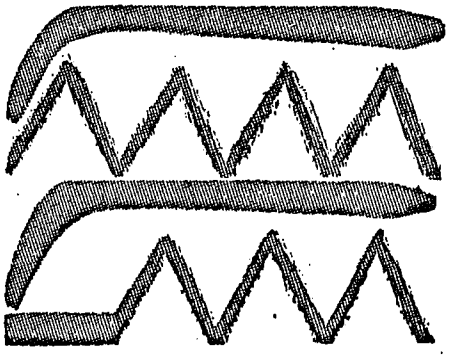
VOICE-ONSET-TIME, +30 msec V-O-T and -90 msec V-O-T.



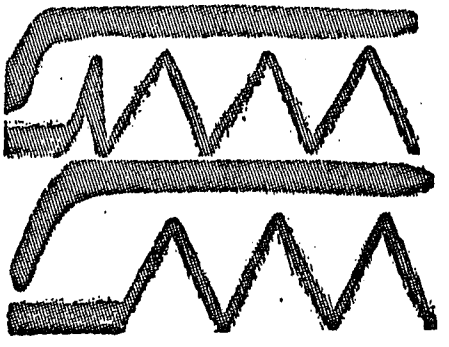
ONSET+TRANSITION, +0 msec V-O-T and -60 msec V-O-T.

APPENDIX E (Continued)

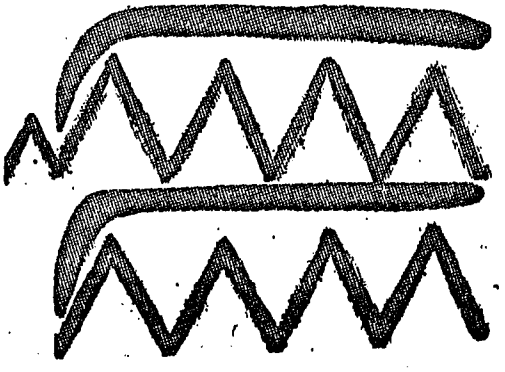
SCHEMATIC REPRESENTATION OF EACH ALIGNMENT CONDITION



ONSET+TRANSITION, +0 msec V-O-T and -90 msec V-O-T.



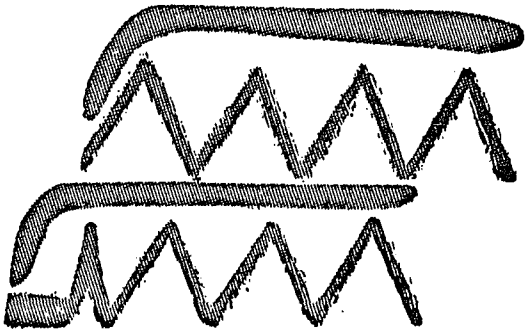
ONSET+TRANSITION, -60 msec V-O-T and -90 msec V-O-T.



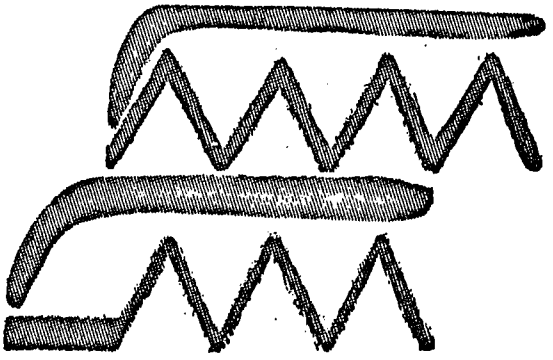
TRANSITION+BOUNDARY, +30 msec V-O-T and +0 msec V-O-T.

APPENDIX E (Continued)

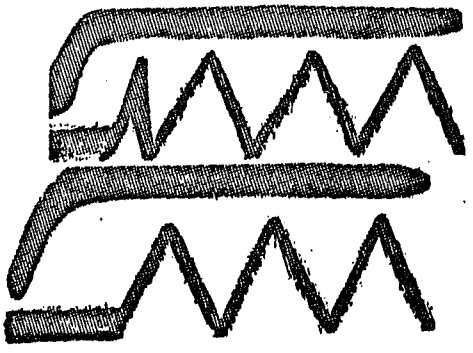
SCHEMATIC REPRESENTATION OF EACH ALIGNMENT CONDITION



BOUNDARY+VOICE-ONSET-TIME, +0 msec V-O-T and -60 msec V-O-T.



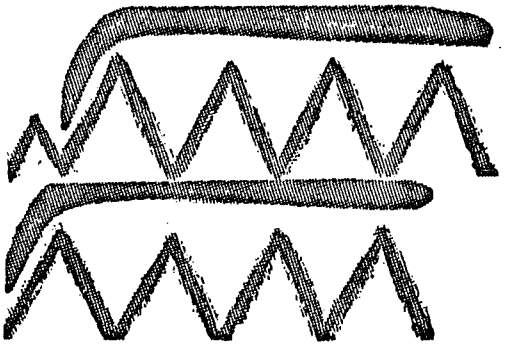
BOUNDARY+VOICE-ONSET-TIME, +0 msec V-O-T and -90 msec V-O-T.



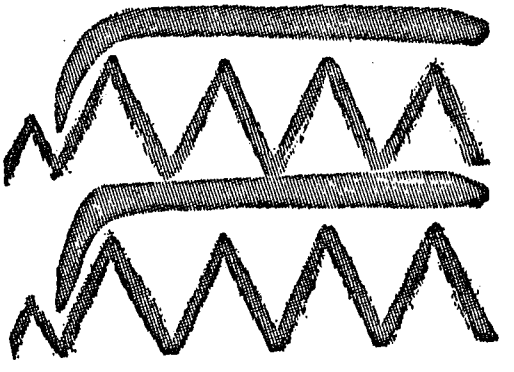
BOUNDARY+VOICE-ONSET-TIME, -60 msec V-O-T and -90 msec V-O-T.

APPENDIX E (Continued)

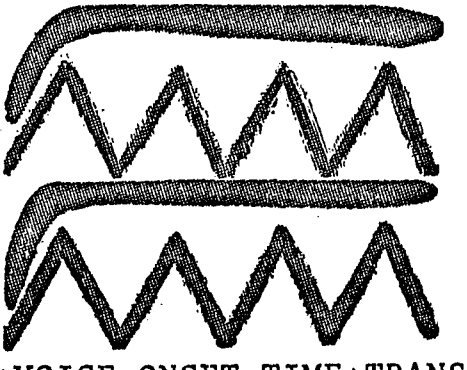
SCHEMATIC REPRESENTATION OF EACH ALIGNMENT CONDITION



ONSET+VOICE-ONSET-TIME, +30 msec V-O-T and +0 msec V-O-T.



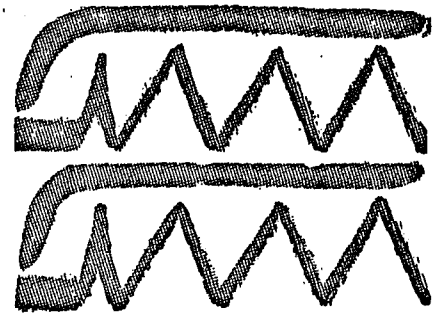
BOUNDARY+ONSET+VOICE-ONSET-TIME+TRANSITION, +30 msec V-O-T and +30 msec V-O-T.



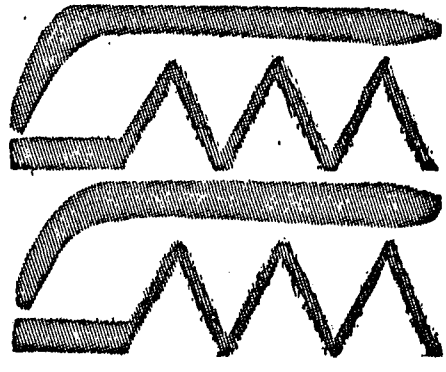
BOUNDARY+ONSET+VOICE-ONSET-TIME+TRANSITION, +0 msec V-O-T and +0 msec V-O-T

APPENDIX E (Continued)

SCHEMATIC REPRESENTATION OF EACH ALIGNMENT CONDITION

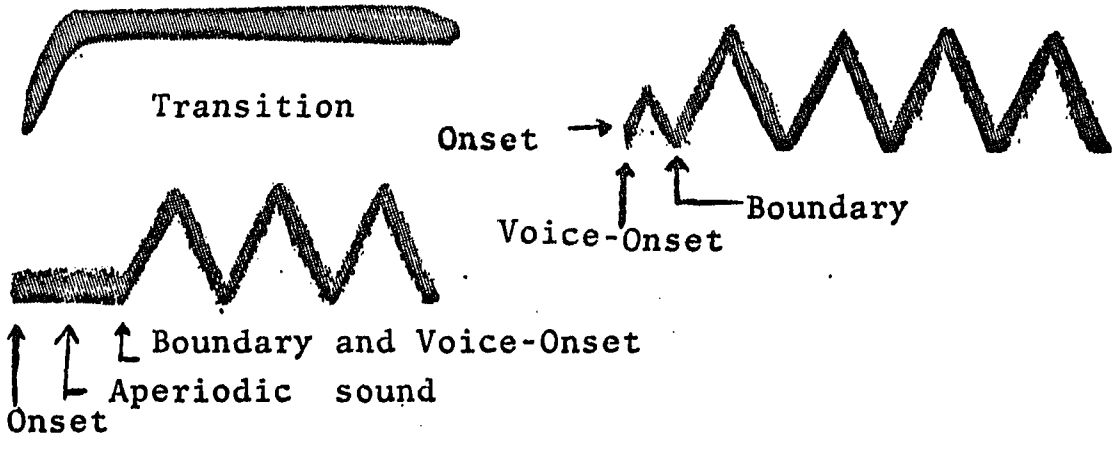


BOUNDARY+ONSET+VOICE-ONSET-TIME+TRANSITION, -60 msec V-O-T and -60 msec V-O-T.



BOUNDARY+ONSET+VOICE-ONSET-TIME+TRANSITION, -90 msec V-O-T and -60 msec V-O-T.

LEGEND



APPENDIX F

SCRIPT FOR SIMULTANEOUS ALIGNMENT CONDITION 1

BOUNDARY (B)

Pair	Channel I	Channel II	Pair	Channel I	Channel II
1	PA60	BA30	2	BA30	PA60
3	PA90	BA30	4	BA30	PA90
5	TA60	BA30	6	BA30	TA60
7	TA90	BA30	8	BA30	TA90
9	KA60	BA30	10	BA30	KA60
11	KA90	BA30	12	BA30	KA90
13	PA60	DA30	14	DA30	PA60
15	KA90	DA30	16	DA30	KA90
17	TA60	DA30	18	DA30	TA60
19	TA90	DA30	20	DA30	TA90
21	KA60	DA30	22	DA30	KA60
23	KA90	DA30	24	DA30	KA90

APPENDIX F

BOUNDARY (B)

(Continued)

Pair	Channel I	Channel II	Pair	Channel I	Channel II
25	PA60	GA30	26	GA30	PA60
27	PA90	GA30	28	GA30	PA90
29	TA60	GA30	30	GA30	TA60
31	TA90	GA30	32	GA30	TA90
33	KA60	GA30	34	GA30	KA60
35	KA90	GA30	36	GA30	KA90

APPENDIX F (Continued)

SCRIPT FOR SIMULTANEOUS ALIGNMENT CONDITION 2

ONSET (0)

Pair	Channel I	Channel II	Pair	Channel I	Channel II
1	BA30	PA60	2	PA60	BA30
3	BA30	PA90	4	PA90	BA30
5	BA30	TA60	6	TA60	BA30
7	BA30	TA90	8	TA90	BA30
9	BA30	KA60	10	KA60	BA30
11	BA30	KA90	12	KA90	BA30
13	DA30	PA60	14	PA60	DA30
15	DA30	PA90	16	PA90	DA30
17	DA30	TA60	18	TA60	DA30
19	DA30	TA90	20	TA90	DA30
21	DA30	KA60	22	KA60	DA30
23	DA30	KA90	24	KA90	DA30

APPENDIX F

ONSET (0)

(Continued)

Pair	Channel I	Channel II	Pair	Channel I	Channel II
25	GA30	PA60	26	PA60	GA30
27	GA30	PA90	28	PA90	GA30
29	GA30	TA60	30	TA60	GA30
31	GA30	TA90	32	TA90	GA30
33	GA30	KA60	34	KA60	GA30
35	GA30	KA90	36	KA90	GA30

APPENDIX F (Continued)

SCRIPT FOR SIMULTANEOUS ALIGNMENT CONDITION 3

TRANSITION (T)

Pair	Channel I	Channel II	Pair	Channel I	Channel II
1	BA30	PA60	2	PA60	BA30
3	BA30	PA90	4	PA90	BA30
5	BA30	TA60	6	TA60	BA30
7	BA30	TA90	8	TA90	BA30
9	BA30	KA60	10	KA60	BA30
11	BA30	KA90	12	KA90	BA30
13	DA30	PA60	14	PA60	DA30
15	DA30	PA90	16	PA90	DA30
17	DA30	TA60	18	TA60	DA30
19	DA30	TA90	20	TA90	DA30
21	DA30	KA60	22	KA60	DA30
23	DA30	KA90	24	KA90	DA30

APPENDIX F

TRANSITION (T)

(Continued)

Pair	Channel I	Channel II	Pair	Channel I	Channel II
25	GA30	PA60	26	PA60	GA30
27	GA30	PA90	28	PA90	GA30
29	GA30	TA60	30	TA60	GA30
31	GA30	TA90	32	TA90	GA30
33	GA30	KA60	34	KA60	GA30
35	GA30	KA90	36	KA90	GA30

APPENDIX F (Continued)

SCRIPT FOR SIMULTANEOUS ALIGNMENT CONDITION 4

VOICE ONSET TIME (V)

Pair	Channel I	Channel II	Pair	Channel I	Channel II
1	BA30	PA60	2	PA60	BA30
3	BA30	PA90	4	PA90	BA30
5	BA30	TA60	6	TA60	BA30
7	BA30	TA90	8	TA90	BA30
9	BA30	KA60	10	KA60	BA30
11	BA30	KA90	12	KA90	BA30
13	DA30	PA60	14	PA60	DA30
15	DA30	PA90	16	PA90	DA30
17	DA30	TA60	18	TA60	DA30
19	DA30	TA90	20	TA90	DA30
21	DA30	KA60	22	KA60	DA30
23	DA30	KA90	24	KA90	DA30

APPENDIX F

VOICE ONSET TIME (V)

(Continued)

Pair	Channel I	Channel II	Pair	Channel I	Channel II
25	GA30	PA60	26	PA60	GA30
27	GA30	PA90	28	PA90	GA30
29	GA30	TA60	30	TA60	GA30
31	GA30	TA90	32	TA90	GA30
33	GA30	KA60	34	KA60	GA30
35	GA30	KA90	36	KA90	GA30

APPENDIX F (Continued)

SCRIPT FOR SIMULTANEOUS ALIGNMENT CONDITION 5

ONSET AND TRANSITION (OT)

Pair	Channel I	Channel II	Pair	Channel I	Channel II
1	BA0	PA60	2	PA60	BA0
3	BA0	PA90	4	PA90	BA0
5	BA0	TA60	6	TA60	BA0
7	BA0	TA90	8	TA90	BA0
9	BA0	KA60	10	KA60	BA0
11	BA0	KA90	12	KA90	BA0
13	DA0	PA60	14	PA60	DA0
15	DA0	PA90	16	PA90	DA0
17	DA0	TA60	18	TA60	DA0
19	DA0	TA90	20	TA90	DA0
21	DA0	KA60	22	KA60	DA0
23	DA0	KA90	24	KA90	DA0

APPENDIX F

ONSET AND TRANSITION (OT)

(Continued)

Pair	Channel I	Channel II	Pair	Channel I	Channel II
25	GA0	PA60	26	PA60	GA0
27	GA0	PA90	28	PA90	GA0
29	GA0	TA60	30	TA60	GA0
31	GA0	TA90	32	TA90	GA0
33	GA0	KA60	34	KA60	GA0
35	GA0	KA90	36	KA90	GA0
37	PA60	TA90	38	TA90	PA60
39	PA60	KA90	40	KA90	PA60
41	TA60	PA90	42	PA90	TA60
43	TA90	KA90	44	KA90	TA90
45	KA60	PA90	46	PA90	KA60
47	KA90	TA90	48	TA90	KA90

APPENDIX F (Continued)

SCRIPT FOR SIMULTANEOUS ALIGNMENT CONDITION 6

TRANSITION AND BOUNDARY (TB)

	Channel	Channel		Channel	Channel
Pair	I	II	Pair	I	II
1	BA30	DA0	2	DA0	BA30
3	BA30	GA0	4	GA0	BA30
5	DA30	BA0	6	BA0	DA30
7	DA30	GA0	8	GA0	DA30
9	GA30	BA0	10	BA0	GA30
11	GA30	DA0	12	DA0	GA30

APPENDIX F (Continued)

SCRIPT FOR SIMULTANEOUS ALIGNMENT CONDITION 7

VOICE ONSET TIME AND BOUNDARY (VB)

Pair	Channel I	Channel II	Pair	Channel I	Channel II
1	BA0	PA60	2	PA60	BA0
3	BA0	PA90	4	PA90	BA0
5	BA0	TA60	6	TA60	BA0
7	BA0	TA90	8	TA90	BA0
9	BA0	KA60	10	KA60	BA0
11	BA0	KA90	12	KA90	BA0
13	DA0	PA60	14	PA60	DA0
15	DA0	PA90	16	PA90	DA0
17	DA0	TA60	18	TA60	DA0
19	DA0	TA90	20	TA90	DA0
21	DA0	KA60	22	KA60	DA0
23	DA0	KA90	24	KA90	DA0

APPENDIX F

VOICE ONSET TIME AND BOUNDARY (VB)

(Continued)

Pair	Channel I	Channel II	Pair	Channel I	Channel II
25	GA0	PA60	26	PA60	GA0
27	GA0	PA90	28	PA90	GA0
29	GA0	TA60	30	TA60	GA0
31	GA0	TA90	32	TA90	GA0
33	GA0	KA60	34	KA60	GA0
35	GA0	KA90	36	KA90	GA0
37	PA60	TA90	38	TA90	PA60
39	PA60	KA90	40	KA90	PA60
41	TA60	PA90	42	PA90	TA60
43	TA60	KA90	44	KA90	TA60
45	KA60	PA90	46	PA90	KA60
47	KA60	TA90	48	TA90	KA60

APPENDIX F (Continued)

SCRIPT FOR SIMULTANEOUS ALIGNMENT CONDITION 8

VOICE ONSET TIME AND ONSET (VO)

Pair	Channel I	Channel II	Pair	Channel I	Channel II
1	BA30	DA0	2	DA0	BA30
3	BA30	GA0	4	GA0	BA30
5	DA30	BA0	6	BA0	DA30
7	DA30	GA0	8	GA0	DA30
9	GA30	BA0	10	BA0	GA30
11	GA30	DA0	12	DA0	GA30

APPENDIX F (Continued)

SCRIPT FOR SIMULTANEOUS ALIGNMENT CONDITION 9

VOICE ONSET TIME, ONSET, TRANSITION,

AND BOUNDARY (VOTB)

Pair	Channel I	Channel II	Pair	Channel I	Channel II
1	DA30	BA30	2	BA30	DA30
3	GA30	BA30	4	BA30	GA30
5	GA30	DA30	6	DA30	GA30
7	DA0	BA0	8	BA0	DA0
9	GA0	BA0	10	BA0	GA0
11	GA0	DA0	12	DA0	GA0
13	TA60	PA60	14	PA60	TA60
15	KA60	PA60	16	PA60	KA60
17	KA60	TA60	18	TA60	KA60
19	TA90	PA90	20	PA90	TA90
21	KA90	PA90	22	PA90	KA90
23	KA90	TA90	24	TA90	KA90

APPENDIX G

SCRIPT FOR TEST LIST 1

RANDOMIZATION A

PAIR NO.	CONDITION	CHANNEL I		CHANNEL II	
		VOT*	ITEM	VOT*	ITEM
1	4	90	TA	30	BA
2	6	0	DA	30	BA
3	5	0	BA	90	PA
4	9	60	KA	60	TA
5	2	60	PA	30	GA
6	8	30	GA	0	DA
7	2	60	TA	30	BA
8	2	90	PA	30	DA
9	5	60	PA	90	TA
10	4	30	GA	60	KA
11	3	90	TA	30	GA
12	1	30	BA	90	TA
13	7	90	KA	0	GA
14	7	60	TA	90	KA
15	6	30	DA	0	GA
16	3	30	GA	60	PA

*VOT = Voice Onset Time (60 & 90 = Voice Trail; 30 = Voice Lead)

APPENDIX G

RANDOMIZATION A

(Continued)

PAIR NO.	CONDITION	CHANNEL I		CHANNEL II	
		VOT*	ITEM	VOT*	ITEM
17	2	30	GA	90	TA
18	4	90	PA	30	GA
19	3	60	KA	30	DA
20	9	90	TA	90	PA
21	7	0	GA	60	TA
22	3	90	KA	30	BA
23	3	30	DA	90	PA
24	7	60	PA	0	DA
25	1	30	DA	60	TA
26	1	60	PA	30	BA
27	1	60	KA	30	GA
28	5	90	PA	60	KA
29	9	30	BA	30	DA
30	5	90	TA	0	DA
31	2	30	BA	90	KA
32	1	90	KA	30	DA

*VOT = Voice Onset Time (60 & 90 = Voice Trail; 30 = Voice Lead)

APPENDIX G

RANDOMIZATION A

(Continued)

PAIR NO.	CONDITION	CHANNEL I		CHANNEL II	
		VOT*	ITEM	VOT*	ITEM
33	3	30	BA	60	TA
34	5	0	GA	90	KA
35	7	90	KA	60	PA
36	7	0	DA	90	TA
37	5	60	KA	0	BA
38	5	0	DA	60	PA
39	4	30	BA	60	PA
40	2	30	DA	60	KA
41	4	60	TA	30	DA
42	4	30	DA	90	KA
43	7	0	BA	60	KA
44	5	60	TA	0	GA
45	9	0	GA	0	BA
46	8	0	BA	30	GA
47	7	90	PA	0	BA
48	1	30	GA	90	PA

*VOT = Voice Onset Time (60 & 90 = Voice Trail; 30 = Voice Lead)

APPENDIX G (Continued)

SCRIPT FOR TEST LIST 1

RANDOMIZATION B

PAIR NO.	CONDITION	CHANNEL I		CHANNEL II	
		VOT*	ITEM	VOT*	ITEM
1	5	0	DA	60	PA
2	5	60	KA	0	BA
3	3	90	TA	30	GA
4	4	30	DA	90	KA
5	7	0	DA	90	TA
6	3	30	BA	60	TA
7	1	30	DA	60	TA
8	4	60	TA	30	DA
9	5	90	PA	60	KA
10	7	60	TA	90	KA
11	6	0	DA	30	BA
12	5	0	GA	90	KA
13	7	90	KA	60	PA
14	7	0	BA	60	KA
15	2	30	GA	90	TA
16	1	30	BA	90	TA

*VOT = Voice Onset Time (60 & 90 = Voice Trail; 30 = Voice Lead)

APPENDIX G

RANDOMIZATION B

(Continued)

PAIR NO.	CONDITION	CHANNEL I		CHANNEL II	
		VOT*	ITEM	VOT*	ITEM
17	9	90	TA	90	PA
18	1	90	KA	30	DA
19	9	0	GA	0	BA
20	4	30	GA	60	KA
21	1	60	KA	30	GA
22	3	90	KA	30	BA
23	4	90	TA	30	BA
24	8	0	BA	30	GA
25	4	30	BA	60	PA
26	7	90	KA	0	GA
27	1	60	PA	30	BA
28	3	60	KA	30	DA
29	9	60	KA	60	TA
30	3	30	GA	60	PA
31	3	30	DA	90	PA
32	7	90	PA	0	BA

*VOT = Voice Onset Time (60 & 90 = Voice Trail; 30 = Voice Lead)

APPENDIX G

RANDOMIZATION B

(Continued)

PAIR NO.	CONDITION	CHANNEL I		CHANNEL II	
		VOT*	ITEM	VOT*	ITEM
33	2	30	BA	90	KA
34	8	30	GA	0	DA
35	5	0	BA	90	PA
36	4	90	PA	30	GA
37	5	90	TA	0	DA
38	2	60	PA	30	GA
39	2	90	PA	30	DA
40	5	60	PA	90	TA
41	2	30	DA	60	KA
42	9	30	BA	30	DA
43	2	60	TA	30	BA
44	7	0	GA	60	TA
45	6	30	DA	0	GA
46	5	60	TA	0	GA
47	1	30	GA	90	PA
48	7	60	PA	0	DA

*VOT = Voice Onset Time (60 & 90 = Voice Trail; 30 = Voice Lead)

APPENDIX G (Continued)

SCRIPT FOR TEST LIST 2

RAMDOMIZATION A

PAIR NO.	CONDITION	CHANNEL I		CHANNEL II	
		VOT*	ITEM	VOT*	ITEM
1	6	0	GA	30	DA
2	4	30	DA	60	TA
3	2	90	KA	30	BA
4	3	60	PA	30	GA
5	3	90	PA	30	DA
6	9	30	DA	30	BA
7	2	30	BA	60	TA
8	2	90	TA	30	GA
9	6	30	BA	0	DA
10	5	90	PA	0	BA
11	9	90	KA	90	PA
12	4	60	PA	30	BA
13	5	90	TA	60	PA
14	3	30	GA	90	TA
15	5	0	BA	60	KA
16	1	60	TA	30	DA

*VOT = Voice Onset Time (60 & 90 = Voice Trail;
30 = Voice Lead)

APPENDIX G

RANDOMIZATION A

(Continued)

PAIR NO.	CONDITION	CHANNEL I		CHANNEL II	
		VOT*	ITEM	VOT*	ITEM
17	4	30	BA	90	TA
18	7	0	GA	90	KA
19	3	30	DA	60	KA
20	8	0	DA	30	GA
21	5	60	PA	0	DA
22	4	30	GA	90	PA
23	5	60	TA	90	KA
24	7	90	PA	60	TA
25	4	90	KA	30	DA
26	7	90	TA	0	DA
27	7	60	TA	0	GA
28	1	90	TA	30	BA
29	1	30	DA	90	KA
30	1	90	PA	30	GA
31	9	0	BA	0	GA
32	4	60	KA	30	GA

*VOT = Voice Onset Time (60 & 90 = Voice Trail; 30 = Voice Lead)

APPENDIX G

RANDOMIZATION A

(Continued)

PAIR NO.	CONDITION	CHANNEL I		CHANNEL II	
		VOT*	ITEM	VOT*	ITEM
33	7	0	DA	60	PA
34	5	0	GA	60	TA
35	3	30	BA	90	KA
36	7	0	BA	90	PA
37	7	60	KA	0	BA
38	5	0	DA	90	TA
39	2	60	KA	30	DA
40	7	60	KA	90	TA
41	2	30	GA	60	PA
42	3	60	TA	30	BA
43	8	30	GA	0	BA
44	1	30	GA	60	KA
45	9	60	PA	60	KA
46	5	90	KA	0	GA
47	1	30	BA	60	PA
48	2	30	DA	90	PA

*VOT = Voice Onset Time (60 & 90 = Voice Trail; 30 = Voice Lead)

APPENDIX G (Continued)

SCRIPT FOR TEST LIST 2

RANDOMIZATION B

PAIR NO.	CONDITION	CHANNEL I		CHANNEL II	
		VOT*	ITEM	VOT*	ITEM
1	1	30	DA	90	KA
2	1	30	GA	60	KA
3	4	30	GA	90	PA
4	5	60	TA	90	KA
5	4	60	KA	30	GA
6	8	30	GA	0	BA
7	4	90	KA	30	DA
8	3	60	PA	30	GA
9	2	30	DA	90	PA
10	3	30	BA	90	KA
11	3	60	TA	30	BA
12	7	0	BA	90	PA
13	2	90	TA	30	GA
14	9	60	PA	60	KA
15	1	60	TA	30	DA
16	5	60	PA	0	DA

*VOT = Voice Onset Time (60 & 90 = Voice Trail;
30 = Voice Lead)

APPENDIX G

RANDOMIZATION B

(Continued)

PAIR NO.	CONDITION	CHANNEL I		CHANNEL II	
		VOT*	ITEM	VOT*	ITEM
17	3	30	DA	60	KA
18	5	0	BA	60	KA
19	7	90	TA	0	DA
20	6	30	BA	0	DA
21	1	30	BA	60	PA
22	9	90	KA	90	PA
23	1	90	PA	30	GA
24	7	60	KA	0	BA
25	1	90	TA	30	BA
26	8	0	DA	30	GA
27	4	30	BA	90	TA
28	7	0	DA	60	PA
29	2	30	GA	60	PA
30	7	60	TA	0	GA
31	3	90	PA	30	DA
32	5	0	DA	90	TA

*VOT = Voice Onset Time (60 & 90 = Voice Trail; 30 = Voice Lead)

APPENDIX G

RANDOMIZATION B

(Continued)

PAIR NO.	CONDITION	CHANNEL I		CHANNEL II	
		VOT*	ITEM	VOT*	ITEM
33	5	90	KA	0	GA
34	7	0	GA	90	KA
35	9	0	BA	0	GA
36	2	60	KA	30	DA
37	2	30	BA	60	TA
38	5	90	TA	60	PA
39	6	0	GA	30	DA
40	4	60	PA	30	BA
41	3	30	GA	90	TA
42	4	30	DA	60	TA
43	5	0	GA	60	TA
44	2	90	KA	30	BA
45	9	30	DA	30	BA
46	7	60	KA	90	TA
47	5	90	PA	0	BA
48	7	90	PA	60	TA

*VOT = Voice Onset Time (60 & 90 = Voice Trail; 30 = Voice Lead)

APPENDIX G (Continued)

SCRIPT FOR TEST LIST 3

RANDOMIZATION A

PAIR NO.	CONDITION	CHANNEL I		CHANNEL II	
		VOT*	ITEM	VOT*	ITEM
1	5	60	KA	0	GA
2	7	0	DA	90	KA
3	9	60	KA	60	PA
4	3	30	BA	60	KA
5	7	60	TA	0	DA
6	1	60	TA	30	BA
7	5	60	TA	90	PA
8	5	0	BA	90	TA
9	6	0	BA	30	DA
10	4	90	KA	30	BA
11	4	30	BA	60	TA
12	5	90	TA	60	KA
13	9	30	DA	30	GA
14	8	0	DA	30	BA
15	2	60	TA	30	GA
16	8	30	BA	0	GA

*VOT = Voice Onset Time (60 & 90 = Voice Trail; 30 = Voice Lead)

APPENDIX G

RANDOMIZATION A

(Continued)

PAIR NO.	CONDITION	CHANNEL I		CHANNEL II	
		VOT*	ITEM	VOT*	ITEM
17	2	60	KA	30	BA
18	1	30	GA	90	TA
19	7	60	PA	90	TA
20	1	90	PA	30	DA
21	5	90	KA	0	DA
22	2	30	DA	60	PA
23	3	60	PA	30	DA
24	3	30	DA	90	TA
25	3	30	GA	60	TA
26	2	30	GA	90	KA
27	1	60	PA	30	GA
28	4	60	KA	30	DA
29	2	30	BA	90	PA
30	3	90	PA	30	BA
31	9	0	GA	0	DA
32	7	90	TA	0	BA

*VOT = Voice Onset Time (60 & 90 = Voice Trail; 30 = Voice Lead)

APPENDIX G

RANDOMIZATION A

(Continued)

PAIR NO.	CONDITION	CHANNEL I		CHANNEL II	
		VOT*	ITEM	VOT*	ITEM
33	5	0	GA	90	PA
34	7	90	PA	0	GA
35	4	30	DA	90	PA
36	9	90	PA	90	KA
37	4	90	TA	30	GA
38	4	39	GA	60	PA
39	5	60	PA	0	BA
40	7	90	KA	60	TA
41	1	30	DA	60	KA
42	7	0	GA	60	KA
43	7	0	BA	60	PA
44	5	0	DA	60	TA
45	1	30	BA	90	KA
46	3	90	KA	30	GA
47	2	90	TA	30	DA
48	6	30	GA	0	BA

*VOT = Voice Onset Time (60 & 90 = Voice Trail; 30 = Voice Lead)

APPENDIX G (Continued)

SCRIPT FOR TEST LIST 3

RANDOMIZATION B

PAIR NO.	CONDITION	CHANNEL I		CHANNEL II	
		VOT*	ITEM	VOT*	ITEM
1	4	30	BA	60	TA
2	1	90	PA	30	DA
3	5	90	TA	60	KA
4	2	30	GA	90	KA
5	3	90	PA	30	BA
6	9	30	DA	30	GA
7	1	60	TA	30	BA
8	3	60	PA	30	DA
9	4	30	GA	60	PA
10	2	60	TA	30	GA
11	5	0	GA	90	PA
12	3	90	KA	30	GA
13	9	60	KA	60	PA
14	7	60	TA	0	DA
15	3	30	DA	90	TA
16	2	60	KA	30	BA

*VOT = Voice Onset Time (60 & 90 = Voice Trail;
30 = Voice Lead)

APPENDIX G

RANDOMIZATION B

(Continued)

PAIR NO.	CONDITION	CHANNEL I		CHANNEL II	
		VOT*	ITEM	VOT*	ITEM
17	4	90	KA	30	BA
18	7	0	GA	60	KA
19	5	60	TA	90	PA
20	4	90	TA	30	GA
21	7	90	PA	0	GA
22	1	30	DA	60	KA
23	3	30	BA	60	KA
24	7	0	BA	60	PA
25	1	30	GA	90	TA
26	9	90	PA	90	KA
27	5	60	PA	0	BA
28	7	0	DA	90	KA
29	6	0	BA	30	DA
30	7	90	KA	60	TA
31	4	30	DA	90	PA
32	8	0	DA	30	BA

*VOT = Voice Onset Time (60 & 90 = Voice Trail; 30 = Voice Lead)

APPENDIX G

RANDOMIZATION B

(Continued)

PAIR NO.	CONDITION	CHANNEL I		CHANNEL II	
		VOT*	ITEM	VOT*	ITEM
33	5	0	BA	90	TA
34	2	30	BA	90	PA
35	7	90	TA	0	BA
36	8	30	BA	0	GA
37	9	0	GA	0	DA
38	1	60	PA	30	GA
39	7	60	PA	90	TA
40	3	30	GA	60	TA
41	4	60	KA	30	DA
42	5	90	KA	0	DA
43	2	30	DA	60	PA
44	5	60	KA	0	GA
45	2	90	TA	30	DA
46	6	30	GA	0	BA
47	1	30	BA	90	KA
48	5	0	DA	60	TA

*VOT = Voice Onset Time (60 & 90 = Voice Trail; 30 = Voice Lead)

APPENDIX G (Continued)

SCRIPT FOR TEST LIST 4

RANDOMIZATION A

PAIR NO.	CONDITION	CHANNEL I		CHANNEL II	
		VOT*	ITEM	VOT*	ITEM
1	7	90	KA	0	DA
2	9	0	DA	0	GA
3	2	90	KA	30	GA
4	4	30	BA	90	KA
5	3	30	BA	90	PA
6	4	60	TA	30	BA
7	8	0	GA	30	BA
8	2	90	PA	30	BA
9	7	0	BA	90	TA
10	1	30	GA	60	PA
11	1	90	TA	30	GA
12	5	0	BA	60	PA
13	4	30	GA	90	TA
14	2	30	GA	60	TA
15	5	90	TA	0	BA
16	9	60	PA	60	TA

*VOT = Voice Onset Time (60 & 90 = Voice Trail; 30 = Voice Lead)

APPENDIX G

RANDOMIZATION A

(Continued)

PAIR NO.	CONDITION	CHANNEL I		CHANNEL II	
		VOT*	ITEM	VOT*	ITEM
17	1	30	DA	90	PA
18	7	60	TA	90	PA
19	3	60	TA	30	GA
20	3	90	TA	30	DA
21	7	0	GA	90	PA
22	1	30	BA	60	TA
23	7	90	PA	60	KA
24	5	60	KA	90	TA
25	7	60	PA	0	BA
26	8	30	BA	0	DA
27	1	90	KA	30	BA
28	4	30	DA	60	KA
29	6	30	DA	0	BA
30	7	0	DA	60	TA
31	2	30	DA	90	TA
32	5	90	PA	0	GA

*VOT = Voice Onset Time (60 & 90 = Voice Trail; 30 = Voice Lead)

APPENDIX G

RANDOMIZATION A

(Continued)

PAIR NO.	CONDITION	CHANNEL I		CHANNEL II	
		VOT*	ITEM	VOT*	ITEM
33	1	60	KA	30	DA
34	7	60	KA	0	GA
35	9	90	TA	90	KA
36	4	60	PA	30	GA
37	5	0	DA	90	KA
38	6	0	BA	30	GA
39	4	90	PA	30	DA
40	5	60	TA	0	DA
41	3	30	GA	90	KA
42	3	60	KA	30	BA
43	5	0	GA	60	KA
44	5	90	KA	60	PA
45	3	30	DA	60	PA
46	9	30	GA	30	DA
47	2	60	PA	30	DA
48	2	30	BA	60	KA

*VOT = Voice Onset Time (60 & 90 = Voice Trail; 30 = Voice Lead)

APPENDIX G (Continued)

SCRIPT FOR TEST LIST 4

RANDOMIZATION B

PAIR NO.	CONDITION	CHANNEL I		CHANNEL II	
		VOT*	ITEM	VOT*	ITEM
1	3	90	TA	30	DA
2	9	0	DA	0	GA
3	4	90	PA	30	DA
4	6	30	DA	0	BA
5	3	60	TA	30	GA
6	7	90	PA	60	KA
7	2	90	KA	30	GA
8	5	90	TA	0	BA
9	9	60	PA	60	TA
10	1	30	DA	90	PA
11	7	90	KA	0	DA
12	4	30	BA	90	KA
13	2	30	GA	60	TA
14	4	30	DA	60	KA
15	5	0	GA	60	KA
16	7	60	PA	0	BA

*VOT = Voice Onset Time (60 & 90 = Voice Trail;
30 = Voice Lead)

APPENDIX G

RANDOMIZATION B

(Continued)

PAIR NO.	CONDITION	CHANNEL I		CHANNEL II	
		VOT*	ITEM	VOT*	ITEM
17	6	0	BA	30	GA
18	7	0	DA	60	TA
19	7	0	GA	90	PA
20	2	90	PA	30	BA
21	5	0	BA	60	PA
22	5	90	KA	60	PA
23	3	30	DA	60	PA
24	7	60	KA	0	GA
25	5	60	TA	0	DA
26	1	30	BA	60	TA
27	9	90	TA	90	KA
28	4	60	PA	30	GA
29	8	30	BA	0	DA
30	4	60	TA	30	BA
31	5	0	DA	90	KA
32	5	90	PA	0	GA

*VOT = Voice Onset Time (60 & 90 = Voice Trail; 30 = Voice Lead)

APPENDIX G

RANDOMIZATION B

(Continued)

PAIR NO.	CONDITION	CHANNEL I		CHANNEL II	
		VOT*	ITEM	VOT*	ITEM
33	3	30	BA	90	PA
34	1	90	KA	30	BA
35	2	30	DA	90	TA
36	1	90	TA	30	GA
37	1	60	KA	30	DA
38	3	60	KA	30	BA
39	5	60	KA	90	TA
40	7	60	TA	90	PA
41	9	30	GA	30	DA
42	4	30	GA	90	TA
43	7	0	BA	90	TA
44	2	60	PA	30	DA
45	3	30	GA	90	KA
46	2	30	BA	60	KA
47	1	30	GA	60	PA
48	8	0	GA	30	BA

*VOT = Voice Onset Time (60 & 90 = Voice Trail; 30 = Voice Lead)

APPENDIX G (Continued)

SCRIPT FOR TEST LIST 5

RANDOMIZATION A

PAIR NO.	CONDITION	CHANNEL I		CHANNEL II	
		VOT*	ITEM	VOT*	ITEM
1	1	30	DA	60	PA
2	4	30	GA	60	TA
3	7	60	PA	90	KA
4	5	0	DA	60	KA
5	3	30	BA	60	PA
6	4	30	DA	90	TA
7	3	90	TA	30	BA
8	4	30	BA	60	KA
9	8	0	BA	30	DA
10	4	90	KA	30	GA
11	9	90	PA	90	TA
12	2	30	DA	60	TA
13	3	60	TA	30	DA
14	8	30	DA	0	GA
15	9	30	BA	30	GA
16	7	0	GA	60	PA

*VOT = Voice Onset Time (60 & 90 = Voice Trail;
30 = Voice Lead)

APPENDIX G

RANDOMIZATION A

(Continued)

PAIR NO.	CONDITION	CHANNEL I		CHANNEL II	
		VOT*	ITEM	VOT*	ITEM
17	2	30	GA	90	PA
18	1	30	GA	90	KA
19	5	90	KA	60	TA
20	6	0	GA	30	BA
21	1	60	TA	30	GA
22	3	90	PA	30	GA
23	1	30	BA	90	PA
24	2	90	KA	30	DA
25	7	0	BA	60	TA
26	3	30	DA	90	KA
27	2	30	BA	90	TA
28	7	90	TA	0	GA
29	4	60	PA	30	DA
30	5	60	PA	0	GA
31	5	60	KA	90	PA
32	7	90	TA	60	KA

*VOT = Voice Onset Time (60 & 90 = Voice Trail; 30 = Voice Lead)

APPENDIX G

RANDOMIZATION A

(Continued)

PAIR NO.	CONDITION	CHANNEL I		CHANNEL II	
		VOT*	ITEM	VOT*	ITEM
33	7	90	KA	0	BA
34	5	0	BA	90	KA
35	5	0	GA	90	TA
36	6	30	GA	0	DA
37	5	90	PA	0	DA
38	2	60	KA	30	GA
39	9	60	TA	60	PA
40	7	60	KA	0	DA
41	2	60	PA	30	BA
42	1	60	KA	30	BA
43	1	90	TA	30	DA
44	7	0	DA	90	PA
45	3	30	GA	60	KA
46	4	90	PA	30	BA
47	9	0	DA	0	BA
48	5	60	TA	0	BA

*VOT = Voice Onset Time (60 & 90 = Voice Trail; 30 = Voice Lead)

APPENDIX G (Continued)

SCRIPT FOR TEST LIST 5

RANDOMIZATION B

PAIR NO.	CONDITION	CHANNEL I		CHANNEL II	
		VOT*	ITEM	VOT*	ITEM
1	5	0	DA	60	KA
2	4	30	DA	90	TA
3	7	90	TA	0	GA
4	6	0	GA	30	BA
5	5	90	KA	60	TA
6	8	30	DA	0	GA
7	3	60	TA	30	DA
8	4	90	PA	30	BA
9	5	60	TA	0	BA
10	2	30	GA	90	PA
11	8	0	BA	30	DA
12	4	30	BA	60	KA
13	7	0	BA	60	TA
14	3	90	TA	30	BA
15	1	90	TA	30	DA
16	2	30	DA	60	TA

*VOT = Voice Onset Time (60 & 90 = Voice Trail;
30 = Voice Lead)

APPENDIX G

RANDOMIZATION B

(Continued)

PAIR NO.	CONDITION	CHANNEL I		CHANNEL II	
		VOT*	ITEM	VOT*	ITEM
17	6	30	GA	0	DA
18	5	90	PA	0	DA
19	4	30	GA	60	TA
20	4	90	KA	30	GA
21	1	30	GA	90	KA
22	7	60	KA	0	DA
23	1	60	TA	30	GA
24	1	60	KA	30	BA
25	7	90	KA	0	BA
26	7	60	PA	90	KA
27	4	60	PA	30	DA
28	7	0	GA	60	PA
29	1	30	BA	90	PA
30	7	0	DA	90	PA
31	2	60	PA	30	BA
32	9	60	TA	60	PA

*VOT = Voice Onset Time (60 & 90 = Voice Trail; 30 = Voice Lead)

APPENDIX G

RANDOMIZATION B

(Continued)

PAIR NO.	CONDITION	CHANNEL I		CHANNEL II	
		VOT*	ITEM	VOT*	ITEM
33	3	30	BA	60	PA
34	2	60	KA	30	GA
35	5	0	GA	90	TA
36	3	30	DA	90	KA
37	9	30	BA	30	GA
38	7	90	TA	60	KA
39	1	30	DA	60	PA
40	5	60	KA	90	PA
41	5	0	BA	90	KA
42	2	30	BA	90	TA
43	9	90	PA	90	TA
44	9	0	DA	0	BA
45	3	30	GA	60	KA
46	5	60	PA	0	GA
47	3	90	PA	30	GA
48	2	90	KA	30	DA

*VOT = Voice Onset Time (60 & 90 = Voice Trail; 30 = Voice Lead)

APPENDIX G (Continued)

SCRIPT FOR TEST LIST 6

RANDOMIZATION A

PAIR NO.	CONDITION	CHANNEL I		CHANNEL II	
		VOT*	ITEM	VOT*	ITEM
1	2	30	GA	60	KA
2	5	90	KA	0	BA
3	1	30	GA	60	TA
4	7	60	KA	90	PA
5	3	60	KA	30	GA
6	1	30	DA	90	TA
7	2	30	DA	90	KA
8	4	60	TA	30	GA
9	3	30	BA	90	TA
10	7	90	PA	0	DA
11	1	60	PA	30	DA
12	4	30	DA	60	PA
13	4	90	TA	30	DA
14	5	0	BA	60	TA
15	3	60	PA	30	BA
16	8	30	DA	0	BA

*VOT = Voice Onset Time (60 & 90 = Voice Trail; 30 = Voice Lead)

APPENDIX G

RANDOMIZATION A

(Continued)

PAIR NO.	CONDITION	CHANNEL I		CHANNEL II	
		VOT*	ITEM	VOT*	ITEM
17	7	0	DA	60	KA
18	5	90	TA	0	GA
19	7	60	TA	0	BA
20	9	90	KA	90	TA
21	5	0	GA	60	PA
22	7	60	PA	0	GA
23	1	90	KA	30	GA
24	5	90	PA	60	TA
25	4	60	KA	30	BA
26	1	90	PA	30	BA
27	7	0	GA	90	TA
28	6	30	BA	0	GA
29	3	90	KA	30	DA
30	6	0	DA	30	GA
31	2	90	PA	30	GA
32	1	30	BA	60	KA

*VOT = Voice Onset Time (60 & 90 = Voice Trail; 30 = Voice Lead)

APPENDIX G

RANDOMIZATION A

(Continued)

PAIR NO.	CONDITION	CHANNEL I		CHANNEL II	
		VOT*	ITEM	VOT*	ITEM
33	3	30	DA	60	TA
34	4	30	BA	90	PA
35	8	0	GA	30	DA
36	5	60	KA	0	DA
37	9	0	BA	0	DA
38	4	30	GA	90	KA
39	2	30	BA	60	PA
40	9	60	TA	60	KA
41	7	90	TA	60	PA
42	2	60	TA	30	DA
43	7	0	BA	90	KA
44	3	30	GA	90	PA
45	5	60	PA	90	KA
46	5	0	DA	90	PA
47	2	90	TA	30	BA
48	9	30	GA	30	BA

*VOT = Voice Onset Time (60 & 90 = Voice Trail; 30 = Voice Lead)

APPENDIX G (Continued)

SCRIPT FOR TEST LIST 6

RANDOMIZATION B

PAIR NO.	CONDITION	CHANNEL I		CHANNEL II	
		VOT*	ITEM	VOT*	ITEM
1	3	30	BA	90	TA
2	7	60	PA	0	GA
3	2	90	PA	30	GA
4	4	30	GA	90	KA
5	3	90	KA	30	DA
6	4	90	TA	30	DA
7	7	90	TA	60	PA
8	8	30	DA	0	BA
9	4	60	TA	30	GA
10	9	60	TA	60	KA
11	1	90	PA	30	BA
12	8	0	GA	30	DA
13	2	30	GA	60	KA
14	3	30	GA	90	PA
15	7	0	DA	60	KA
16	5	90	TA	0	GA

*VOT = Voice Onset Time (60 & 90 = Voice Trail; 30 = Voice Lead)

APPENDIX G

RANDOMIZATION B

(Continued)

PAIR NO.	CONDITION	CHANNEL I		CHANNEL II	
		VOT*	ITEM	VOT*	ITEM
17	9	90	KA	90	TA
18	6	0	DA	30	GA
19	3	60	PA	30	BA
20	1	30	GA	60	TA
21	3	30	DA	60	TA
22	5	60	KA	0	DA
23	1	60	PA	30	DA
24	4	30	BA	90	PA
25	5	0	DA	90	PA
26	5	0	BA	60	TA
27	4	60	KA	30	BA
28	3	60	KA	30	GA
29	7	90	PA	0	DA
30	5	90	PA	60	TA
31	1	30	BA	60	KA
32	1	30	DA	90	TA

*VOT = Voice Onset Time (60 & 90 = Voice Trail; 30 = Voice Lead)

APPENDIX G

RANDOMIZATION B

(Continued)

PAIR NO.	CONDITION	CHANNEL I		CHANNEL II	
		VOT*	ITEM	VOT*	ITEM
33	9	30	GA	30	BA
34	7	0	BA	90	KA
35	7	60	TA	0	BA
36	2	30	DA	90	KA
37	4	30	DA	60	PA
38	5	60	PA	90	KA
39	6	30	BA	0	GA
40	1	90	KA	30	GA
41	7	0	GA	90	TA
42	2	90	TA	30	BA
43	5	90	KA	0	BA
44	7	60	KA	90	PA
45	9	0	BA	0	DA
46	2	30	BA	60	PA
47	2	60	TA	30	DA
48	5	0	GA	60	PA

*VOT = Voice Onset Time (60 & 90 = Voice Trail; 30 = Voice Lead)

APPENDIX H

CALIBRATION CHECK LIST

Date_____ SUBJECT #S_____

A. Turn on equipment. Ampex AG440__, Dynaco 120A power amplifier __, B&K microphone amplifiers __.

B. Place 1000 Hz calibration tone on AG440.

C. Set microphone amplifier dials:

(1) Range multiplier switch on 0 dB__ __ (__ __after test).
(2) Set meter switch to RMS slow __ __ (__ __after test).
(3) Set meter range on 60 dB __ __ (__ __after test).
(4) Set weighting network on linear__ __ (__ __after test).
(5) Set input switch on direct __ __ (__ __after test).
(6) Set input potentiometer on) __ __ (__ __after test).

D. Set attenuator boxes to 20 dB of attenuation__ __.

E. Play both channels of the AG440 __ __(__ __after test).

F. Adjust AG440 reproduce level until microphone amplifier

#1 equals 72.5 dB SPL(___revision)__(__after).
#2 equals 72.5 dB SPL(___revision)__(__after).

APPENDIX H (Continued)

G. Check SPL with B&K 2203 sound level meter with 1000 Hz filter __ __(__ __after test).

H. Adjust AG440 reproduce level until 78 dB is obtained for the sound level meter reading on Ch I__ and Ch II__.

I. Check the microphone amplifier dB levels and revise if necessary.

J. Begin test. Recheck calibration following completion of the test. For post-test calibration use Item B__, C__ __, and E__. Then relate microphone amplifier dB levels to the initial levels__ __. Recheck the SPL(G)__ __ in relation to the 78 dB SPL reference.

APPENDIX I

SUBJECT INFORMATION

I. IDENTIFYING INFORMATION

Name_____ Sex_____ Date_____

Birthdate_____ S.S. No._____

Address_____

Telephone No._____

When would be the best time for you to participate in a listening study? morning____ afternoon____ evening____

II. MEDICAL HISTORY

A. Have you had any severe blows to your head?_____

B. Do you presently or have you in the past suffered from seizures or convulsions?_____

C. Do you presently take any type of drugs? If yes, explain._____

_____

D. Have you ever had chronic ear infections, dizziness, or earaches?____ If yes, explain.____

_____

E. Do you have or have you had a hearing loss?_____ If yes, explain._____

_____

F. Have you ever had a speech problem?_____ If yes, explain._____

_____

G. Are you right-handed, left-handed, or ambidextrous?

_____

APPENDIX I (Continued)

H. Have you ever changed handedness?____ If yes, explain. _____

III. LANGUAGE BACKGROUND

A. Do you speak any language other than English?
_____

B. Have you ever lived in a home in which English was not the only language spoken?_____

C. Would you say your speech is best described as General American, Southern American, Northeastern American, Cajun, or other?_____ If other, explain._____

D. Have you ever had any training in phonetics?____
If yes, list the number of college credits._____

APPENDIX J

ORDER OF LIST PRESENTATION

	List Presented to Subject						Odd Numbered	Even Numbered
Order	1-2	3-4	5-6	7-8	9-10	11-12	Subject	Subject
1	1A	3A	5A	2A	4A	6A	Right	Left
2	3A	5A	2A	4A	6A	1B	Right	Left
3	5A	2A	4A	6A	1B	3B	Left	Right
4	2A	4A	6A	1B	3B	5B	Left	Right
5	4A	6A	1B	3B	5B	2B	Right	Left
6	6A	1B	3B	5B	2B	4B	Right	Left
7	1B	3B	5B	2B	4B	6B	Left	Right
8	3B	5B	2B	4B	6B	1A	Left	Right
9	5B	2B	4B	6B	1A	3A	Right	Left
10	2B	4B	6B	1A	3A	5A	Right	Left
11	4B	6B	1A	3A	5A	2A	Left	Right
12	6B	1A	3A	5A	2A	4A	Left	Right

APPENDIX J (Continued)

	List Presented to Subject						Odd Numbered	Even Numbered
Order	13-14	15-16	17-18	19-20	21-22	23-24	Subject	Subject
1	1B	3B	5B	2B	4B	6B	Right	Left
2	3B	5B	2B	4B	6B	1A	Right	Left
3	5B	2B	4B	6B	1A	3A	Left	Right
4	2B	4B	6B	1A	3A	5A	Left	Right
5	4B	6B	1A	3A	5A	2A	Right	Left
6	6B	1A	3A	5A	2A	4A	Right	Left
7	1A	3A	5A	2A	4A	6A	Left	Right
8	3A	5A	2A	4A	6A	1B	Left	Right
9	5A	2A	4A	6A	1B	3B	Right	Left
10	2A	4A	6A	1B	3B	5B	Right	Left
11	4A	6A	1B	3B	5B	2B	Left	Right
12	6A	1B	3B	5B	2B	4B	Left	Right

APPENDIX K

SCRIPT

INSTRUCTIONS AND FAMILIARIZATION TAPE

A. INTRODUCTION

The tape you are about to hear consists of synthetic speech syllables made with a computer. The individual syllables are nonsense syllables such as those you heard on the preceding tape. These syllables are BA, DA, GA, PA, TA, and KA.

Please look at your answer sheet and notice the numbers which proceed from Number 1 downward to Number 24 in the left column and from Number 25 downward to Number 48 in the right column. To the right of each number are two answer blanks. Please mark your answers in the blank immediately following the appropriate nonsense syllable. The nonsense syllables will not be numbered so slide your cover sheet down over each answer to help you maintain your place and follow each item.

Please attend to each presentation and write down the syllable which you hear. Do you have any questions? (five second pause) We will begin.

APPENDIX K (Continued)

B. TEST ITEMS

1 BAO	2 GAO	3 KA90	4 TA90	5 PA90	6 GA30
7 BAO	8 PA90	9 GAO	10 KA60	11 DA30	12 GA30
13 TA60	14 KA60	15 DAO	16 PA60	17 BA30	18 DAO
19 TA60	20 BA30	21 KA90	22 DA30	23 PA60	24 TA90
25 GAO	26 DAO	27 TA90	28 KA90	29 KA90	30 DAO
31 DAO	32 TA90	33 BAO	34 TA60	35 BA30	36 BA30
37 PA60	38 PA60	39 GAO	40 TA60	41 DA30	42 BAO
43 KA60	44 GA30	45 PA90	46 GA30	47 KA60	48 PA90

C. FINAL INSTRUCTIONS

You probably found the syllables easier to identify as you went along. We will be hearing these syllables again in the following tapes. However, from now on, there will always be two syllables given at the same time. A different syllable will be given to each ear. Please write down your response after the appropriate number beginning with Blank 1. Write your second answer for that response in the second blank.

REMEMBER: - There will always be two syllables, a different one for each ear.

- Begin writing in the first blank after the item number.

APPENDIX K (Continued)

- Use your cover sheet.
- Attend carefully to each stimulus presentation.

APPENDIX L

ANSWER SHEET

LIST_____ DATE_____ S.No._____

RAND._____ NAME_____

1.	_____	_____	17.	_____	_____
2.	_____	_____	18.	_____	_____
3.	_____	_____	19.	_____	_____
4.	_____	_____	20.	_____	_____
5.	_____	_____	21.	_____	_____
6.	_____	_____	22.	_____	_____
7.	_____	_____	23.	_____	_____
8.	_____	_____	24.	_____	_____
9.	_____	_____	25.	_____	_____
10.	_____	_____	26.	_____	_____
11.	_____	_____	27.	_____	_____
12.	_____	_____	28.	_____	_____
13.	_____	_____	29.	_____	_____
14.	_____	_____	30.	_____	_____
15.	_____	_____	31.	_____	_____
16.	_____	_____	32.	_____	_____

APPENDIX L (Continued)

33.	_____	_____
34.	_____	_____
35.	_____	_____
36.	_____	_____
37.	_____	_____
38.	_____	_____
39.	_____	_____
40.	_____	_____
41.	_____	_____
42.	_____	_____
43.	_____	_____
44.	_____	_____
45.	_____	_____
46.	_____	_____
47.	_____	_____
48.	_____	_____

APPENDIX M

RESPONSE MATRICES BY CONDITION

GLOSSARY OF SYMBOLS

LE = LEFT EAR

R = RIGHT

C = CORRECT RESPONSE

F = FRONT

V = VOICED

RE = RIGHT EAR

TS = TRAILING STIMULUS

E = SUBSTITUTION ERROR

M = MIDDLE

U = UNVOICED

L = LEFT

LS = LEADING STIMULUS

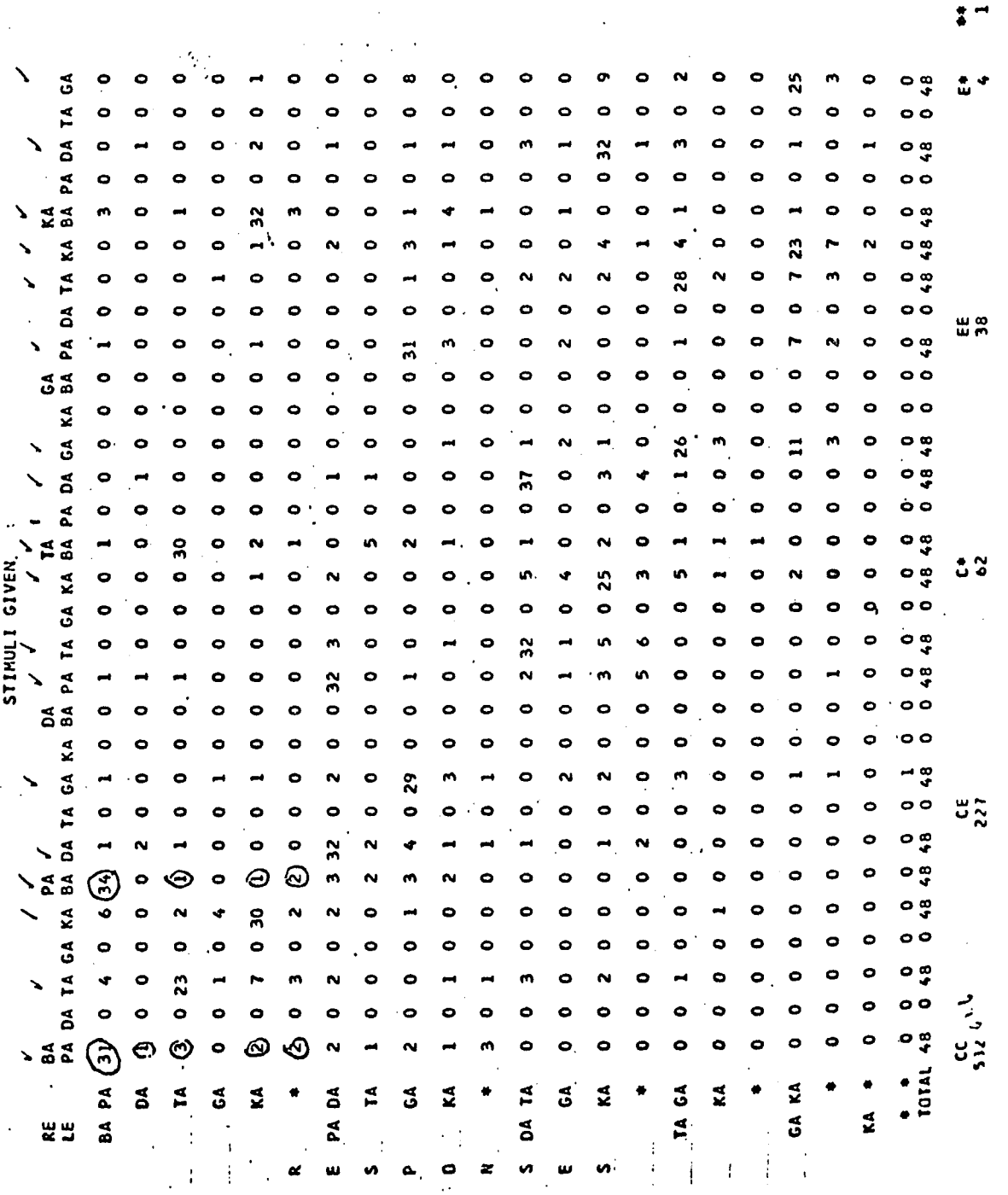
* = BLANK RESPONSE

B = BACK

APPENDIX M

RESPONSE MATRICES BY CONDITION

BOUNDARY, CHANNEL I - RIGHT, CHANNEL II - LEFT



APPENDIX M (Continued)

RESPONSE MATRICES BY CONDITION

BOUNDARY, CHANNEL I - LEFT, CHANNEL II - RIGHT

STIMULI GIVEN

RE / LE	BA	PA	DA	TA	GA	KA	BA	PA	DA	TA	GA	KA	BA	PA	DA	TA	GA	KA	BA	PA	DA	TA	GA	KA	BA	PA	DA	TA	GA	KA	
BA	PA	39	0	6	0	6	35	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	1	0	0		
DA		1	0	2	0	1	0	4	0	0	0	0	0	1	1	0	0	3	0	2	0	0	0	0	0	1	0	4	0	0	
TA		1	0	27	0	1	0	0	0	0	0	0	0	0	0	0	27	0	1	0	0	0	0	0	3	0	0	0	0		
GA		2	0	1	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	2	0	0	1	0	0	0		
KA		0	0	4	0	29	1	1	0	3	0	0	0	0	0	0	4	0	0	0	0	0	0	1	0	29	0	1	0	0	
R	*	1	0	2	0	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
E PA	DA	1	0	1	0	1	2	34	0	2	0	0	36	1	0	5	1	0	2	0	0	0	0	0	1	0	3	0	0		
S	TA	1	0	1	0	1	1	1	0	0	0	0	0	1	0	0	5	0	1	1	0	0	0	0	0	0	0	0	0		
P	GA	0	0	0	0	1	4	1	0	26	0	0	1	0	0	0	0	0	1	0	0	0	4	0	30	0	0	0	3		
O	KA	0	0	0	0	1	0	1	0	2	0	0	1	0	0	1	2	0	0	0	0	0	0	0	1	2	0	1	0	3	
N	*	0	0	0	0	1	3	3	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	
S DA	TA	0	0	4	0	0	0	0	0	0	0	0	3	33	0	10	0	0	31	2	0	0	0	0	3	0	1	0	2	0	0
E	GA	0	0	0	0	0	0	1	0	4	0	0	0	0	1	0	1	0	0	1	5	0	0	1	0	7	5	0	1	0	4
S	KA	0	0	0	0	0	0	0	0	1	0	0	2	7	0	24	0	0	2	5	0	0	0	1	3	0	30	0	5		
	*	0	0	0	0	0	1	0	1	0	0	0	0	2	3	0	0	0	1	0	0	0	0	0	0	0	2	0	0		
TA	GA	0	0	0	0	0	0	0	0	3	0	0	0	0	1	0	3	1	0	4	19	0	0	4	0	24	5	0	2	0	5
	KA	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	1	1	1	0	0	0	0	0	1	0	0	1	
	*	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	
GA	KA	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	2	1	0	1	8	0	0	7	0	4	21	0	1	0	24
	*	2	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	2	0	0	3	0	4	3	1	0	0	2
	KA	*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1
	*	*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	TOTAL	48	0	48	0	48	48	48	0	48	0	0	48	48	0	48	48	0	48	48	48	0	0	48	48	48	48	0	48	0	48

CC 518 | CE 263 | C* 40 | EE 33 | E* 10 | ** 0

APPENDIX M (Continued)

RESPONSE MATRICES BY CONDITION

ONSET, CHANNEL I - RIGHT, CHANNEL II - LEFT

STIMULI GIVEN

RE / LE		BA				PA				DA				TA				GA				KA					
		PA	DA	TA	GA	KA	BA	DA	TA	GA	KA	BA	PA	TA	GA	KA	BA	PA	DA	GA	KA	BA	PA	DA	TA	KA	BA	PA	DA	TA	GA
	BA	23	0	3	0	12	28	10	0	1	0	0	1	0	0	1	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0
	DA	2	0	1	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	TA	0	0	14	0	1	0	0	0	0	0	0	2	3	0	0	11	0	3	1	0	0	0	1	0	0	0	1	0	0	0
	GA	0	0	0	0	1	0	0	0	1	0	0	0	0	0	2	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0
	KA	0	0	0	0	12	0	1	0	3	0	0	0	0	0	3	2	0	0	0	0	0	1	0	1	4	18	0	8	0	3
R	*	1	0	2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
E	PA	DA	6	0	3	0	5	4	21	0	0	0	0	0	26	0	0	2	1	0	0	0	0	1	0	0	0	4	0	0	0	0
S	TA	5	0	7	0	0	4	6	0	1	0	0	2	0	0	1	3	0	2	1	0	0	0	0	0	0	2	0	0	0	0
P	GA	4	0	0	0	4	2	4	0	20	0	0	3	0	0	1	0	0	0	0	0	11	0	1	1	1	1	0	3	0	0
O	KA	0	0	2	0	2	0	2	0	6	0	0	1	0	0	2	2	0	0	0	0	3	0	2	0	8	0	4	0	1	
N	*	7	0	0	0	2	10	0	0	2	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
S	BA	TA	0	0	8	0	1	0	1	0	0	0	0	0	3	29	0	0	10	0	26	3	0	0	0	0	5	0	0	1	0	0
E	GA	0	0	1	0	1	0	0	0	1	0	0	2	1	0	5	0	0	1	0	0	0	0	6	0	5	7	0	0	0	1
S	KA	0	0	0	0	2	0	0	0	3	0	0	1	6	0	16	3	0	7	12	0	0	0	4	0	9	10	4	0	12	0	5
	*	0	0	0	0	0	0	1	0	0	0	0	0	4	2	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
	TA	GA	0	0	2	0	0	0	0	0	1	0	0	0	0	2	0	0	3	0	3	7	0	0	4	0	9	1	0	0	3	0	0
	KA	0	0	1	0	1	0	0	0	1	0	0	1	2	0	0	4	0	4	13	0	0	0	2	0	2	1	2	0	2	0	5
	*	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	5	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0
	GA	KA	0	0	0	0	3	0	0	0	5	0	0	0	1	0	10	3	0	0	8	0	0	11	0	9	19	2	0	8	0	23
	*	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	1	0	0	0	0	0	0	5	0	3	1	0	0	0	0	0
	KA	*	0	0	2	0	0	0	1	0	3	0	0	0	0	0	2	0	0	0	3	0	0	0	0	0	4	4	0	6	0	9
	*	*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL			48	0	48	0	48	48	48	0	48	0	0	48	48	48	48	48	48	48	48	0	0	48	0	48	48	48	0	48	0	48

CC 325 | CE 359 | C* 76 | EE 88 | E* 16 | ** 0

APPENDIX M (Continued)

RESPONSE MATRICES BY CONDITION

ONSET, CHANNEL I - LEFT, CHANNEL II - RIGHT

STIMULI GIVEN

RE LE	BA PA	BA DA	BA TA	BA GA	BA KA	PA BA	PA DA	PA TA	PA GA	PA KA	DA BA	DA PA	DA TA	DA GA	DA KA	TA BA	TA PA	TA DA	TA GA	TA KA	GA BA	GA PA	GA DA	GA TA	GA KA	KA BA	KA PA	KA DA	KA TA	KA GA
BA PA	18	0	4	0	6	25	8	0	1	0	0	5	0	0	0	3	0	0	0	0	0	0	0	0	0	4	0	2	0	0
DA	0	0	2	0	0	0	2	0	0	0	0	3	2	0	2	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
TA	1	0	13	0	3	0	1	0	0	0	0	1	2	0	0	13	0	2	2	0	0	0	0	0	0	2	0	0	0	0
GA	0	0	0	0	2	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0
KA	0	0	1	0	13	0	0	0	2	0	0	0	1	0	4	0	0	0	5	0	0	2	0	4	2	14	0	4	0	7
R *	2	0	2	0	3	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
E PA DA	5	0	2	0	1	8	23	0	1	0	0	25	2	0	1	2	0	0	0	0	0	2	0	0	0	1	0	0	0	0
S TA	3	0	6	0	0	2	3	0	0	0	0	0	0	0	0	5	0	1	0	0	0	0	0	0	0	2	0	0	0	0
P GA	7	0	1	0	3	2	3	0	14	0	0	3	0	0	2	1	0	0	0	0	0	10	0	1	2	2	0	0	0	0
O KA	1	0	1	0	11	2	2	0	11	0	0	0	0	0	2	1	0	1	2	0	0	4	0	1	3	9	0	3	0	1
N *	10	0	0	0	1	7	2	0	3	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	4	0	0	0	0
S DA TA	0	0	7	0	0	1	1	0	0	0	0	2	23	0	1	7	0	22	3	0	0	0	0	1	0	0	0	0	0	1
E GA	0	0	0	0	0	0	0	0	0	0	0	1	1	0	4	0	0	1	2	0	0	5	0	2	4	0	0	0	0	2
S KA	0	0	3	0	0	0	0	0	7	0	0	3	5	0	14	4	0	3	9	0	0	3	0	8	5	4	0	19	0	14
*	0	0	0	0	0	0	1	0	0	0	0	3	2	0	2	0	0	2	1	0	0	0	0	0	0	1	0	1	0	0
TA GA	0	0	2	0	0	0	1	0	3	0	0	1	2	0	1	1	0	4	7	0	0	4	0	6	2	1	0	1	0	1
KA	0	0	1	0	1	0	0	0	1	0	0	0	4	0	1	2	0	6	8	0	0	0	0	2	3	0	0	3	0	0
*	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	7	0	4	2	0	0	0	0	1	0	0	0	0	0	0
GA KA	1	0	0	0	3	0	1	0	2	0	0	0	2	0	10	1	0	1	5	0	0	14	0	15	19	2	0	10	0	13
*	0	0	0	0	0	0	0	0	0	0	0	0	1	0	2	0	0	0	1	0	0	2	0	3	4	0	0	0	0	0
KA *	0	0	1	0	1	1	0	0	1	0	0	0	1	0	1	1	0	0	1	0	0	0	0	4	3	2	0	5	0	9
* *	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	48	0	48	0	48	48	48	0	48	0	0	48	48	0	48	48	0	48	48	0	0	48	0	48	48	48	0	48	0	48

CC	CE	C*	EE	E*	**
291	374	89	89	21	0

APPENDIX M (Continued)

RESPONSE MATRICES BY CONDITION

TRANSITION, CHANNEL I - RIGHT, CHANNEL II - LEFT

STIMULI GIVEN

RE	LE	BA PA	DA	TA	GA	KA	PA BA	DA	TA	GA	KA	DA BA	PA	TA	GA	KA	TA BA	PA	DA	GA	KA	GA BA	PA	DA	TA	KA	KA BA	PA	DA	TA	GA
BA	PA	31	0	2	0	8	29	7	0	1	0	0	5	0	0	0	2	0	0	0	0	0	1	0	0	0	4	0	0	0	0
	DA	1	0	0	0	2	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	TA	2	0	8	0	0	0	0	0	0	0	0	0	2	0	0	10	0	4	1	0	0	0	0	0	0	1	0	0	0	0
	GA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	1	0	0	0	1
	KA	1	0	3	0	8	0	2	0	3	0	0	0	0	0	1	1	0	0	1	0	0	7	0	1	4	6	0	4	0	4
	*	2	0	2	0	1	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
PA	DA	3	0	2	0	5	5	17	0	2	0	0	20	1	0	0	1	0	0	0	0	0	2	0	0	0	2	0	3	0	0
	TA	2	0	0	0	2	4	6	0	3	0	0	4	3	0	0	5	0	1	0	0	0	2	0	0	0	1	0	0	0	0
	GA	1	0	3	0	2	2	4	0	17	0	0	1	0	0	1	0	0	0	0	0	0	8	0	1	0	5	0	0	0	0
	KA	1	0	1	0	7	1	4	0	8	0	0	2	0	0	2	0	0	0	1	0	0	4	0	1	2	6	0	5	0	3
	*	4	0	0	0	1	7	8	0	1	0	0	5	0	0	0	0	0	0	0	0	0	2	0	0	0	2	0	0	0	0
DA	TA	0	0	15	0	1	0	0	0	0	0	0	5	26	0	0	10	0	23	4	0	0	0	0	3	0	0	0	0	0	0
	GA	0	0	1	0	1	0	0	0	1	0	0	0	1	0	1	1	0	2	0	0	0	3	0	3	1	1	0	2	0	1
	KA	0	0	2	0	4	0	0	0	2	0	0	1	5	0	14	2	0	4	7	0	0	3	0	9	13	4	0	12	0	14
	*	0	0	0	0	0	0	0	0	0	0	0	1	2	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TA	GA	0	0	4	0	0	0	0	0	1	0	0	1	5	0	3	3	0	4	6	0	0	0	0	5	2	0	0	0	0	1
	KA	0	0	3	0	2	0	0	0	1	0	0	0	0	0	2	5	0	3	10	0	0	4	0	5	2	4	0	6	0	5
	*	0	0	2	0	0	0	0	0	0	0	0	0	1	0	0	7	0	7	1	0	0	0	0	2	0	0	0	0	0	0
GA	KA	0	0	0	0	3	0	0	0	3	0	0	0	1	0	16	0	0	0	12	0	0	4	0	10	14	4	0	10	0	10
	*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	4	0	3	2	0	0	2	0	0
KA	*	0	0	0	0	1	0	0	0	5	0	0	0	0	0	5	1	0	0	4	0	0	1	0	4	8	7	0	4	0	9
*	*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL		48	0	48	0	48	48	48	0	48	0	0	48	48	0	48	48	0	48	48	0	0	48	0	48	48	48	0	48	0	48

CC	CE	C*	EE	E*	**
254	374	101	81	24	0

APPENDIX M (Continued)

RESPONSE MATRICES BY CONDITION

TRANSITION, CHANNEL I - LEFT, CHANNEL II - RIGHT

STIMULI GIVEN

	BA					PA					DA					TA					GA					KA				
	PA	DA	TA	GA	KA	BA	DA	TA	GA	KA	BA	PA	TA	GA	KA	BA	PA	DA	GA	KA	BA	PA	DA	TA	KA	BA	PA	DA	TA	GA
BA PA	26	0	2	0	5	23	16	0	5	0	0	9	0	0	0	1	0	2	0	0	0	1	0	0	0	4	0	1	0	0
DA	1	0	1	0	1	0	2	0	1	0	0	0	4	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0
TA	2	0	4	0	3	1	0	0	2	0	0	2	2	0	1	6	0	3	2	0	0	0	0	0	0	0	0	0	0	0
GA	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	2	0	1	1	1	0	0	0	0
KA	0	0	1	0	4	0	0	0	1	0	0	0	0	0	1	2	0	0	1	0	0	3	0	3	2	9	0	2	0	0
R *	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
E PA DA	4	0	1	0	4	9	17	0	1	0	0	20	1	0	0	1	0	2	0	0	0	3	0	0	0	5	0	0	0	0
S TA	2	0	4	0	2	2	2	0	3	0	0	2	1	0	0	3	0	5	0	0	0	0	0	0	0	1	0	0	0	0
P GA	4	0	1	0	4	1	2	0	5	0	0	6	2	0	1	0	0	0	0	0	0	6	0	0	0	3	0	0	0	0
O KA	2	0	1	0	8	4	4	0	11	0	0	1	0	0	1	1	0	1	1	0	0	7	0	1	1	6	0	2	0	1
N *	4	0	0	0	2	7	2	0	1	0	0	4	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	1	0	0
S DA TA	0	0	20	0	1	0	1	0	1	0	0	2	22	0	1	17	0	24	3	0	0	1	0	1	0	0	0	0	0	0
E GA	0	0	0	0	1	0	0	0	0	0	0	0	3	0	1	2	0	1	1	0	0	1	0	2	1	0	0	2	0	3
S KA	0	0	3	0	5	0	0	0	5	0	0	0	7	0	14	3	0	4	9	0	0	4	0	17	4	8	0	17	0	16
*	0	0	3	0	0	0	2	0	0	0	0	1	2	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
TA GA	0	0	2	0	0	0	0	0	1	0	0	0	2	0	4	6	0	0	6	0	0	2	0	5	0	1	0	0	0	1
KA	0	0	3	0	0	0	0	0	3	0	0	0	1	0	1	1	0	0	12	0	0	2	0	3	5	3	0	6	0	6
*	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	4	0	4	1	0	0	0	0	2	0	0	0	0	0	0
GA KA	0	0	0	0	5	1	0	0	3	0	0	0	0	0	17	0	0	2	7	0	0	8	0	9	21	3	0	11	0	11
*	0	0	0	0	0	0	0	0	2	0	0	1	0	0	2	0	0	0	1	0	0	3	0	1	3	0	0	1	0	0
KA *	0	0	0	0	3	0	0	0	3	0	0	0	0	0	4	1	0	0	3	0	0	1	0	2	10	3	0	5	0	10
* *	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	48	0	48	0	48	48	48	0	48	0	0	48	48	0	48	48	0	48	48	0	0	48	0	48	48	48	0	48	0	48

CC	CE	C*	EE	E*	**
240	407	87	109	21	0

APPENDIX M (Continued)

RESPONSE MATRICES BY CONDITION

VOICE-ONSET-TIME, CHANNEL I -- RIGHT, CHANNEL II - LEFT

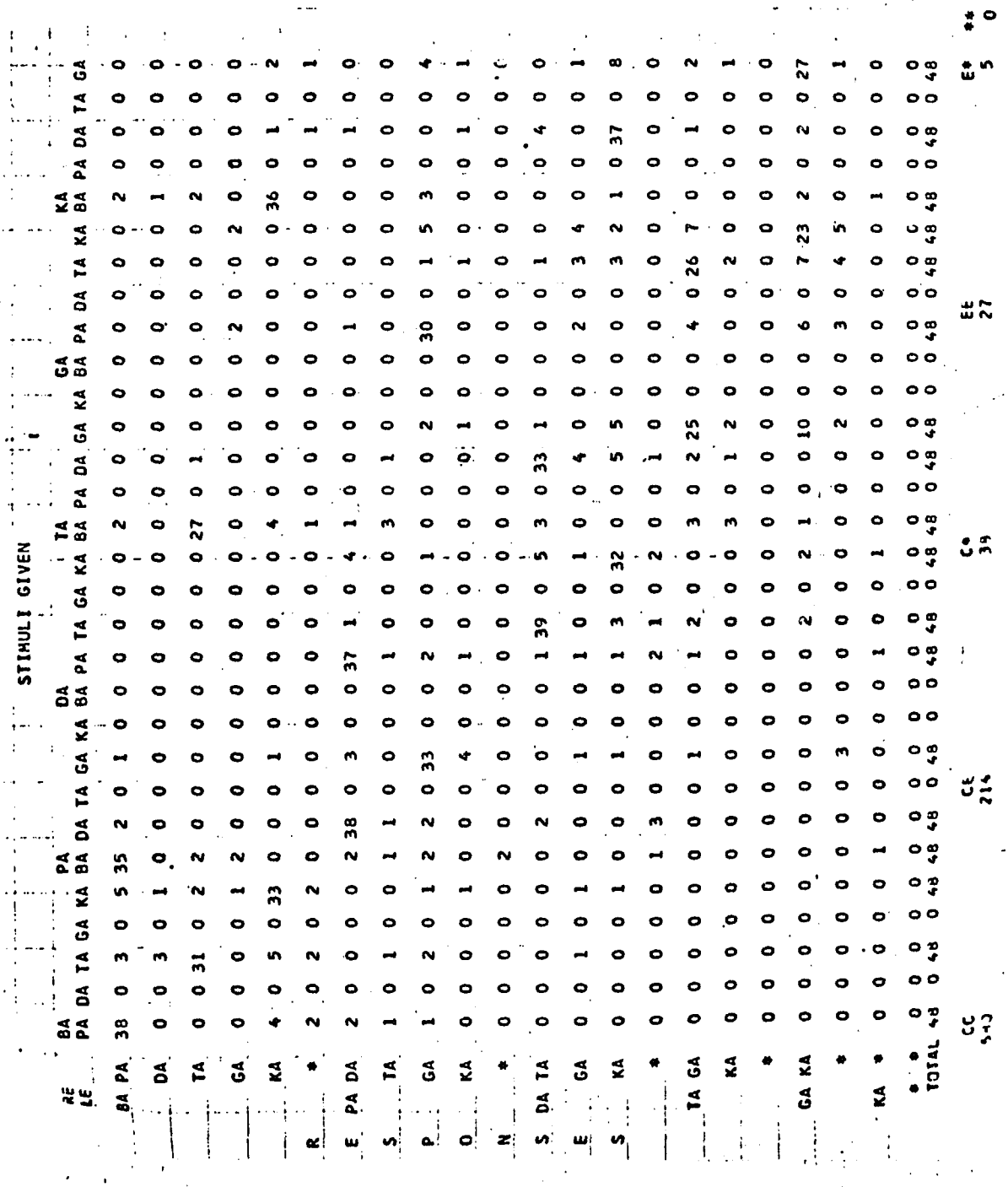
STIMULI GIVEN

RE / LE		BA				PA				DA				TA				GA				KA					
		BA	PA	DA	TA	GA	KA	BA	PA	DA	TA	GA	KA	BA	PA	DA	TA	GA	KA	BA	PA	DA	TA	GA	KA		
BA	PA	35	0	0	0	4	36	2	0	2	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	** 0	
DA		1	0	0	0	1	0	1	0	0	0	0	0	0	1	2	0	0	0	0	0	0	0	0	0	E* 3	
TA		1	0	38	0	1	0	0	0	0	0	0	0	26	0	1	3	0	0	0	0	0	0	0	0		
GA		0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0		
KA		2	0	3	0	35	0	0	0	1	0	0	0	0	0	0	3	0	0	33	0	0	0	0	1		
R *		2	0	2	0	2	1	0	0	0	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0		
E PA		2	0	2	0	1	2	33	0	1	0	0	0	38	0	0	4	0	3	1	0	0	0	4	0	1	
S TA		1	0	0	0	0	5	1	0	0	0	0	0	0	0	0	1	0	1	1	0	0	0	0	0		
P GA		3	0	0	0	0	0	1	5	0	35	0	0	0	0	0	0	4	0	0	39	0	1	9	1		
O KA		0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	1	0	0	0	2	0	0	3		
N *		1	0	0	0	0	0	3	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
S DA		0	0	1	0	0	0	1	0	0	0	0	0	4	30	0	3	2	0	0	0	0	0	1	0		
E GA		0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	2	0	0	1	0	0	0	1	0		
S KA		0	0	1	0	1	0	0	0	0	0	0	0	0	5	0	38	0	0	4	2	0	0	0	1		
*		0	0	0	0	0	0	0	0	3	0	0	0	0	2	4	0	3	0	0	1	0	0	0	0		
TA GA		0	0	1	0	0	0	0	0	0	0	0	0	0	2	0	0	1	0	3	28	0	0	1	0		
KA		0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	4	0	0	3	4	0	0	0		
*		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
GA KA		0	0	0	0	0	1	0	0	0	3	0	0	0	0	0	0	0	0	0	0	1	0	0	0		
*		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0		
KA *		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
* *		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
TOTAL		48	0	48	0	48	48	48	0	48	0	48	48	48	0	48	0	48	48	48	0	48	0	48	48		
		CC 589				CE 206				C* 41				EE 25													

APPENDIX M (Continued)

RESPONSE MATRICES BY CONDITION

VOICE-ONSET-TIME, CHANNEL I - LEFT, CHANNEL II - RIGHT



APPENDIX M (Continued)

RESPONSE MATRICES BY CONDITION

ONSET+TRANSITION, CHANNEL I - RIGHT, CHANNEL II - LEFT

STIMULI GIVEN

RE / LE		BA				PA				DA				TA				GA				KA					
		PA	DA	TA	GA	KA	BA	DA	TA	GA	KA	BA	PA	TA	GA	KA	BA	PA	DA	GA	KA	BA	PA	DA	TA	KA	BA	PA	DA	TA	GA	
BA	PA	26	0	2	0	11	20	6	2	3	3	0	4	0	0	0	1	2	0	0	0	0	1	0	0	0	3	9	0	0	0	CC 291
DA		1	0	0	0	0	1	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	CE 515
TA		0	0	3	0	1	0	0	1	0	0	0	3	2	0	2	2	7	1	1	1	0	0	0	1	0	2	1	0	0	0	EE 107
GA		0	0	0	0	2	0	1	0	1	0	0	2	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	
KA		1	0	1	0	8	1	0	0	4	3	0	1	0	0	2	0	0	0	2	3	0	8	0	1	3	8	0	0	2	6	
R	*	1	0	0	0	1	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
E	PA	4	0	5	0	3	6	10	7	4	7	0	11	0	0	1	1	3	0	0	0	0	0	0	0	0	4	4	0	0	0	
S	TA	2	0	2	0	2	4	7	17	2	2	0	4	0	0	0	7	16	1	0	0	0	1	0	0	0	2	6	0	0	0	
P	GA	2	0	1	0	3	3	7	1	7	3	0	5	0	0	0	0	1	2	1	1	0	0	8	0	1	1	4	3	1	0	0
O	KA	2	0	1	0	3	2	2	5	8	12	0	2	0	0	1	0	2	0	1	3	0	4	0	2	1	6	9	1	4	2	
N	*	9	0	0	0	3	11	8	6	3	9	0	4	0	0	1	0	1	0	0	0	0	2	0	0	0	4	10	0	0	0	
S	DA	TA	0	0	12	0	0	0	2	1	0	0	0	3	18	0	0	12	1	16	0	1	0	0	0	1	0	1	0	0	1	0
E	GA	0	0	0	0	0	0	2	0	1	0	0	0	1	2	0	1	0	0	0	0	0	0	2	0	1	2	0	0	3	0	1
S	KA	0	0	4	0	2	0	1	0	2	1	0	2	11	0	11	3	0	5	11	2	0	5	0	7	9	5	0	15	3	7	
	*	0	0	1	0	0	0	0	0	0	0	0	1	4	0	2	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	
TA	GA	0	0	1	0	1	0	1	1	1	1	0	0	1	2	0	1	3	0	3	1	1	0	3	0	2	1	0	0	0	1	0
	KA	0	0	5	0	1	0	0	3	2	1	0	0	0	0	4	0	4	6	3	9	8	23	0	3	0	6	3	0	1	9	18	5
	*	0	0	6	0	0	0	0	3	0	0	0	0	3	0	0	0	11	8	8	1	3	0	0	0	1	0	0	0	0	2	0
GA	KA	0	0	3	0	4	0	0	1	6	2	0	0	1	0	15	1	1	1	14	3	0	7	0	14	15	3	2	10	5	15	
	*	0	0	0	0	0	0	1	0	0	0	0	0	0	0	2	0	0	0	0	1	0	0	1	0	3	4	0	0	0	0	1
KA	*	0	0	1	0	3	0	0	0	3	5	0	0	1	0	5	0	2	2	6	8	0	2	0	7	9	6	3	9	12	11	
*	*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
TOTAL		48	0	48	0	48	48	48	48	48	48	0	48	48	0	48	48	48	48	48	48	0	48	0	48	48	48	48	48	48	48	E* 39

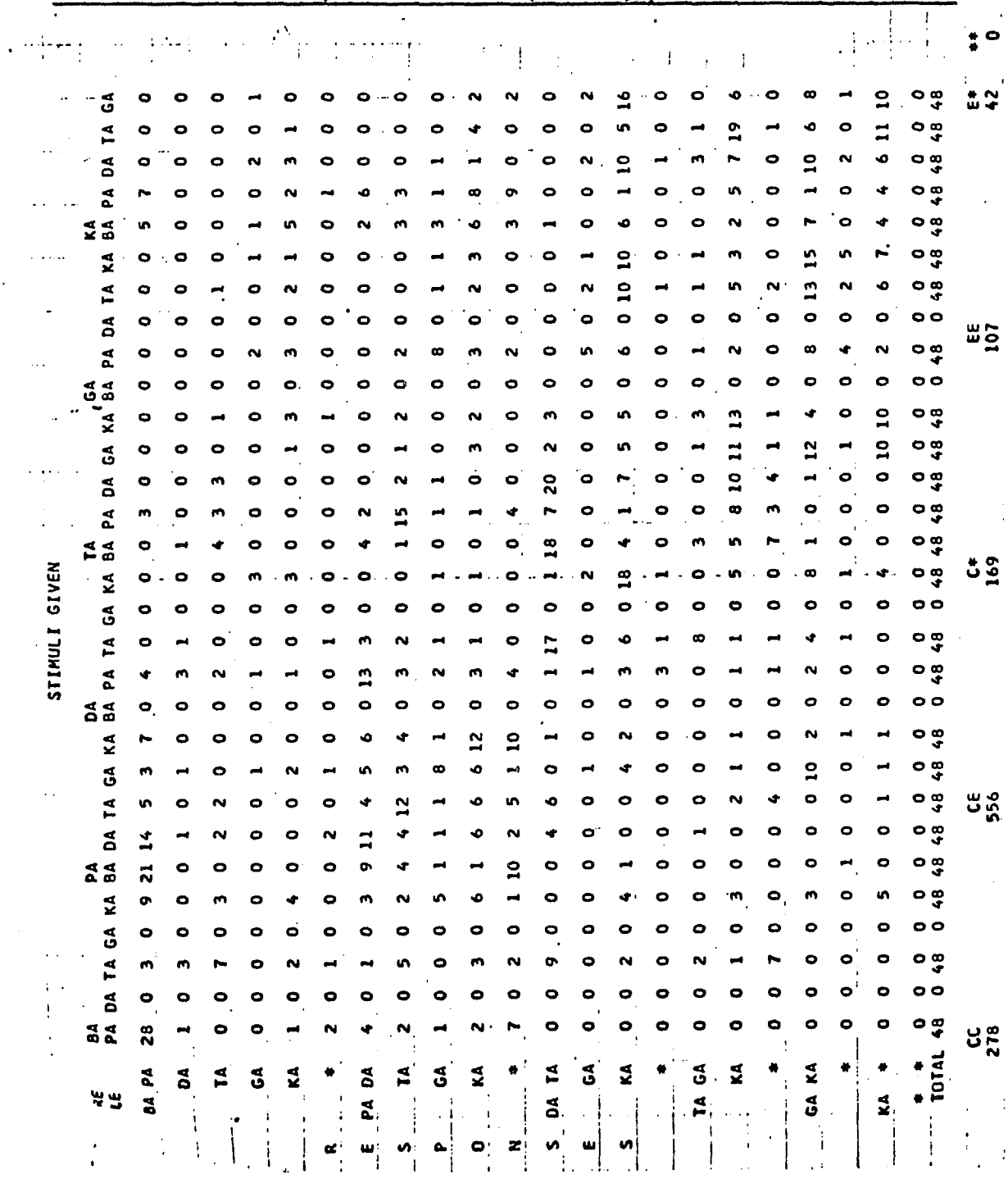
C* 200

** 0

APPENDIX M (Continued)

RESPONSE MATRICES BY CONDITION

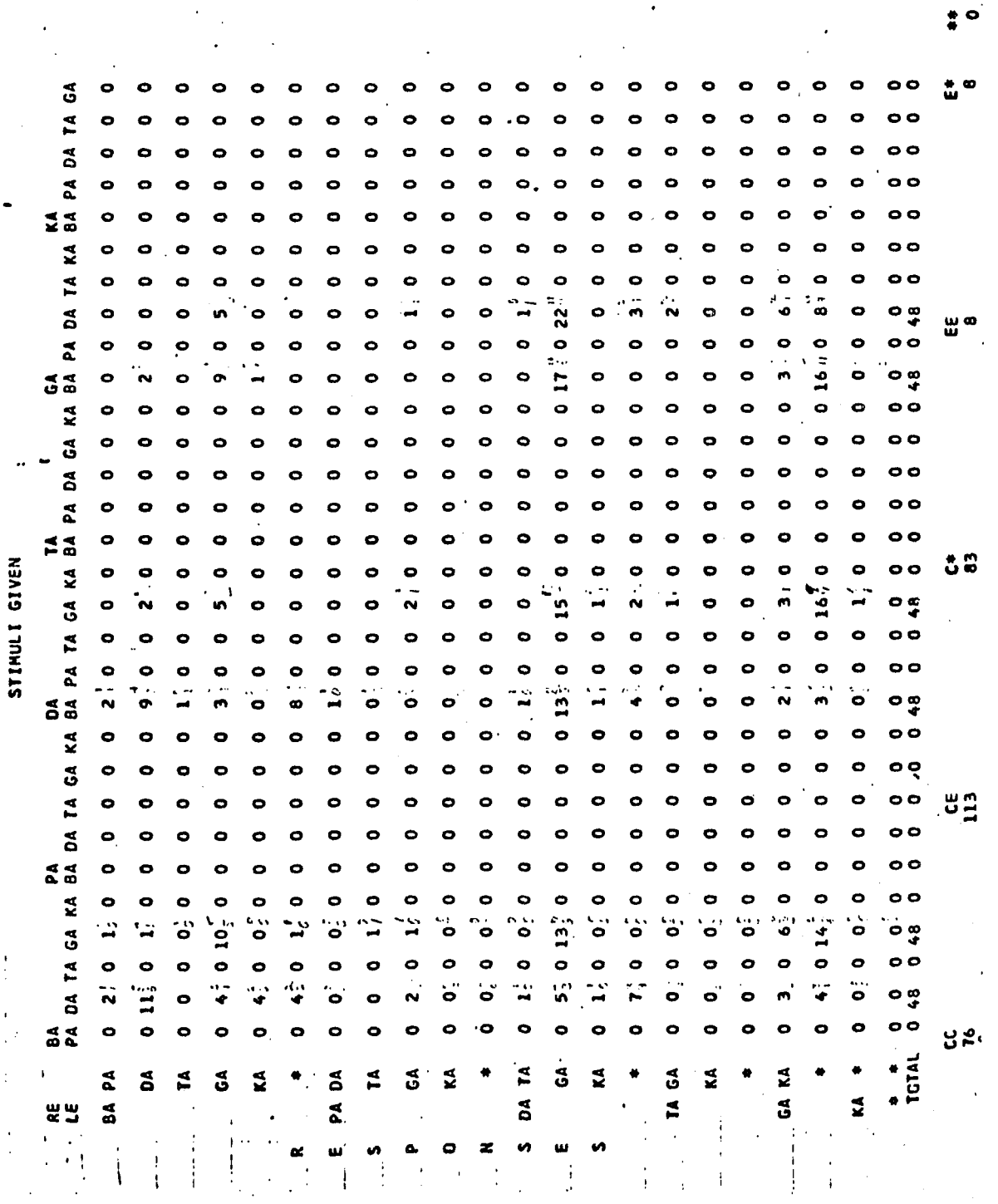
ONSET+TRANSITION, CHANNEL I - LEFT, CHANNEL II - RIGHT



APPENDIX M (Continued)

RESPONSE MATRICES BY CONDITION

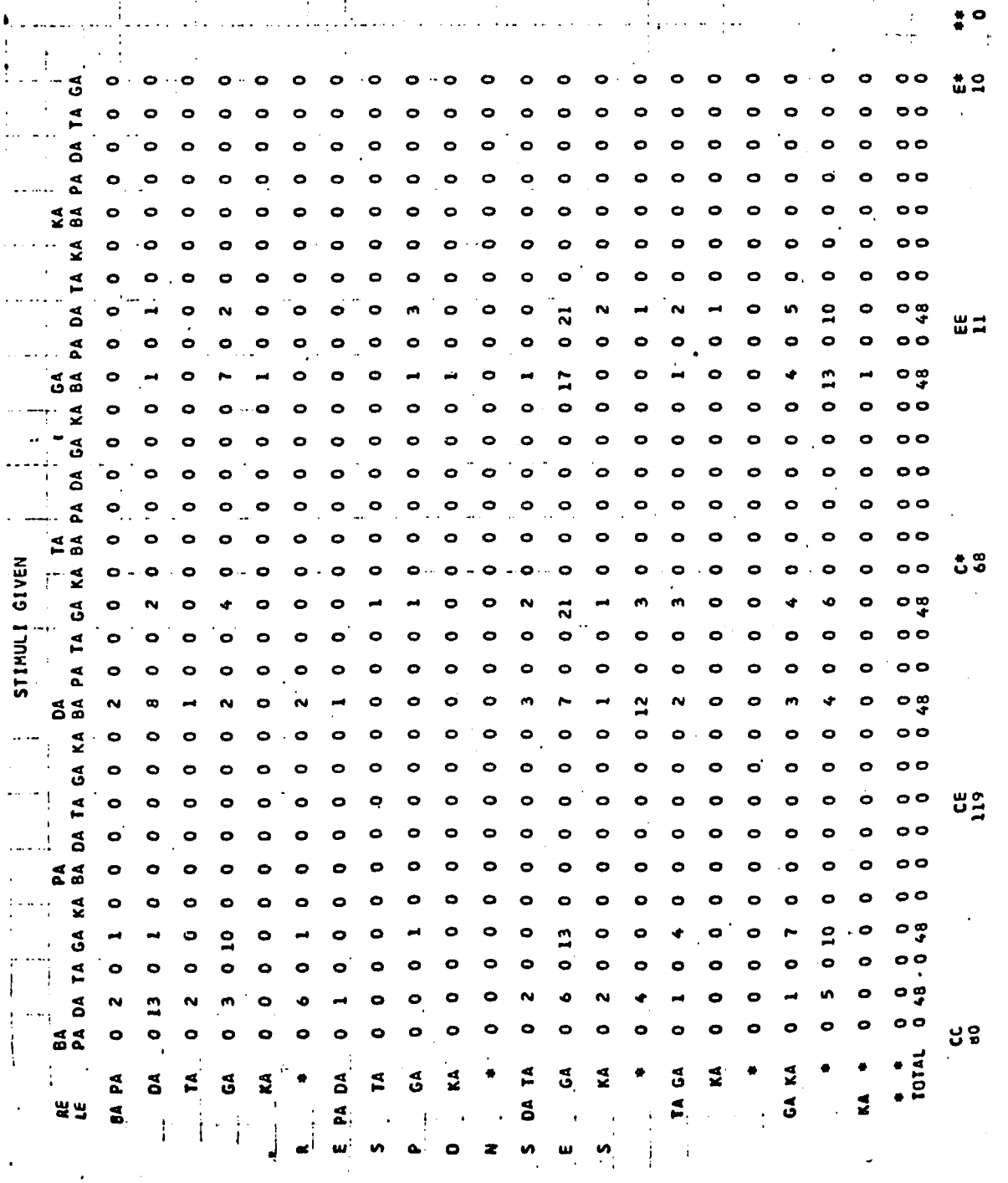
BOUNDARY+TRANSITION, CHANNEL I - RIGHT, CHANNEL II - LEFT



APPENDIX M (Continued)

RESPONSE MATRICES BY CONDITION

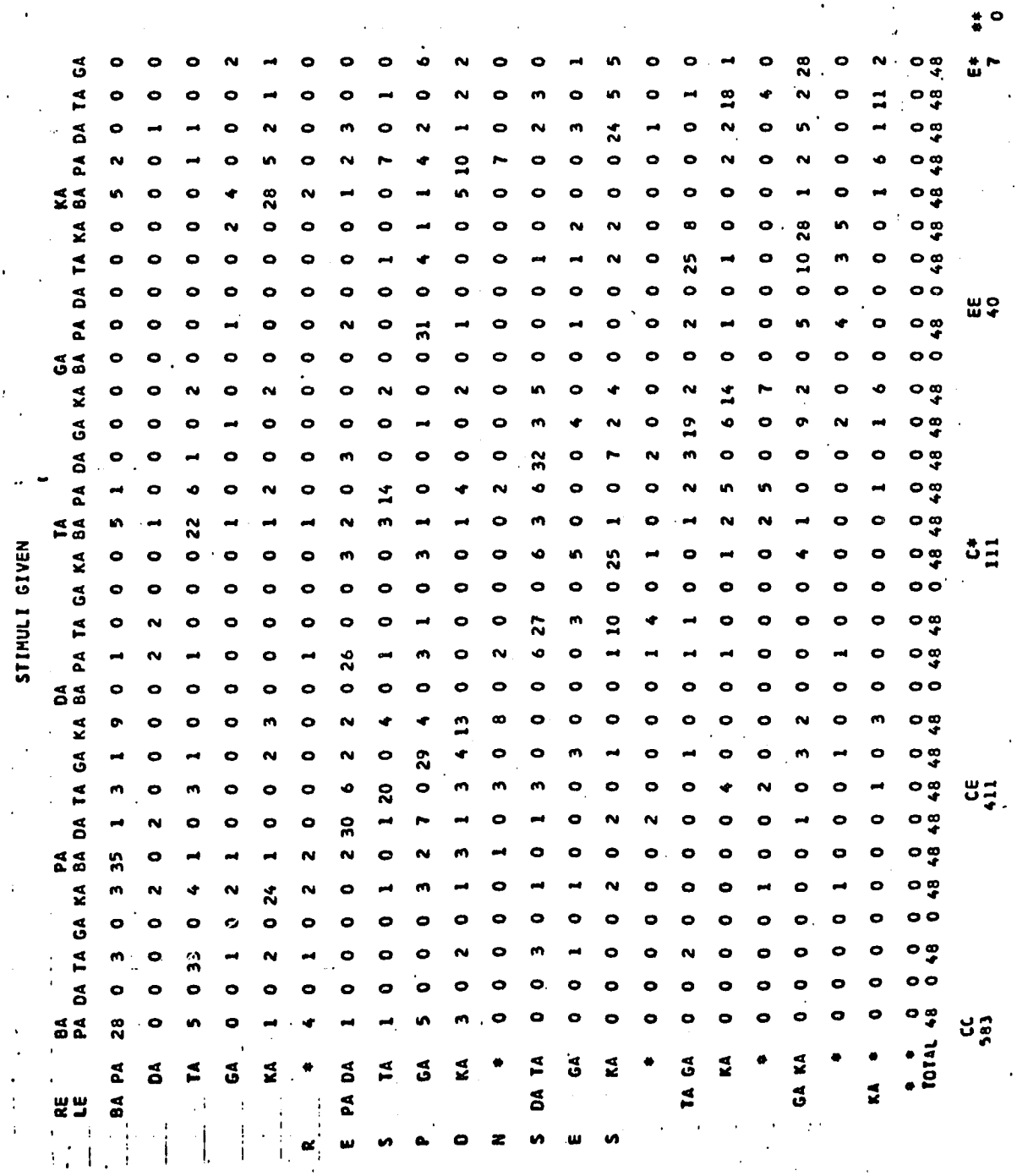
BOUNDARY+TRANSITION, CHANNEL I - LEFT, CHANNEL II - RIGHT



APPENDIX M (Continued)

RESPONSE MATRICES BY CONDITION

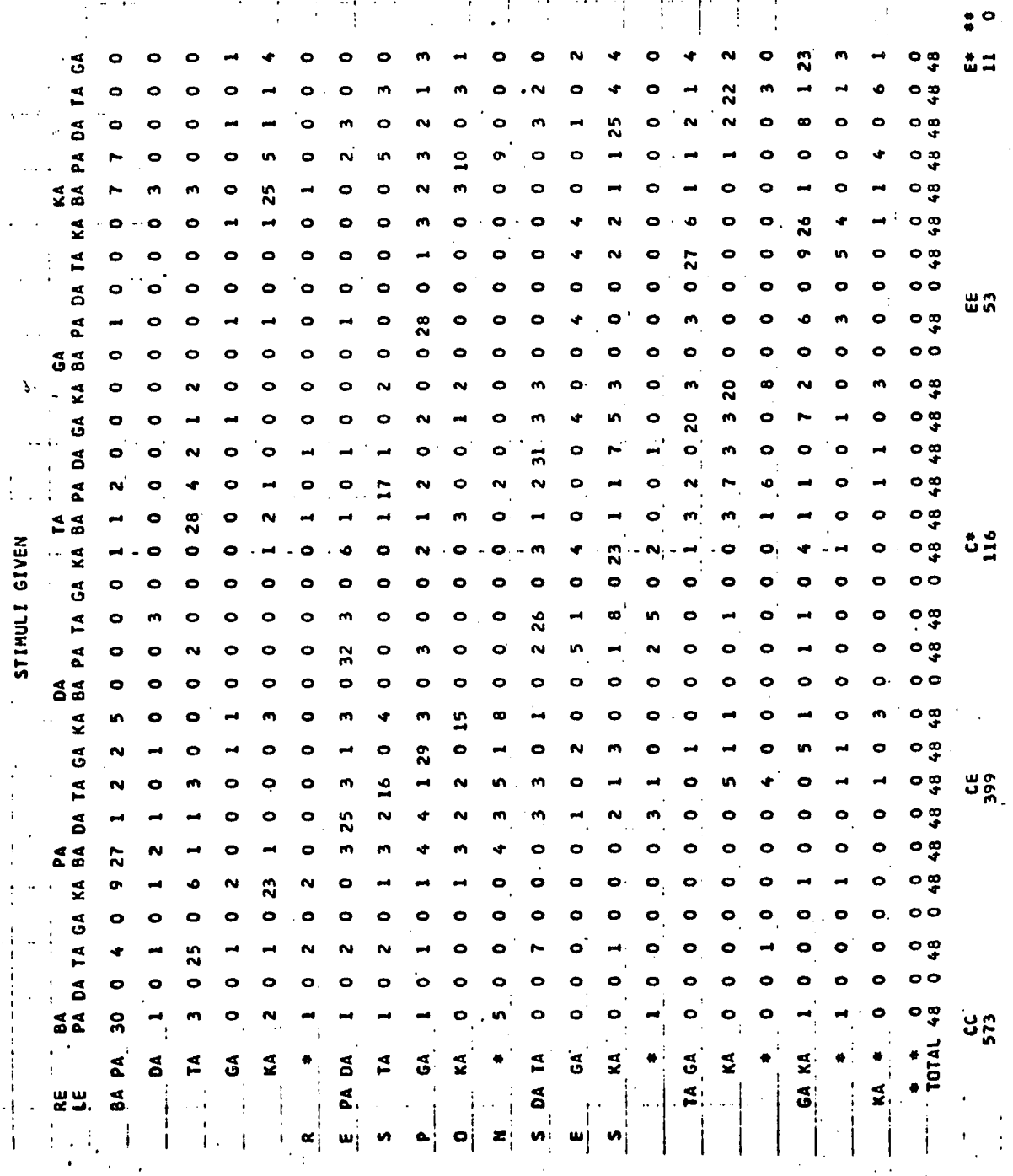
BOUNDARY+VOICE-ONSET-TIME, CHANNEL I - RIGHT, CHANNEL II - LEFT



APPENDIX M (Continued)

RESPONSE MATRICES BY CONDITION

BOUNDARY+VOICE-ONSET-TIME, CHANNEL I - LEFT, CHANNEL II - RIGHT



APPENDIX M (Continued)

RESPONSE MATRICES BY CONDITION

ONSET+VOICE-ONSET-TIME, CHANNEL I - RIGHT, CHANNEL II - LEFT

STIMULI GIVEN

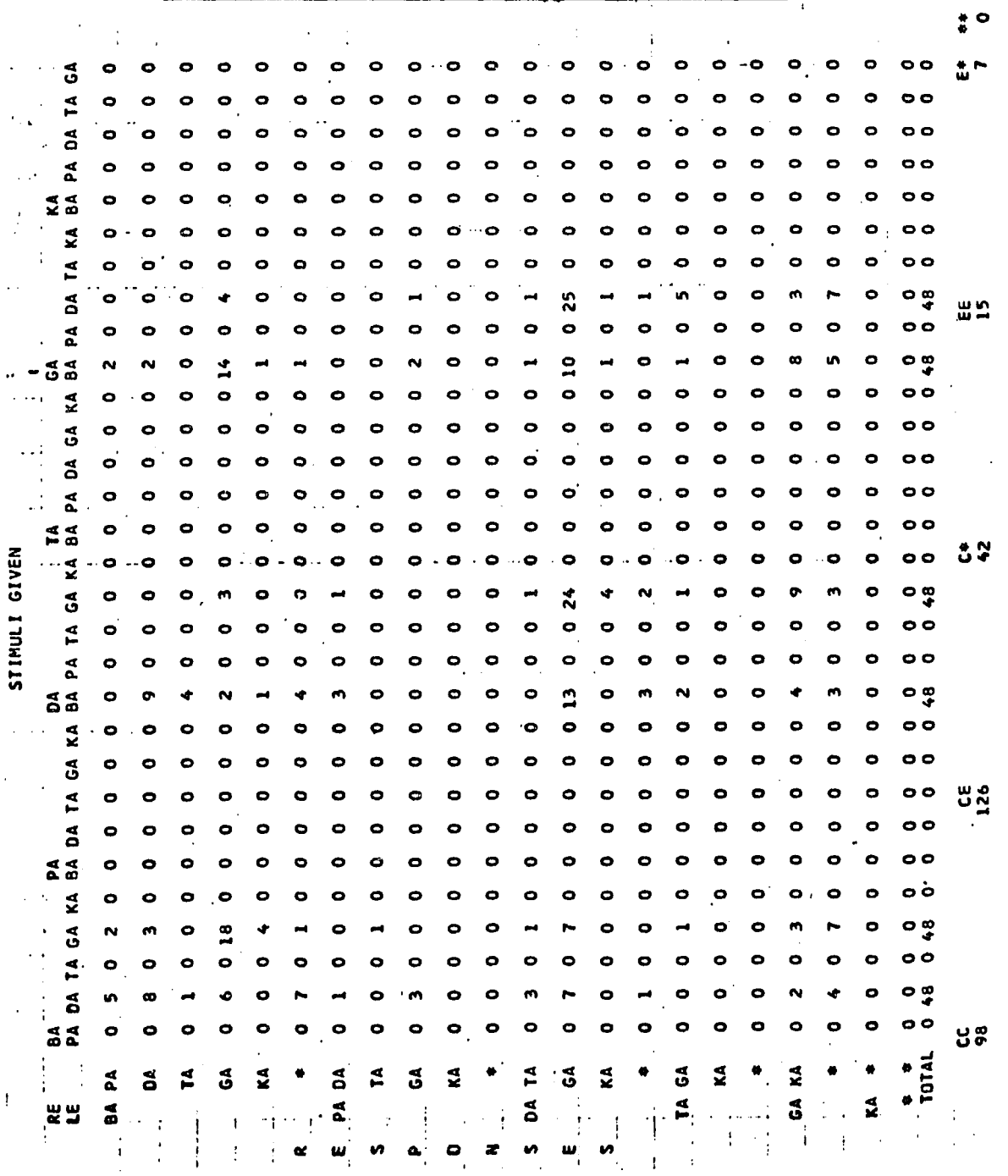
RESPONSE RE / LE	BA				PA				DA				TA				GA				KA					
	BA	PA	DA	TA	GA	KA	BA	DA	TA	GA	KA	BA	PA	DA	GA	KA	BA	PA	DA	TA	KA	BA	PA	DA	TA	GA
BA	PA	0	1	0	2	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DA		0	14	0	5	0	0	0	0	0	0	10	0	0	1	0	0	0	0	1	0	0	0	0	0	0
TA		0	1	0	1	0	0	0	0	0	0	2	0	0	0	0	1	0	0	0	0	0	0	0	0	0
GA		0	7	0	15	0	0	0	0	0	0	2	0	0	5	0	0	16	0	4	0	0	0	0	0	0
KA		0	3	0	5	0	0	0	0	0	0	3	0	0	0	0	0	2	0	0	0	0	0	0	0	0
R *		0	5	0	2	0	0	0	0	0	0	2	0	0	0	0	0	1	0	0	0	0	0	0	0	0
E PA	DA	0	1	0	0	0	0	0	0	0	0	2	0	0	1	0	0	0	0	0	0	0	0	0	0	0
S TA		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
P GA		0	1	0	3	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0
O KA		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
N *		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
S DA	TA	0	2	0	0	0	0	0	0	0	0	2	0	0	1	0	0	0	0	0	0	0	0	0	0	0
E GA		0	2	0	4	0	0	0	0	0	0	9	0	0	23	0	0	0	0	24	0	0	0	0	0	0
S KA		0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	2	0	0	0	0	0	0
*		0	0	0	0	0	0	0	0	0	0	3	0	0	3	0	0	0	0	1	0	0	0	0	0	0
TA GA		0	2	0	0	0	0	0	0	0	0	1	0	0	2	0	0	1	0	4	0	0	0	0	0	0
KA		0	0	0	0	0	0	0	0	0	0	4	0	0	6	0	0	0	0	3	0	0	0	0	0	0
*		0	0	0	0	0	0	0	0	0	0	4	0	0	5	0	0	6	0	9	0	0	0	0	0	0
GA KA		0	4	0	4	0	0	0	0	0	0	4	0	0	6	0	0	0	0	3	0	0	0	0	0	0
*		0	4	0	7	0	0	0	0	0	0	4	0	0	5	0	0	5	0	9	0	0	0	0	0	0
KA *		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
* * TOTAL		0	48	0	48	0	0	0	0	0	0	48	0	0	48	0	0	48	0	48	0	0	0	0	0	0

CC 102 | CE 123 | C* 43 | EE 12 | E* 8 | ** 0

APPENDIX M (Continued)

RESPONSE MATRICES BY CONDITION

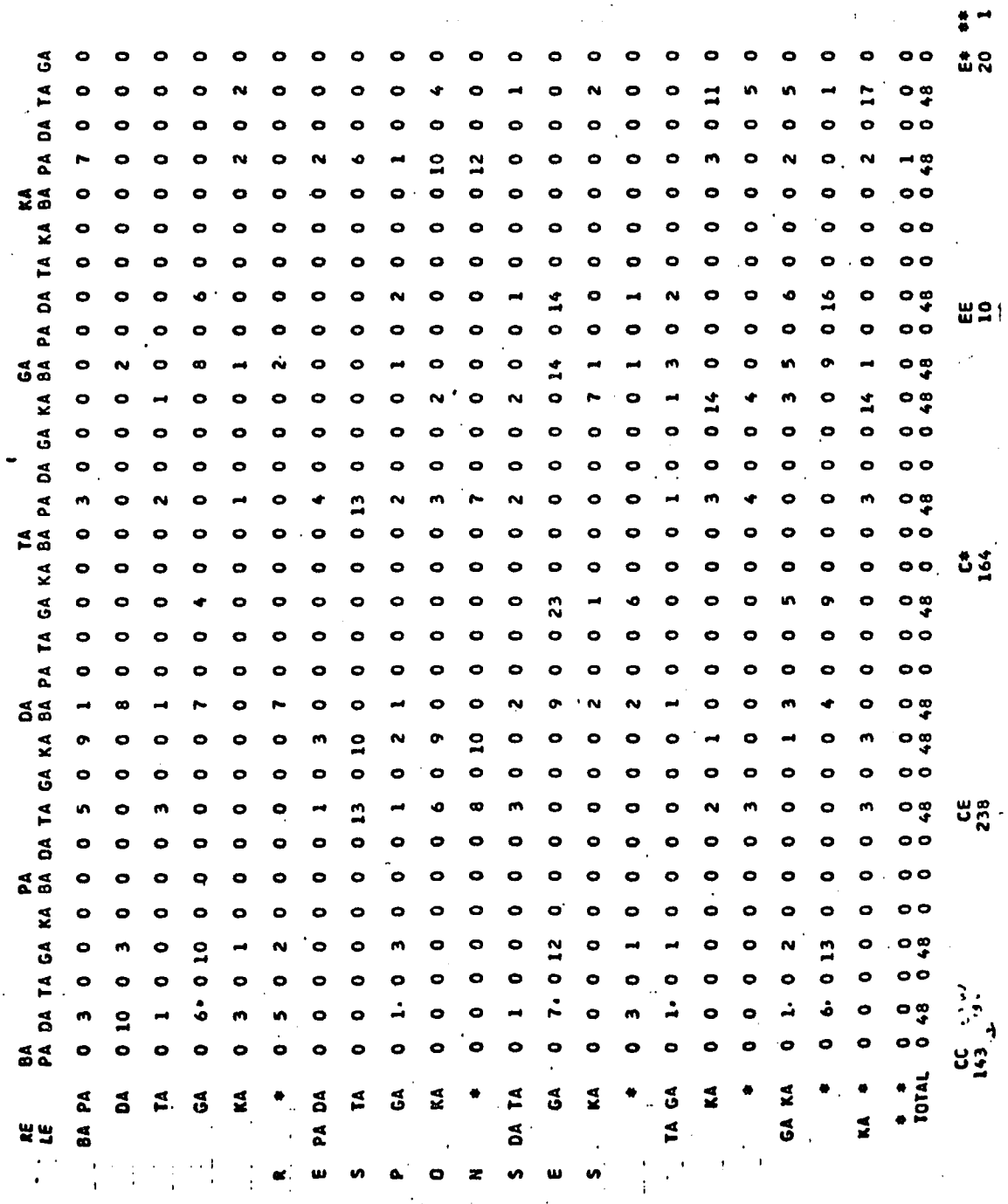
ONSET+VOICE-ONSET-TIME, CHANNEL I - LEFT, CHANNEL II - RIGHT



APPENDIX M (Continued)

RESPONSE MATRICES BY CONDITION

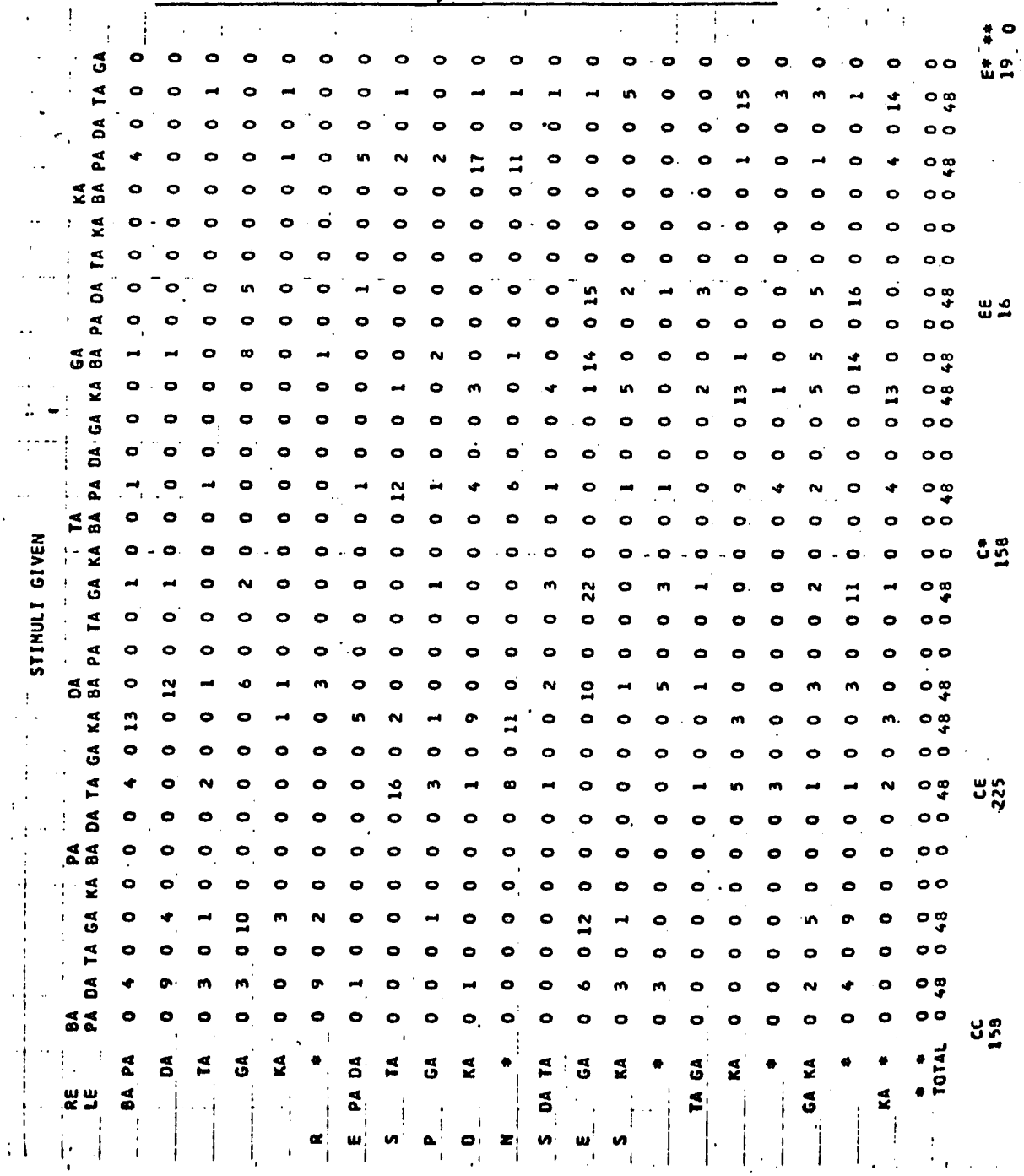
BOUNDARY+ONSET+TRANSITION+VOICE-ONSET-TIME, CHANNEL I - RIGHT, CHANNEL II - LEFT



APPENDIX M (Continued)

RESPONSE MATRICES BY CONDITION

BOUNDARY+ONSET+TRANSITION+VOICE-ONSET-TIME, CHANNEL I - LEFT, CHANNEL II - RIGHT



APPENDIX N

NUMBERS OF CORRECT RESPONSES BY CHANNEL AND EAR

CONDITION Onset DATE 12/21/70

ANALYZED

SUBJECT No.	CH I	CH II	CH II	CH I	TOTAL	
	LEFT	RIGHT	LEFT	RIGHT	LEFT	RIGHT
1.	12	23	9	25	21	48
2.	17	21	18	20	35	41
3.	22	24	23	27	45	51
4.	16	23	16	26	32	49
5.	9	19	13	18	22	37
6.	21	26	20	31	41	57
7.	22	26	19	24	41	50
8.	15	24	18	24	33	48
9.	24	29	27	28	51	57
10.	23	23	23	28	46	51
11.	18	27	24	23	42	50
12.	18	27	25	32	43	59
13.	19	21	20	28	39	49
14.	22	28	21	26	43	54
15.	15	21	17	21	32	42
16.	26	28	22	26	48	54

APPENDIX N (Continued)

Subject No.	Ch I	Ch II	Ch II	Ch I	Total	
	LEFT	RIGHT	LEFT	RIGHT	LEFT	RIGHT
17.	12	32	14	31	26	63
18.	5	21	7	29	12	50
19.	22	29	18	23	40	52
20.	20	20	24	23	44	43
21.	21	23	17	29	38	52
22.	28	28	26	27	54	55
23.	20	29	27	27	47	56
24.	25	21	24	17	49	38
Total	452	593	472	613	924	1206

$\bar{x}$	38.5	50.3
$SE\bar{x}$	2.10	1.32

t (correlated) 5.35

df = 23

p<.001

(one tailed)

APPENDIX N

(Continued)

CONDITION Transition + Boundary DATE 12/21/70

ANALYZED

SUBJECT NO.	CH I	CH II	CH II	CH I	TOTAL	
	LEFT	RIGHT	LEFT	RIGHT	LEFT	RIGHT
1.	8	5	6	7	14	12
2.	6	7	5	8	11	15
3.	6	6	6	4	12	10
4.	4	8	8	7	12	15
5.	3	5	5	5	8	10
6.	11	10	8	12	19	22
7.	9	6	6	9	15	15
8.	6	8	6	7	12	15
9.	5	9	9	7	14	16
10.	8	9	8	9	16	18
11.	10	7	7	5	17	12
12.	6	10	8	11	14	21
13.	6	6	6	7	12	13
14.	6	7	7	5	13	12
15.	10	8	7	8	17	16
16.	6	8	6	9	12	17

APPENDIX N (Continued)

Subject No.	Ch I	Ch II	Ch II	Ch I	Total	
	LEFT	RIGHT	LEFT	RIGHT	LEFT	RIGHT
17.	3	9	4	8	7	17
18.	4	8	6	8	10	16
19.	6	10	9	7	15	17
20.	8	8	9	7	17	15
21.	10	9	12	9	22	18
22.	8	10	9	9	17	19
23.	5	8	8	3	13	11
24.	7	5	7	5	14	10
Total	161	186	172	176	333	362

$\bar{x}$	13.9	15.1
$SE\bar{x}$	6.9	.68

t (correlated) = 1.60

df = 23

p<.10

(one tailed)

APPENDIX O

PERCENTAGES OF CORRECT RESPONSES BY EAR FOR ONSET TRANSITION+BOUNDARY CONDITIONS

SUBJECT	LEFT		RIGHT	
	ONSET	TRANSITION BOUNDARY	ONSET	TRANSITION BOUNDARY
1.	29	58	67	50
2.	49	46	57	63
3.	63	50	71	42
4.	44	50	68	63
5.	31	33	51	42
6.	57	79	79	92
7.	57	63	69	63
8.	46	50	67	63
9.	71	58	79	67
10.	64	67	71	75
11.	58	71	69	50
12.	60	58	82	88
13.	54	50	68	54
14.	60	54	75	50
15.	44	71	58	67
16.	67	50	75	71

APPENDIX O

(Continued)

SUBJECT	LEFT		RIGHT	
	ONSET	TRANSITION BOUNDARY	ONSET	TRANSITION BOUNDARY
17.	36	29	88	71
18.	17	42	69	67
19.	56	63	72	71
20.	61	71	60	63
21.	53	92	72	75
22.	75	71	76	79
23.	65	54	78	46
24.	68	58	53	42
TOTAL	1285	1388	1674	1514
	r = .45		r = .51	

VITA

Name: Joseph Edward Hannah

Born: February 24, 1941, Geneva, Alabama

Education: B.A. University of Alabama, 1964

M.A. University of Alabama, 1966

Ph.D. Louisiana State University, 1971

EXAMINATION AND THESIS REPORT

Candidate: Joseph Edward Hannah

Major Field: Speech

Title of Thesis: Phonetic and Temporal Titration of the Dichotic Right Ear Effect

Approved:

Major Professor and Chairman

Dean of the Graduate School

EXAMINING COMMITTEE:

Date of Examination:

January 8, 1971