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The effect of strength and type of conflict on vocal responses.

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Introduction

This study is concerned with conflict involving vocal responses.[1] Preliminary to a description of the experimental design and of orienting theoretical considerations, however, it would seem desirable to discuss the principle of conflict and its applications in general terms, and then to indicate some procedural shortcomings of various investigations in which vocal conflict has been introduced as an explanatory factor for various behavioral phenomena.

1. Vocal responses as used here refer to any activity of the laryngeal muscles and the musculature involved in articulation.

The Principle and Procedural Shortcomings

Principle of Conflict

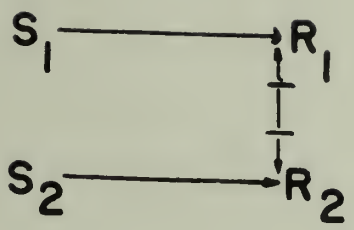
Conflict has been introduced to explain behavioral phenomena ranging from approach-avoidance behavior in a straight runway (17) to the neurotic and psychotic symptoms observed in complex situations (7,11). In these explanations the common denominator of the many definitions proposed has been the simultaneous arousal of two or more incompatible states. Specific applications of the conflict principle, however, have differed markedly with respect to the identification or locus of the conflicting states, the stimulus antecedents of conflict, the manner of summation of the conflicting states, the nature and extent of the behavioral consequences of conflict, and the

range of application of the principle.

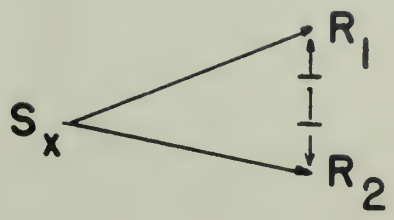
Identification or locus.--Whether conflicting states are to be identified or localized as "ideas" (8,9), perceptual events (25), drives (25), intervening variables (3), chemical or neural processes (10,19,21,25,33,34), or effector events (11,12,13,14, 15,25,31) has been one area of disagreement. However, more data are required for selection among and possible reconciliation of these diverse views.

Stimulus antecedents.--What seem to be the alternative conceptions of the stimulus antecedents of conflict reduced to simplest form are diagrammed in Fig. 1. Paradigm A represents the simultaneous presentation of two stimuli (S_1, S_2) each of which when presented alone elicits incompatible states which, for illustrative purposes, are identified as effector events or responses (R_1, R_2). The incompatibility of these responses (indicated by the cross-hatched, double-end arrows) can be specified by anatomical-physiological criteria or in terms of reciprocal modification of one or more of the attributes (frequency, latency, etc.) of R_1 and R_2 under conditions of simultaneous presentation of S_1 and S_2. If generalized to other attributes and/or to other stimuli, the latter criterion involves no circularity.

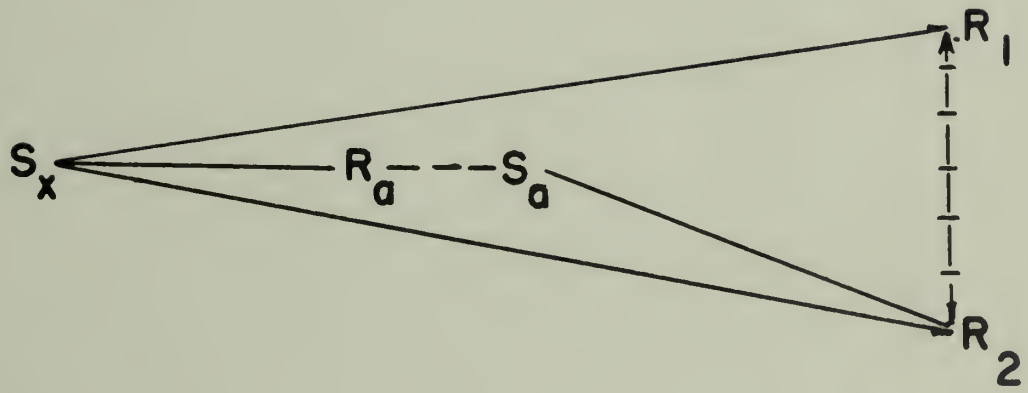
Simultaneous activation of two or more incompatible responses by the "same" stimulus is represented in paradigm B. While conceivable that the "same" stimulus may prove to be constituted of two separate sets of components, no satisfactory



TYPE A



TYPE B



TYPE C

Fig. 1. Stimulus antecedents of conflict.

empirical confirmation of this possibility is presently available (4).

Paradigm A has been introduced most frequently in studies of reflex activity (21,33,34,35), and of approach-approach or avoidance-avoidance conflicts between manipulative or locomotor responses (1,12,25,31). Conversely, explanations of negative transfer and forgetting have usually postulated original learning of S_x-----R_1 followed by interpolated strengthening of the S_x-----R_2 association (23,27).

Both paradigms seem relevant to analyses of association experiments (18,27), various psychoanalytic mechanisms (6,7,24,28), stuttering (32,37), and other approach-avoidance conflicts (2,7, 17,25,31). Thus, in paradigm C an external stimulus (S_x) is pictured as evoking incompatible manipulative (locomotor or vocal) responses (R_1, R_2), and a compatible anxiety response (R_a) identified as visceral activity. The stimuli (S_a) produced by R_a are, for illustrative purposes, assumed to be conditioned only to R_2. In this mixed case, simultaneous arousal of R_1 and R_2 by S_x is a type B conflict while presence of the S_a-----R_2 association introduces a modification of paradigm A in that S_x evokes R_1 while S_a contributes to the arousal of R_2.

Summation.--Skinner (35) and Miller (25) have suggested that strengths of conflicting stimulus-response relationships summate algebraically. Equation 1 is used in Hull's (15) system

$$[1] \qquad \underline{Z} = \frac{S\underline{E}R_s \text{ --- } S\underline{E}R_w}{6_d}$$

to obtain the $\underline{Z}$ necessary for determining the probability of occurrence ($\underline{p}$) of the conflicting spatial response with the stronger reaction potential (${}_{S}\underline{E}R_{s}$). ${}_{S}\underline{E}R_{w}$ designates the weaker reaction potential, $\frac{\cdot}{\cdot}$ is a special withdrawal operation given by an additional equation (15, p. 9, equation 13), and σd is arbitrarily taken as 1.414. Once $\underline{Z}$ is computed the corresponding $\underline{p}$ can be looked up in a table for the unit normal curve.

In Equation 2 strength of emotion ($\underline{F}$) is defined by a ratio

$$[2] \qquad \underline{F} = \frac{\underline{E}_{w}^{\,n}}{\underline{E}_{s}^{\,n-1}}$$

of strengths of weaker ($\underline{E}_{w}$) and stronger ($\underline{E}_{s}$) excitatory tendencies of two stimulus-response relationships raised to the $\underline{n}$th and $\underline{n}$-1th powers, respectively. The two excitatory tendencies are defined as increasing functions of the number of reinforcements of the two responses, and frequency, latency, and other response measures are treated as monotonic functions of $\underline{F}$ (3).

Bush and Whiting (4) have proposed that rate of response in instrumental conditioning situations involving conflicting responses can be based on Equation 3. In this equation $\underline{f}$ =

$$[3] \qquad \underline{f} = \frac{\underline{p}_{e}\underline{p}_{r}}{\underline{p}_{e} + \underline{p}_{w}}\,\underline{w}_{o}$$

number of occurrences of a response $\underline{r}$ (pecking a key, pressing a bar, etc.), $\underline{w}_{o}$ = the number of trials per minute, and $\underline{p}_{e}$, $\underline{p}_{r}$, and $\underline{p}_{w}$ represent the probability of response $\underline{r}$ in state 1 (in

the immediate neighborhood of the stimulus for response r), the probability of going from state 1 to state 2 (being elsewhere than the immediate neighborhood of the stimulus for response r), and the probability of going from state 2 to state 1, respectively. In practice, the last three quantities would have to be defined as functions of number of trials, a similarity index, η, and possibly other factors.

Equation 4 is a modification of one employed by Schoeffler

$$[4] \qquad p = \frac{N_1 \theta_1}{N_1 \theta_1 + N_2 \theta_2}$$

(29) to predict the probability of occurrence (p) of the correct one of two incompatible motor responses. θ_1 represents the probability of occurrence of N_1 stimulus elements and θ_2 the probability of occurrence of N_2 stimulus elements conditioned to the correct and incorrect motor responses, respectively.

Each of these summation or combinational formulas was developed for specific situations and/or response measures. Therefore, as will be noted in somewhat greater detail below, in their present forms none is generally applicable.

Behavioral consequences.--Even when differences arising from terminological preferences are disregarded, the behavioral consequences of conflict which have been hypothesized and/or measured are extensive. Thus, for a given response the changes may include heightened latencies and durations, vacillation, and lowered probability of occurrence or even complete cessation.

Maier has attributed one type of convulsive seizure in rats to conflict (22). The fixated jumping responses established by random reward-punishment schedules have also been interpreted as one type of solution to frustration-conflict conditions (22). Effects on other effectors may often be observed when, for example, displacement from motor to verbal responses presumably occurs (6).

Range of application.--Some investigators have been concerned with the role of conflict in relatively restricted areas such as displacement (4), and negative transfer and forgetting (23). For others (7,11,27) conflict is of central importance for a wide range of behavioral phenomena.

Shortcomings of Investigations of Vocal Conflict

In experimental investigations of conflict or when conflict is introduced to explain behavioral phenomena, three conditions should be approximated. First, the conflicting states should be identified and degree of incompatibility of these states specified. If conflict is localized at the effector level, anatomical or reciprocal modification criteria can be used. In view of the limitations of present knowledge, however, even if other loci are hypothesized, criteria for effector incompatibility will probably still serve as bases for inferring degree of incompatibility. While complete denotation of stimulus antecedents is unnecessary, identification of some of the stimulus elements evoking the conflicting states is desirable. Finally, strength of association between stimulus antecedents and each of the conflicting states

should be estimated and determined.

Most investigations of vocal conflict fall short of meeting one or more of these criteria. For example, in association experiments, in many investigations of psychoanalytic mechanisms, and in stuttering, while one of the responses can often be identified, the conflicting response(s) or the degree of incompatibility between the two responses have usually not been determined independently.

In general, it has been possible to specify some of the stimulus antecedents for the observed and inferred incompatible responses. The postulated relationships of stimulus antecedents to the presumed conflicting vocal responses have fit either the Type B or Type C paradigms. Unlike the situation for manipulative and locomotor responses, however, there appear to be no studies of vocal conflict which clearly approximate the Type A paradigm.

The strengths of relationships between stimulus antecedents and incompatible locomotor or manipulative responses have been determined prior to simultaneous arousal of those responses. Observational protocols of association experiments, psychoanalytic mechanisms, stuttering, the negative transfer and forgetting of vocal responses have usually been restricted to stimulus antecedents and behavioral consequences (increased latencies, repetitions, intrusion errors, etc.) from which the conflicting responses and relative strengths of component stimulus-response associations have been inferred. In fact, there appear to be no

studies involving vocal conflict in which strengths of relationships between stimulus antecedents and both incompatible responses have been independently assessed.

The identification of conflicting responses and the assessment of their relative strengths in interpretations of negative transfer and forgetting has also been complicated by the fairly large number of possible stimulus-response associations involved, and the complexity of the stimuli and responses.

In view of these limitations, additional information concerning vocal conflict is desirable. This information should be based on procedures which permit more precise specification of the incompatible responses, of degree of incompatibility, of stimulus antecedents of the responses, and of strengths of stimulus-response associations. Ideally, the stimuli and responses of the initial experimental analyses should be relatively simple with simultaneous presentation of the stimuli for only two incompatible responses.

The Problem

The present experiment was an attempt to approximate more clearly ideal conditions for ascertaining interrelationships among conditions and variables relevant to vocal conflict. Effects of three experimental conditions on various measures of the results of simultaneous arousal of two conflicting vocal responses were studied. One condition was the relative and absolute strengths of the conflicting stimulus-response relationships. The second was type of conflict: more specifically,

whether the conflicting responses were both responses of vocalizing vowels or one was saying a vowel and the other a "non-phonetic" response described as a short "kiss." Subtype of conflict was the third condition. Within vowel-vowel conflict each one of the three vowels was opposed by each of the other two. Each vowel was also in conflict with the kiss response.

Because of the complexity of the design a fairly detailed overview of the experimental conditions and of the "motor-phonetic" characteristics of the conflicting responses seems desirable. Present knowledge precludes detailed description of expected main and interaction effects of these type, subtype, and strength of conflict conditions on response measures. In order to provide some orienting framework possible forms of such interrelationships, both in general and as applied to the conditions of this experiment, will be discussed.

Overview

Table 1 summarizes the combinations of types, subtypes, and strengths of conflict which together constituted the over-all design of the experiment. Two simple light stimuli were used to elicit the conflicting responses. The responses paired with separate presentation of these stimuli were the relatively simple effector patterns involved in vocalization of the vowels [i] as in b<u>ee</u>t, [u] as in b<u>oo</u>t, and [ʌ] as in b<u>u</u>t, or of making the "kiss" response. Vowel sounds were selected because their vocalization results in sounds whose amplitude is greater than that of consonants. Also, the psychoacoustic properties of vowels

Table 1

Summary of Experimental Design

Conflict Type	Subtype	Strengths of Competing Responses SS	WW	WS	SW	Total
Vowel-Vowel	[i-u]	8*	8	8	8	32
	[i-ʌ]	8	8	8	8	32
	[ʌ-u]	8	8	8	8	32
Vowel-Kiss	[i-!]	8	8	8	8	32
	[ʌ-!]	8	8	8	8	32
	[u-!]	8	8	8	8	32
Total		48	48	48	48	192

*Number of Ss in each condition.

have been more extensively investigated and systematized than those of consonants.

There were two reasons for selection of the "kiss" response. One was that the lip-pursing and inhalation pattern seemed to be markedly antagonistic to the lip-opening and exhalation patterns of vowel production. The second reason was that this response produces a distinct, readily recorded sound. Because the author was unable to find a phonetic symbol for this sound, it has been designated with an exclamation mark [!].

Vowel-vowel conflict involved vocalization of one of the three vowels in opposition to one of the other two vowels. The three subtypes were conflict of [i] and [ʌ], [u] and [ʌ], and [i] and [u]. Table 2 summarizes the salient features of the effector patterns employed in producing each of these vowels (16, pp. 119-120). When analyzed psychoacoustically, points representing the first and second formants (peaks of vocal resonance curves) are roughly equidistant from each other (24,28). For normal speakers there is no overlap of the distributions of points representing the first and second formants, and listeners have no difficulty in differentiating among these sounds (5). For the subtypes of vowel-kiss conflict each of the vowels competed with the kiss response.

The two absolute levels of strength of stimulus-response associations, labeled Strong-Strong (SS) and Weak-Weak (WW), were specified in terms of amount of prior practice of each of the stimulus-response relationships. In the complementary

Table 2

Effector Patterns in Vocalization of the Vowels as Adapted from Judson and Weaver (16, pp. 119-121)

Vowel Series	Vowel	Key Words	Position of Tongue	Opening of Oral Orifice Between Lips
Front	[i]	beet	Greatest extent of forward and upward movement	Narrowest orifice in series
Center	[ʌ]	but	Central portion somewhat elevated but not as much as for [i] and [ʌ]	Orifice less narrow than for [i] and [u]
Back	[u]	boot	Back of tongue drawn backward and upward while front is depressed and retracted	Lips most protruded and rounded with narrowest orifice in series

Strong-Weak (SW) and Weak-Strong (WS) conditions one of the stimulus-response associations was stronger (weaker) than the other.

Conflict was aroused by simultaneous presentation of two lights, each of which had previously evoked only one of the responses. Thus, the stimulus antecedents fit the Type A paradigm.

Effects of conflict on latencies and durations of resultant responses were measured. First and second formants of the vowels under nonconflict and conflict conditions were also determined. Finally, Hovland and Sears' categories of responses to conflict (12) were employed.

Orienting Framework

None of the expressions for summation of strengths of competing responses permits exact quantitative specification of relationships between absolute and relative strengths of conflicting responses and degree of incompatibility on the one hand, and the particular response measures to be employed in this study. Bush and Whiting's formulation [3] is only applicable to probability measures obtained under somewhat different conditions. Hull's [1] and Schoeffler's [4] equations also deal only with response probability.

The algebraic summation hypothesis and Brown and Farber's conception are applicable to the response measures to be employed. Neither these nor any of the other equations, however, allow for the possible influence of type of vocal conflict and degree of incompatibility.

Restricting the relevant quantitative expressions to algebraic summation and the Brown and Farber equation [2], only the latter conception explicitly predicts that the degree of change under conflict conditions will increase with absolute strengths of the competing responses. In order to test this prediction, however, it is necessary to extend Brown and Farber's formulation to measures of duration of effector activity, of vacillation, and of compromise responses. Also, provision must be made for the influence of type of conflict and degree of incompatibility of the conflicting responses. Furthermore, the intervening variable F can be eliminated to reduce and simplify the necessary formulas. Equations 5a, 5b, 5c, and 5d are the results of these extensions of Brown and Farber's conception.

$$[5a] \qquad \underline{L} = \underline{a}\left[\left(\frac{E_W^{\underline{n}}}{E_S^{\underline{n-1}}}\right)\underline{I}\right]$$

$$[5b] \qquad \underline{D} = \underline{b}\left[\left(\frac{E_W^{\underline{n}}}{E_S^{\underline{n-1}}}\right)\underline{I}\right]$$

$$[5c] \qquad \underline{V} = \underline{c}\left[\left(\frac{E_W^{\underline{n}}}{E_S^{\underline{n-1}}}\right)\underline{I}\right]$$

$$[5d] \qquad \underline{C} = \underline{d}\left[\left(\frac{E_W^{\underline{n}}}{E_S^{\underline{n-1}}}\right)\underline{I}\right]$$

The symbols of these formulas are defined as follows:

$\underline{L}$ = length of the time interval between presentation of the stimuli and the beginning of overt effector activity.

$\underline{D}$ = duration of the entire sequence of overt effector activity.

$\underline{V}$ = the number of vacillations, once effector activity begins, either from overt activity to implicit responding or from one overt pattern to the other.

$\underline{C}$ = the number of within-field compromise responses (effector patterns made up of some components of the competing responses or having properties which fall between the values for the competing responses on one or more dimensions) and number of compromise responses made by "leaving the field" (giggling, etc.). Formant changes are a specific form of within-field compromise responses.

$\underline{a}, \underline{b}, \underline{c}, \underline{d}$ = empirical constants to allow for differences in units of measurement of the different response measures.

$\underline{E}_w^{\underline{n}}$ = the strength of the weaker S-R association.

$\underline{E}_s^{\underline{n-1}}$ = the strength of the stronger S-R association.

$\underline{n}$ = exponent of the excitatory tendencies >1.00.

$\underline{I}$ = degree of incompatibility of the responses which is assumed to hold up to some as yet indeterminate point for various effector activities where similarity can be said to increase.

Brown and Farber's graphic representation has been adapted in Fig. 2 to illustrate how, if equation [5a] holds, latency of response (L) could be expected to vary as a function of strength and incompatibility of conflicting responses. Excitatory tendency of the weaker response (E_W) is plotted on the abscissa with excitatory tendency of the stronger response (E_S) and degree of incompatibility (I) as parameters. In computing L, values of 1.00 and 2.00 were assumed for a and n, respectively. E_W and E_S were both scaled from 0 to 60 with parametric values for I of 0.50, 0.75, and 1.00 in order of increasing incompatibility. Plots for other response measures with equations [5b], [5c], and [5d] would be essentially similar.

Although empirically determined values are not presently available for substitution in any of the four equations, several properties of the relationships between strength and incompatibility of the conflicting responses and the various response measures can be noted. First, as the absolute levels of the two equal excitatory tendencies increase there is a linear increase in the response measures. A line connecting the terminii of the curves for the parametric values of E_S for I = 1.00 would illustrate this relationship. Also, for any absolute value of E_S, as E_W increases from 0 to equal strength the increase in the response measures will be positively accelerated. In addition, first and second partial derivatives of the response measures with respect to E_W indicate that the larger the values for the constants a, b, c, and d and the greater the degree of incompati-

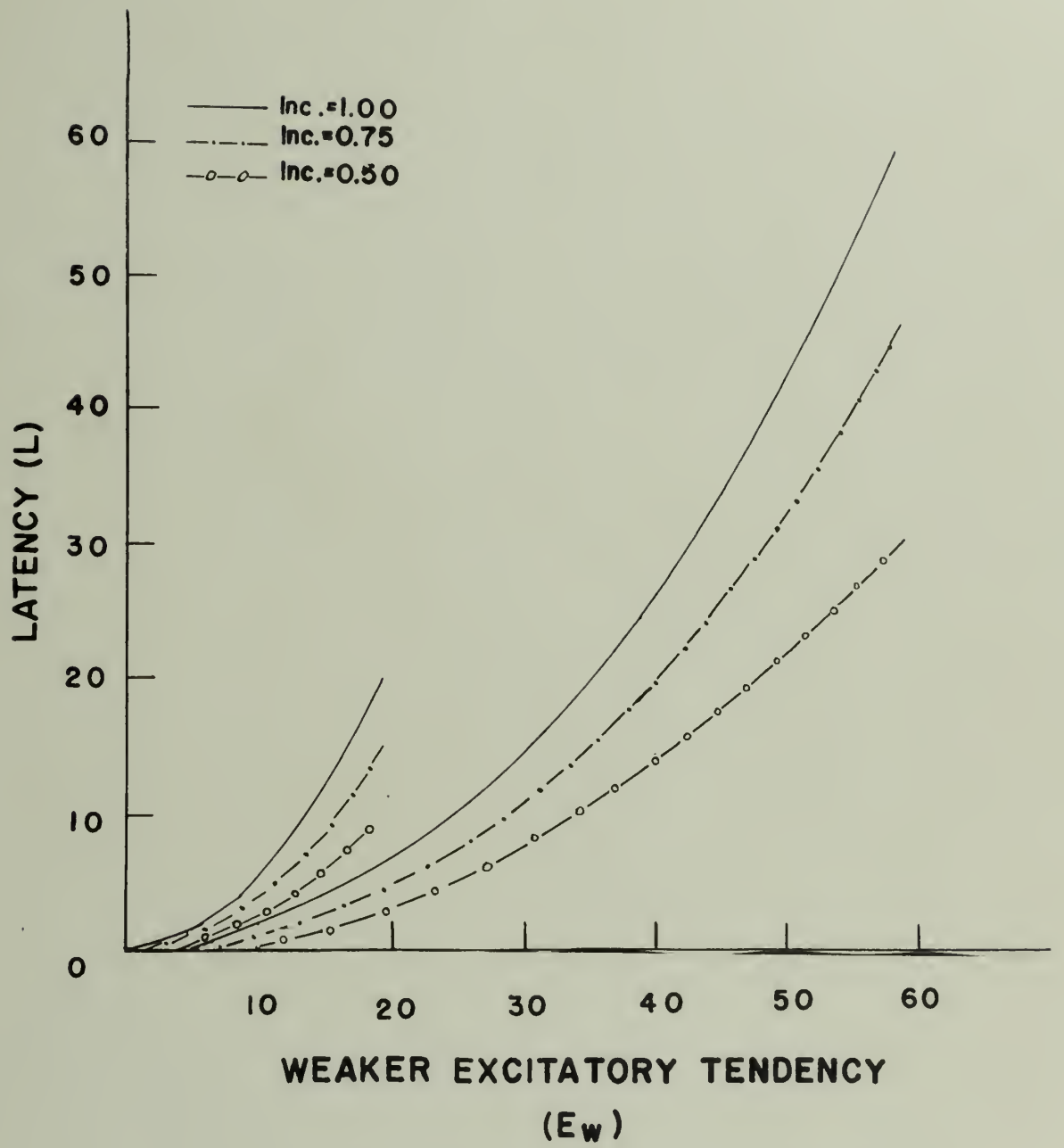


Fig. 2. Latency as a function of strength and incompatibility of conflicting responses. E_w is plotted on the abscissa with E_s and I as parameters.

bility, the steeper the slopes and the greater the positive acceleration of the curves respectively. Conversely, as $\underline{E}_s$ increases both slope and rate of change will decrease. Finally, the response measures themselves should be interrelated by positive, linear functions.

In order to apply these equations to the conditions of this study, type of conflict and subconditions within each type must be interpreted as representing different degrees of incompatibility. Thus, because of the greater dissimilarity in effector patterns it is probable that [i] and [u] are more incompatible than [i] and [ʌ] and [ʌ] and [u]. Also, a different and possibly greater degree of incompatibility for the vowel-vowel or vowel-kiss conflicts seems plausible.[2] When the values of 0.50, 0.75,

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2. Vocalization of [ʌ] involves an effector pattern most similar to the normal "resting" position of the tongue and of the mandibles with reference to the maxilla (16, pp. 118-119). Because of this advantage it was considered possible that vocalization of [ʌ] might have been less affected than vocalization of [i] and [u] for both types of conflict.

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and 1.00 are arbitrarily assigned to the [i]-[ʌ] and [ʌ]-[u] conflicts, the conflict between [i] and [u], and the three vowel-kiss conflicts, respectively, the formulas or Fig. 2 can be used to specify anticipated effects of both strength of conflicting responses and type of conflict. For example, if values of 20 and 60 are assigned to $\underline{E}_w$ and $\underline{E}_s$, the matrix of values for $\underline{L}$ summarized in Table 3 results. These latency values have been plotted in Fig. 3 with strength of conflict along the abscissa

Table 3

Summary of Laws and Predictions of L for

Arbitrary Values for Equation 5a*

Type and Subtype of Conflict	Strengths of Competing Responses					I
	SS	WW	WS	equals	SW	
[i-!] , [ʌ-!] , [u-!]	60	20	6.7	=	6.7	1.00
[i-u]	45	15	5.0	=	5.0	0.75
[i-ʌ] , [ʌ-u]	30	10	3.4	=	3.4	0.50

*a = 1.00, n = 2.00, E_S = 60, E_W = 20.

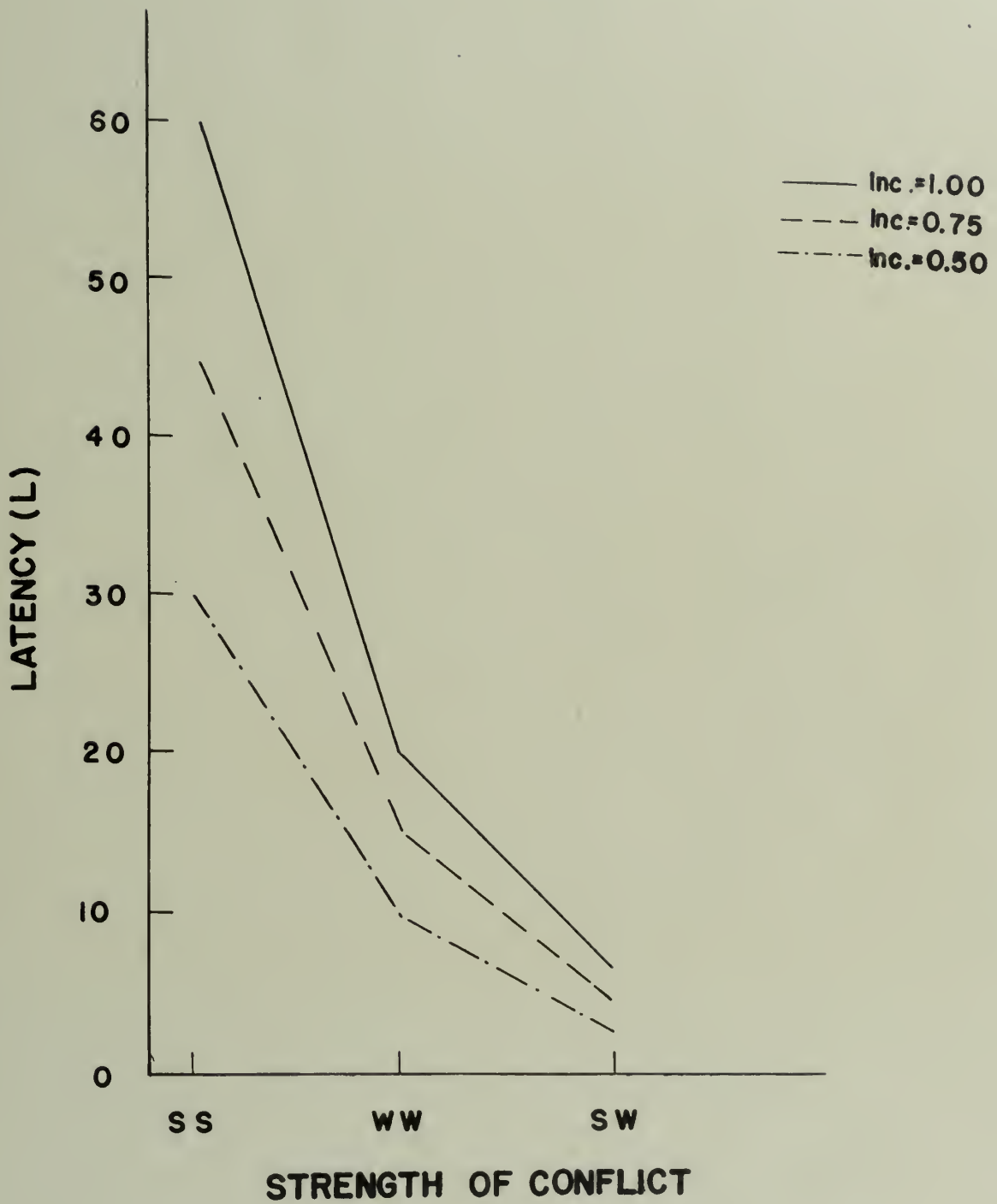

Fig. 3. Effects of strength of conflicting responses and type of conflict on $\underline{L}$ for $\underline{E}_w$ = 20 and $\underline{E}_s$ = 60, with $\underline{I}$ as the parameter.

and degree of incompatibility as the parameter. Although the decrements and degree of negative acceleration from SS to SW or WS would differ if the constants b, c and d $\neq$ 1.00, the same general pattern would be expected for the other response measures (D, V, C).

The purely orienting role of this family of hypothesized formulas both in general and as applied to the specific conditions of this study should again be noted. One reason for this restriction is that little is known of optimum procedures for obtaining requisite differences in absolute and relative excitatory or response strengths. Degree of incompatibility rests on anatomical-kinesiological assumptions which may not be valid and, at present, degree of such incompatibility can only be specified in ordinal rather than interval or ratio values. Furthermore, the summation or combinational formula of "best fit" has not yet been determined for other either similar or different stimulus-response events.

The present experiment then had the primarily empirical objective of ascertaining effects on vocal responses of types, subtypes, and strengths of conflict. There was the hope, however, that the data obtained would prove pertinent to preliminary evaluation of, and, subsequently, more precise study of one or more aspects of the modified Brown and Farber [5a, 5b, 5c, 5d] or other summation formulas.

Method

Subjects

The 192 Ss from classes in introductory psychology were randomly assigned to one of 24 strength-conflict combinations with eight Ss in each. Most were sophomores and all were naive with respect to the general purpose of the study and to specific procedural details.

Apparatus and Stimulus Materials

Apparatus for presentation of stimuli.--Light stimuli and stimuli for vocal responses were presented through the circular and rectangular apertures, respectively, of the stimulus panel of the apparatus pictured in Fig. 4. The circular aperture had a milk glass window and the rectangular a Plexiglas window. A vertical panel, behind and perpendicular to the plane of the stimulus panel, intersected the stimulus panel at the centers of the apertures to divide each into equal left and right halves. In addition, a horizontal panel intersected the stimulus panel between the two apertures to form four separate cells behind the stimulus panel.

Two wing-shields projected from the stimulus panel to the far edge of the base-plate. The microphone was placed in a claw-clamp attached to the base-plate at a position which assured adequate pick-up of Ss' responses. The entire apparatus was painted flat-black.

Each of the four cells behind the stimulus panel had a 60-

Fig. 4. S's view of apparatus.

watt light bulb. Lighting those either behind the left or right or both left and right halves of the circular aperture produced the light stimuli of nonconflict and conflict trials respectively. Cues for vocal responses were provided by lighting the bulb behind the right or left half of the rectangular aperture. The cues for the vocal responses were the words beet for [i], boot for [u], and but for [ʌ].

"Negatives" or stencils of these cues were made by applying black paint to strips of clear plastic except for the letters of the word. When the lights were turned on the words were formed by light coming through these stencils. The cue for the kiss response was a pin-hole of light shining through the center of a clear plastic strip which was otherwise painted black.

The particular vowel or kiss cue to be associated with the left or right light was presented in the left or right half of the rectangular aperture, respectively; that is, the cue was directly below the light stimulus.

The apparatus was placed on a small table in the approximate center of a room with Ss seated about 12 in. in front. There was one 100-watt overhead bulb.

Apparatus for recording and analyzing responses.--Responses were recorded by means of a Pentron tape-recorder (Model No. 9T-3C). They were then played through a Magnecord tape-recorder (Model No. PT6-AH) for reproduction on the tape of the Kay Electric Company Sona-Graph from which sound spectrograms were made.

The tape-recorder was set into action as the first pre-conflict stimulus was presented and stopped after the second post-conflict stimulus. Light stimulus onset was recorded on the tape by means of a 300 cps tone which was sounded simultaneously with occurrence of light stimuli.

Procedure

There were five stages in each S's experience: (a) paired-associate learning of different responses to the lights, (b) strengthening of these responses to each light separately, the last two trials of which have been designated (c) pre-conflict, (d) conflict: simultaneous presentation of both lights on two successive trials, and (e) post-conflict: one further presentation of each light alone.[3] Ss held their tongue, mandible, and

3. See Appendix for instructions for stages (a) and (b).

lips in a constant resting position before and between each trial. More specifically, they relaxed their lower jaw, let their tongue rest on the floor of the mouth with the tip against the lower teeth, and breathed through their mouth.

Verbal learning.--One half of the Ss of each of the 24 treatment combinations learned to make one of the vowel responses to one light and a different vowel or the kiss response to the other light by a paired-associate procedure. The criterion was four successive correct anticipations. Pairings of the responses to the lights were reversed for the other four Ss of each combination. As noted above the vowel responses were [i] as in beet,

[ʌ] as in but, and [u] as in boot. The kiss response involved pursing the lips tightly and inhaling very sharply.

Presentation of the two paired-associates was random with the left or right half of the circular aperture lighted for four sec., during the last two sec. of which the corresponding half of the rectangular aperture was also lighted to present the cues for vowel or kiss responses. With an intertrial or no-light-stimulus interval of four sec., the complete cycle from light on to light on again consumed eight sec.

After Ss had reached criterion, the cues for vowel or kiss responses were removed from the rectangular aperture and the lights behind this aperture were no longer used.

Strengthening of responses to stimuli separately.--After attainment of the verbal learning criterion, Ss were instructed to continue the different responses to the lights, making each as quickly as possible. Each of the conflicting responses of the WW condition was elicited four times in random order, subject to the restriction that one occur on the next-to-last trial and the other on the last trial.

There were twelve trials for each response in the SS condition. The 12-trial value was the number of experiences which preliminary experimentation had indicated would produce an "asymptote" of five successive trials with no apparent decrease in response latencies. The order of presentation was random within the restriction of a different vocal response on each of the last two trials.

In the SW or WS conditions the stimulus for one of the responses was presented 12 times and the stimulus for the other occurred four times. The random order of presentation was subject to the restriction that the stimulus for the weaker response occur on either the next-to-last or last trial.

Any S for whom an error was recorded during the last four trials in any of these conditions was eliminated.

Pre-conflict.--The last two strengthening trials were considered the pre-conflict baseline. Ss' vocalizations of each of the sounds, one on the next-to-last and the other on the last strengthening trial, were recorded.

Conflict.--Immediately following the last two strengthening trials (pre-conflict) and with no further instructions, the two halves were lighted simultaneously on two successive trials. The resultant stimulus was a complete circle with a slightly darker vertical center line caused by the vertical panel.

Post-conflict.--Ss' experiences were terminated with a further presentation of each stimulus alone. This provided a nonconflict baseline subsequent to conflict.

Results

Spectrogram records permitted measurements of latency (the time interval between presentation of the light stimulus and initiation of the vocal response) and duration of consequent vocal activity in hundredths of a sec. First and second frequency formant values were measured at the center of the resonance bars.[4] Due to distortions in spectrograms for which no compensatory allowances were possible, amplitude measures could not be used.

4. The latency, duration, and formant values for individual Ss are included in the Appendix.

Latency and duration values were available or could be estimated for all Ss. Also, all responses during conflict were classified as blocked or compromise. Because complete blocking responses and many compromise responses involving laughter, groaning, or complete sentences could not be analyzed into first and second formants, sound frequency values were determined for only the 127 Ss who responded on at least one of the conflict trials.

Latency.--Of the 174 failures to respond within four sec., 102 were in vowel-kiss and 72 in vowel-vowel conflicts. Within these types, failures occurred with approximately equal frequencies among combinations of strength and subtypes. The four sec. length of the response interval was assigned as the latency

score for all non-response trials. This value is equal to or less than the "true" latencies which might have been obtained had the response interval been longer.

Since it was not known which response of particular pairs would occur during conflict, latencies of the two responses during pre-conflict and of the two during post-conflict were averaged as were those for responses of the two conflict trials. Thus, the latency values of Table 4 are means and standard deviations of averages for the two pre-conflict, the two conflict, and the two post-conflict trials.

Differences among these means were analyzed in two steps. The first step was a mixed-type analysis of variance for main and interaction effects of: (a) type of conflict, (b) subtype of conflict, (c) strength of stimulus-response association, and (d) trials, which was the "within Ss" source (Table 5). Because the two types of conflict are not quite comparable, the second step was separate mixed-type analyses of each for (a) subtype of conflict, (b) strength, and (c) trials (Tables 6, 7).

Trials and type of conflict had effects significant at less than the .001 level (Table 5). The former was attributable to a three- to six-fold increase in latencies during conflict with respect to both pre-conflict and post-conflict values over-all and in all 24 treatment combinations. A *t* (20, p. 272) of 2.32 indicated that the pre- and post-conflict means over all 24 conditions differed. The significant effect of type of conflict reflected the longer latencies for both nonconflict and conflict

Table 4

Means and Standard Deviations of Latencies for Average Pre-conflict, Conflict, and Post-conflict Trials for each of the 24 Treatment Combinations

Type	Sub-type	Strength	Trials					
			Pre-conflict		Conflict		Post-conflict	
			Mean	SD	Mean	SD	Mean	SD
Vowel-Vowel	[i-u]	SS	.48	.49	2.09	2.63	.76	.77
		SW	.53	.56	2.38	2.98	.79	.63
		WS	.50	.56	2,54	3.15	.76	.76
		WW	.61	.69	2.10	2.54	.83	.84
	[u-ʌ]	SS	.58	.70	2.63	3.36	.86	.88
		SW	.56	.60	3.52	3.63	.88	.95
		WS	.46	.49	2.66	3.09	.84	.87
		WW	.59	.60	2.41	3.02	.90	.92
	[i-ʌ]	SS	.49	.53	2.44	3.12	.80	.82
		SW	.53	.55	2.38	2.80	.77	.81
		WS	.56	.56	2.65	3.13	.78	.85
		WW	.49	.51	2.18	2.91	.70	.74
Vowel-Kiss	[i-!]	SS	.51	.51	2.44	2.81	.89	.98
		SW	.51	.53	2.08	2.64	.89	.97
		WS	.58	.61	3.16	3.48	.87	.90
		WW	.74	.75	2.69	3.10	.95	1.00
	[u-!]	SS	.56	.58	2.42	3.01	1.03	1.22
		SW	.63	.63	3.36	3.64	.75	.80
		WS	.65	.72	2.41	3.05	.88	.93
		WW	.59	.62	2.63	3.28	.88	1.03
	[ʌ-!]	SS	.61	.41	3.30	3.57	.88	.93
		SW	.61	.69	3.54	3.68	.82	1.07
		WS	.67	.73	3.30	3.72	.84	.90
		WW	.68	.73	2.36	3.02	.92	.96

Table 5

Analysis of Variance of Latencies for Effects of Type, Subtype, Strength, and Trials

Source	df	SS	ms	F
Between Ss	191	4,623,022.64*		
(B) Type	1	148,481.77	148,481.77	62.71**
(C) Subtype	2	73,417.15	36,708.58	1.55
(D) Strength	3	62,810.01	20,936.67	-
B x C	2	110,298.05	55,149.02	2.32
B x D	3	4,280.52	1,426.84	-
C x D	6	185,512.27	30,918.71	1.30
B x C x D	6	60,761.78	10,126.96	-
error (b)	168	3,977,461.09	23,675.36	
Within Ss	384	27,496,132.00		
(A) Trials	2	19,562,492.34	9,781,246.17	332.31**
A x B	2	69,046.94	34,523.47	1.17
A x C	4	109,838.33	27,459.58	-
A x D	6	213,047.91	35,507.98	1.21
A x B x C	4	116,391.43	29,097.86	-
A x B x D	6	2,701.56	450.26	-
A x C x D	12	325,596.88	27,133.07	-
A x B x C x D	12	150,543.95	12,545.33	-
error (w)	236	6,946,472.66	29,434.21	
Total	575	32,119,154.66		

*These sums of squares and those of Tables 6, 7, 9, 10, and 11 are based on coded values which are equal to 200 x obtained latencies or durations.

**Significant at $<.001$ level.

Table 6

Analysis of Variance of Latencies for Effects of Subtype, Strength, and Trials for Vowel-Vowel Conflict

Source	df	SS	ms	F
Between Ss	95	2,237,013.21		
(C) Subtype	2	100,974.52	50,487.26	2.10
(D) Strength	3	44,386.18	14,795.39	-
C x D	6	67,533.34	11,255.56	-
error (b)	84	2,024,119.17	24,096.66	-
Within Ss	192	12,535,852.08		
(A) Trials	2	8,658,388.03	4,329,194.02	204.17*
A x C	4	104,634.67	26,158.67	1.23
A x D	6	106,213.50	17,202.25	-
A x C x D	12	104,335.39	8,694.62	-
error (w)	168	3,562,280.49	21,204.05	-
Total	287	14,832,117.88		

*Significant at <.001 level.

Table 7

Analysis of Variance of Latencies for Effects of Subtype, Strength, and Trials for Vowel-Kiss Conflict

Source	df	SS	ms	F
Between Ss	95	2,237,527.65		
(C) Subtype	2	82,740.67	41,370.34	1.78
(D) Strength	3	22,704.35	7,568.12	-
C x D	6	178,740.72	29,790.12	1.28
error (b)	84	1,953,341.91	23,254.07	
Within Ss	192	14,901,027.34		
(A) Trials	2	10,973,151.19	5,486,575.60	277.22*
A x C	4	122,649.56	30,662.39	1.55
A x D	6	109,536.03	18,256.01	-
A x C x D	12	370,750.97	30,895.91	1.56
error (w)	168	3,324,939.59	19,791.31	
Total	287	17,138,554.99		

*Significant at <.001 level.

trials under vowel-kiss conflict than vowel-vowel. Since none of the interactions was significant, it was concluded that the simple effects of subtype and strength of conflict for different levels of each other or for pre-conflict, conflict, and post-conflict trials were not significant.

Since only trials produced significant F's, the analyses of each type separately were consistent with findings of the four-dimensional analysis.

Relative or percentage increases in latencies from nonconflict to conflict trials were computed by the formula $\frac{C-NC}{NC}(100)$, where NC equals the averaged latencies for the four non-conflict trials and C is the average for the two conflict trials. As shown in Table 8 type, subtype, and strength had no significant main or interaction effects on relative increases from either pre-conflict or post-conflict levels.

Duration.--Estimated durations of responses of Ss for trials when no response occurred were the averages of their two largest nonconflict trial durations. Means and standard deviations summarized in Table 9 are for averages of the two pre-conflict, the two conflict, and the two post-conflict trials.

Differences among duration means were analyzed for both types together and also separately. Response durations during conflict were from twice to nearly five times as large as those for nonconflict trials. The F of 108.03 for this variable overall 24 conditions was significant at less than the .001 level

Table 8

Analysis of Variance of Relative Increases in Latency from Nonconflict to Conflict Trials

Source	df	SS	ms	F
(B) Type	1	1.60	1.60	-
(C) Subtype	2	9.65	4.82	-
(D) Strength	3	23.94	7.98	-
B x C	2	6.29	3.14	-
B x D	3	0.62	0.21	-
C x D	6	26.73	4.46	-
B x C x D	6	16.58	2.76	-
error (w)	168	2,230.68	13.28	
Total	191	2,316.09		

Table 9

Means and Standard Deviations of Durations for Average Pre-conflict, Conflict, and Post-conflict Trials for each of the 24 Treatment Combinations

Type	Sub-type	Strength	Trials					
			Pre-conflict		Conflict		Post-conflict	
			Mean	SD	Mean	SD	Mean	SD
Vowel-Vowel	[i-u]	SS	.36	.29	.73	.80	.42	.44
		SW	.30	.32	.78	1.05	.33	.35
		WS	.28	.29	.69	.72	.31	.32
		WW	.34	.39	.91	1.11	.33	.38
	[u-ʌ]	SS	.30	.32	1.90	1.04	.34	.44
		SW	.22	.24	.72	.77	.48	.93
		WS	.21	.22	.56	.70	.25	.26
		WW	.33	.37	1.03	1.57	.36	.37
	[i-ʌ]	SS	.36	.37	.76	.84	.40	.45
		SW	.23	.25	.75	1.03	.26	.28
		WS	.25	.26	.74	.94	.26	.27
		WW	.25	.26	.83	1.29	.41	.56
Vowel-Kiss	[i-!]	SS	.21	.22	.62	.71	.30	.26
		SW	.17	.20	.77	1.04	.18	.19
		WS	.19	.20	.68	.98	.20	.22
		WW	.22	.24	.67	.91	.23	.26
	[u-!]	SS	.22	.25	.63	.71	.26	.31
		SW	.19	.20	.97	1.86	.24	.29
		WS	.20	.24	.58	.65	.20	.22
		WW	.20	.21	.58	.63	.40	.77
	[ʌ-!]	SS	.22	.24	.52	.56	.21	.22
		SW	.14	.14	.45	.54	.15	.15
		WS	.13	.14	.64	.94	.18	.23
		WW	.27	.30	.66	.71	.32	.44

(Table 10). A *t* of 1.02 indicated that over-all means of pre- and post-conflict trials did not differ. The significant effect of type of conflict was due to longer durations of effector activity for vowel-vowel than vowel-kiss conflict for nonconflict and conflict trials.

The nonsignificant interactions indicated nonsignificant simple effects of subtype and strengths with respect to each other and for pre-conflict, conflict, and post-conflict trials. These findings were supported by the outcomes of the separate analyses of vowel-vowel and vowel-kiss conflicts within which only trials had significant effects (Tables 11, 12).

Relative increases in durations from the averages of the four nonconflict trials (NC) to conflict trial averages (C) were computed by the formula, $\frac{C-NC}{NC}(100)$. None of the *F*'s of the analysis of variance of these relative increases (Table 13) was significant.

Formants.--Only 155 responses during conflict were of a form satisfactory for determination of first and second formant values. When two analyzable sounds for conflict trials were available for a given *S*, the two first formants and the two second formants were averaged. The remainder were those for *S*s' responses on only one conflict trial. In all, 120 formant pairs or points were obtained. First and second formants for nonconflict trials were determined only for *S*s for whom conflict formants were available. For greater reliability first formants

Table 10

Analysis of Variance of Durations for Effects of Type, Subtype, Strength, and Trials

Source	df	SS	ms	F
Between Ss	191	902,105.00		
(B) Type	1	71,044.46	71,044.46	15.77*
(C) Subtype	2	7,867.21	3,933.61	-
(D) Strength	3	29,404.60	9,801.53	2.18
B x C	2	2,185.47	1,092.74	-
B x D	3	8,493.48	2,831.16	-
C x D	6	17,114.46	2,852.41	-
B x C x D	6	9,206.53	1,534.42	-
error (b)	168	756,788.79	4,504.70	
Within Ss	384	2,266,672.00		
(A) Trials	2	1,041,097.78	520,548.89	108.03*
A x B	2	2,118.97	1,059.48	-
A x C	4	5,152.96	1,288.24	-
A x D	6	9,270.35	1,545.06	-
A x B x C	4	4,175.99	1,043.99	-
A x B x D	6	22,860.82	3,810.14	-
A x C x D	12	17,317.08	1,443.09	-
A x B x C x D	12	27,481.72	2,290.14	-
error (w)	236	1,137,196.33	4,818.63	
Total	575	3,168,777.00		

*Significant at <.001 level.

Table 11

Analysis of Variance of Durations for Effects of Subtype, Strength, and Trials for Vowel-Vowel Conflict

Source	df	SS	ms	F
Between Ss	95	420,233.32		
(C) Subtype	2	1,301.67	650.84	-
(D) Strength	3	32,387.04	10,795.68	2.40
C x D	6	8,070.44	1,345.07	-
error (b)	84	378,474.17	4,505.64	
Within Ss	192	1,214,172.00		
(A) Trials	2	568,563.17	282,281.58	77.42*
A x C	4	2,177.23	544.31	-
A x D	6	14,690.03	2,448.34	-
A x C x D	12	20,161.24	1,680.10	-
error (w)	168	612,580.33	3,646.31	
Total	287	1,634,405.32		

*Significant at <.001 level.

Table 12

Analysis of Variance of Durations for Effects of Subtype, Strength, and Trials for Vowel-Kiss Conflict

Source	df	SS	ms	F
Between Ss	95	410,827.19		
(C) Subtype	2	8,750.97	4,375.48	-
(D) Strength	3	5,511.00	1,837.00	-
C x D	6	18,250.60	3,041.77	-
error (b)	84	378,314.62	4,503.74	
Within Ss	192	1,052,500.00		
(A) Trials	2	478,653.55	239,326.76	76.64*
A x C	4	7,151.76	1,787.94	-
A x D	6	17,441.18	2,906.86	-
A x C x D	12	24,637.51	2,053.12	-
error (w)	168	524,616.00	3,122.71	
Total	287	1,463,327.19		

*Significant at <.001 level.

Table 13

Analysis of Variance of Relative Increases in Duration from Nonconflict to Conflict Trials

Source	df	SS	ms	F
(B) Type	1	11.83	11.83	3.32
(C) Subtype	2	0.59	0.295	-
(D) Strength	3	15.09	5.03	1.41
B x C	2	1.49	0.74	-
B x D	3	14.70	4.90	1.38
C x D	6	17.36	2.89	-
B x C x D	6	5.98	0.997	-
error (w)	168	597.49	3.56	
Total	191	664.53		

for pre- and post-conflict vocalizations of each vowel were averaged as were second formants of those vowels.

First and second formants are conventionally plotted along the abscissa and ordinate, respectively, of rectangular coordinates (5). This has been done for illustrative purposes for selected formants of nonconflict (solid circles) and conflict (open circles) trials for each of the vowels of vowel-vowel (Fig. 5) and vowel-kiss (Fig. 6) conflicts. In order to indicate ranges or areas for nonconflict formants of each vowel, the solid circles have been connected to form polygons which include all nonconflict formants for each vowel. Loci and areas of these polygons for each vowel are consistent with "normal" or nonconflict values obtained previously (36).

Due to the small number of formant pairs for conflict trials there were only two or three first and second formant points for some of the 24 treatment combinations. Because of these small cell frequencies and the resultant disproportionality of frequencies among the 24 combinations, n-dimensional analyses of variance were not feasible. Therefore, instead of comparisons of means of differences between nonconflict and conflict first and second formants separately and combined, proportions or frequencies of conflict points lying outside the boundaries of and within polygons for nonconflict formant points were the statistics analyzed.[5] If conflict had no effect on formants, only

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5. This procedure involves distances between points X_1Y_1 and X_2Y_2 in two-dimensional space. It should be relatively insensitive to any correlation between absolute values of formants and degree of change.

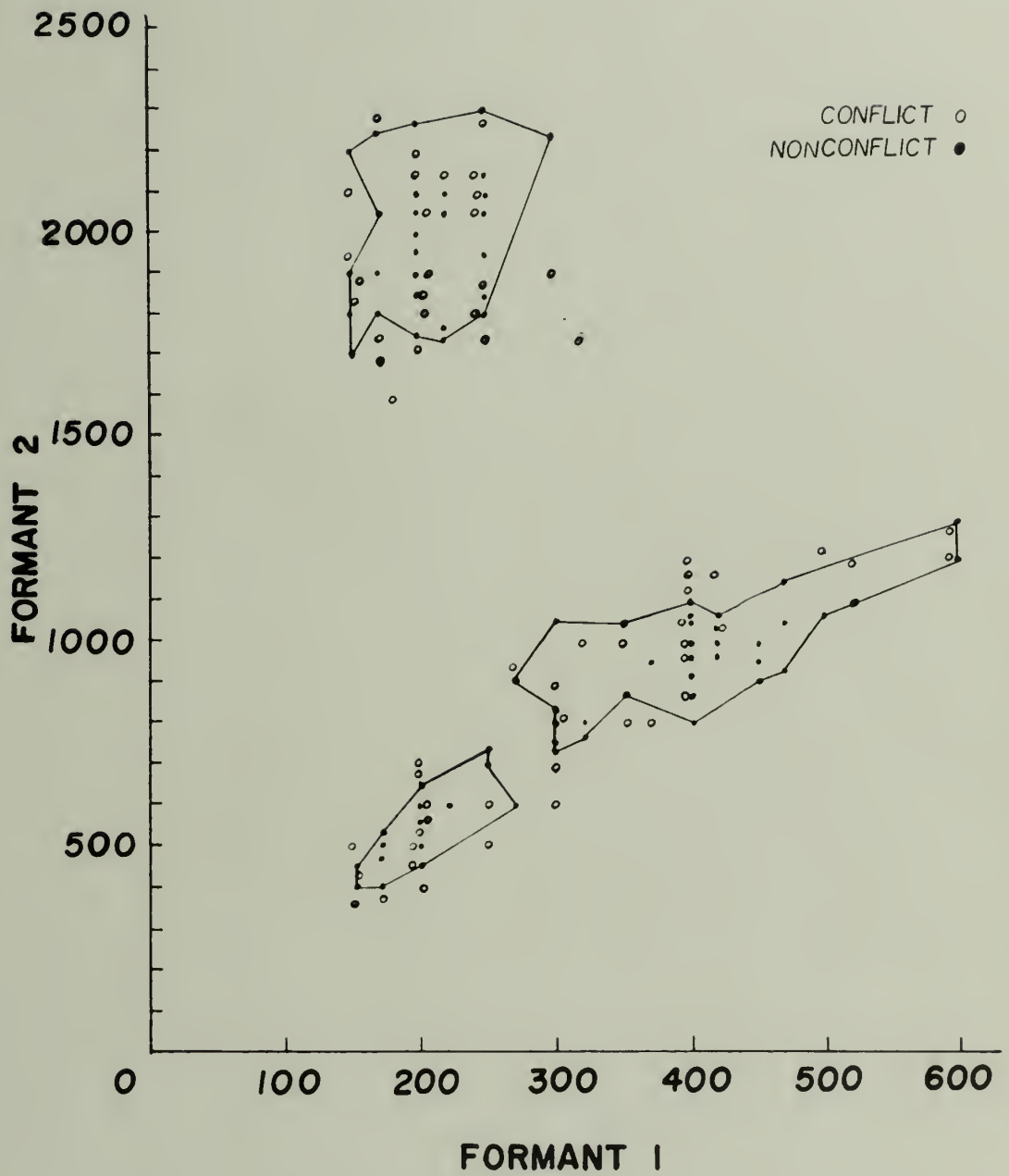

Fig. 5. Representative formant points inside and outside nonconflict polygons for Vowel-Vowel conflict.

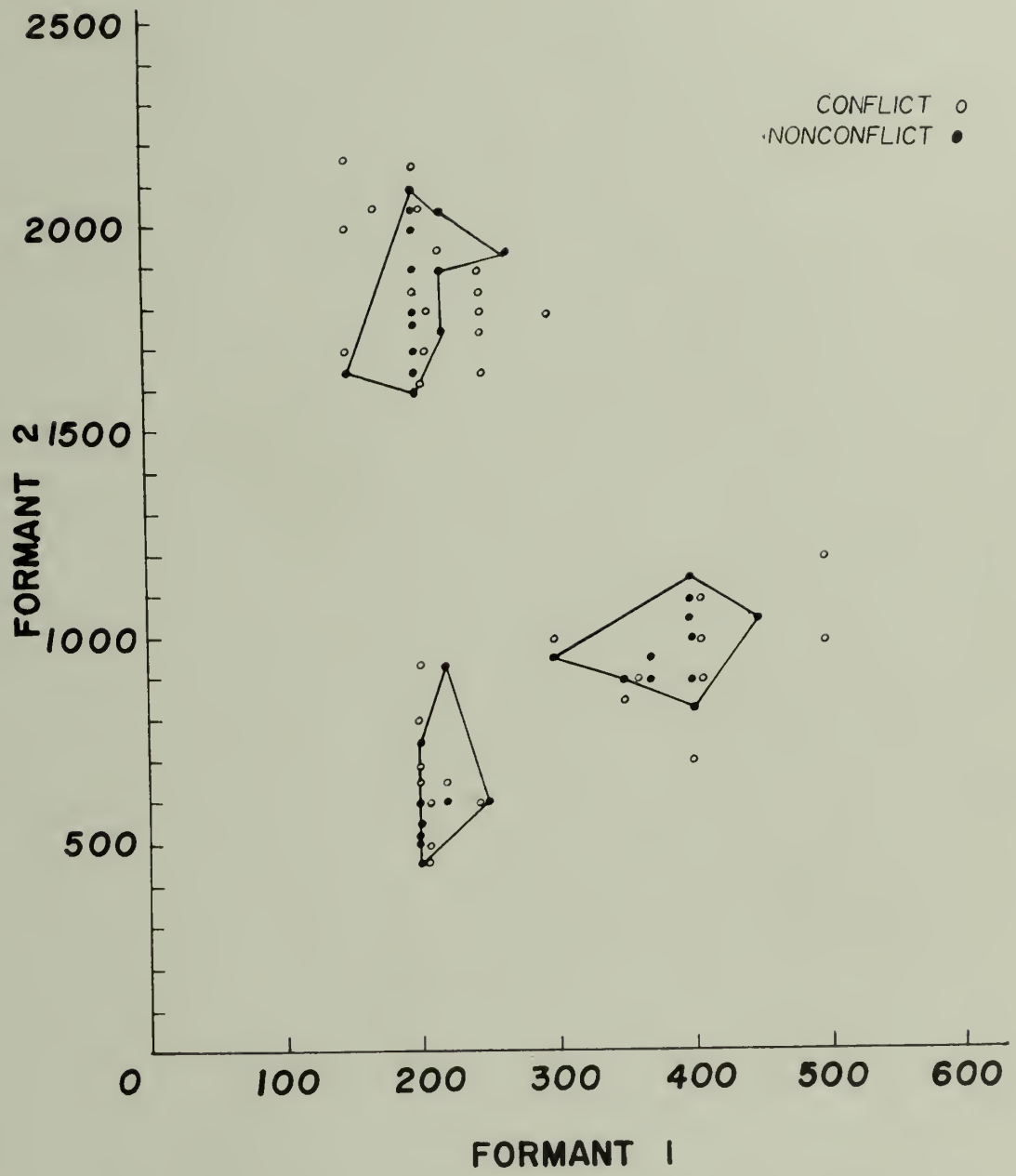

Fig. 6. Representative formant points inside and outside nonconflict polygons for Vowel-Kiss conflict.

chance frequencies or proportions of values outside of the polygons should have been obtained. Moreover, if treatment conditions had no effects, differences among frequencies or proportions of such outside points for the various conditions should be due to random fluctuations.

Frequencies and derivative proportions of conflict points for each vowel which lie inside and outside nonconflict polygons are given in Table 14 for both vowel-vowel and vowel-kiss conflicts. The hypothesis tested was that the proportions of outside points did not differ significantly from zero. Since five of six *t*'s significant at the .05 level would occur only less than once in 10,000 (36) by chance it was concluded that conflict altered all vowel formants. These shifts were in no particular direction suggesting that conflict acts primarily to increase spread or scatter.

Comparison of proportions (frequencies) of conflict points outside polygons for vowels in vowel-vowel conflict combined with those for over-all strength and subtype condition of vowel-kiss conflict yielded a $\underline{X}^2$ of 0.71 (Table 15). Therefore, type of conflict had no differential effect.

The $\underline{X}^2$ of 0.68 for vowels of vowel-vowel conflict was not significant (Table 16). Due primarily to the high proportion of points inside the polygon, the comparable $\underline{X}^2$ for vowel-kiss conflict was significant at the .001 level (Table 16).

When frequencies of outside and inside values for each strength condition over-all types and subtypes of conflict were

Table 14

Frequencies and Derivative Proportions of Formant Points for Conflict Inside and Outside of Nonconflict Polygons for Subtypes of Vowel-Vowel and Vowel-Kiss Conflicts

Type	Vowel	Inside		Outside		df	t
		Freq.	Prop.	Freq.	Prop.		
Vowel-Vowel	beet	31	.79	8	.21	38	3.23**
	boot	16	.57	12	.43	27	4.57**
	but	28	.68	13	.32	40	4.36**
Vowel-Kiss	beet	7	.37	12	.63	18	5.73**
	boot	17	.94	1	.06	17	1.05
	but	5	.50	5	.50	9	2.99*

*Significant at .05 level.

**Significant at ≤.01 level.

Table 15

Frequencies of Formant Points for Conflict Inside and Outside of Nonconflict Polygons for Vowel-Vowel and Vowel-Kiss Conflicts

Type of Conflict	Conflict Responses		$\underline{x}^2$	$\underline{p}$
	In	Out		
Vowel-Vowel	57	51		
Vowel-Kiss	29	18	.71	ns

Table 16

Frequencies of Formant Points for Conflict Inside and Outside of Nonconflict Polygons for Subtypes of Vowel-Vowel and Vowel-Kiss Conflicts Separately and Combined

Vowel	Type					
	Vowel-Vowel		Vowel-Kiss		Combined	
	In	Out	In	Out	In	Out
beet	18	20	7	12	32	25
boot	20	16	17	1	36	19
but	19	15	5	5	29	14
	$\underline{X}^2 = .68$		$\underline{X}^2 = 15.67$*		$\underline{X}^2 = 1.69$	

*Significant at <.001 level.

compared. the $\underline{X}^2$ was not significant (Table 17). Nor did the $\underline{X}^2$ for strength of vowel-vowel conflict reach the .05 level (Table 17). The small theoretical frequencies for strengths of vowel-kiss conflict precluded a $\underline{X}^2$ computation. However, in view of the nonsignificant values for both types combined and for vowel-vowel conflict alone any association of strength and formant changes for vowel-kiss conflict is improbable.

Mode of resolution.--Responses in conflict were first classified in terms of Hovland and Sears' (12) four categories (Table 18):

(a) Single responses only: vocalizing one or the other competing response.

(b) Double reactions: responding successively with each of the competing responses.

(c) Compromise reactions: effector patterns made up of some components of the competing responses or having properties which fall between the values for the competing responses, or giggling, groaning, and/or speaking.

(d) Blocking: no response.

Because of the very small number (11) of single responses and the relatively small number (56) of compromise reactions these were combined with double reactions to form a more inclusive compromise category.

Frequencies of the more inclusive compromise responses and of blocked responses for first and second trials of vowel-vowel conflict and of vowel-kiss conflict are given in Table 19. A

Table 17

Frequencies of Formant Points for Conflict Inside and Outside of Nonconflict Polygons for Strengths of Vowel-Vowel and Vowel-Kiss Conflicts Separately and Combined

Strength	Type					
	Vowel-Vowel		Vowel-Kiss		Combined	
	In	Out	In	Out	In	Out
SS	15	12	-	-	27	13
SW	14	12	-	-	20	17
WS	13	14	-	-	24	13
WW	15	13	-	-	26	15
	$\underline{X}^2 = .33$				$\underline{X}^2 = 1.76$	

Table 18

Mode of Resolution of Conflict Responses on the First and Second Conflict Trials for each of the 24 Treatment Combinations

Type	Subtype	Strength	Conflict Trials: First				Conflict Trials: Second			
			Single	Double	Compro-mise	Blocked	Single	Double	Compro-mise	Blocked
Vowel-Vowel	[i-u]	SS		5	1	2		5	1	2
		SW		4	1	3		3	2	3
		WS		1	3	4		3	2	3
		WW		3	3	2		4	3	1
	[u-ʌ]	SS		2	2	4		5	1	2
		SW			2	6		2	1	5
		WS		2	4	2		2	2	4
		WW	1	3	1	3	1	3	1	3
	[i-ʌ]	SS		3	2	3		4	1	3
		SW		3	1	4	1	4	1	2
		WS		3	2	3		5		3
		WW		4	1	3		5	1	2
Vowel-Kiss	[i-!]	SS	1	2	1	4	1	3	2	2
		SW	1	2	1	4	1	5	1	1
		WS		1		7		3	2	3
		WW		3	1	4	1	4		3
	[u-!]	SS		5		3		5		3
		SW		2		6		2	1	5
		WS		4		4		5		3
		WW	2	2		4	1	2	1	4
	[ʌ-!]	SS		2		6		3		5
		SW		0	1	7		2		6
		WS		1	1	6		1	1	6
		WW		3	2	3		3	2	3

Table 19

Number of Compromise and Blocked Responses on the First and Second Conflict Trials for Vowel-Vowel and Vowel-Kiss Conflicts

Conflict Trials	Type	Number of Responses		$\underline{X}^2$
		Compromise	Blocked	
First	Vowel-Vowel	57	39	
	Vowel-Kiss	38	58	6.75*
Second	Vowel-Vowel	63	33	
	Vowel-Kiss	52	34	2.17

*Significant at <.01 level.

significant $\underline{X}^2$ of 6.75 ($p \leq .01$ was obtained for the first conflict trial, but the $\underline{X}^2$ value of the relationship between vowel-vowel and vowel-kiss conflict on the second trial fell short of the .05 level. The latter result may be attributed to a decrease in number of blocked responses on the second trial of vowel-kiss conflict. Whereas 60.4 per cent of first trial responses were blocked, only 45.8 per cent blocked responses were recorded on the second conflict trial.

The significant $\underline{X}^2$ on the second trial for subtypes of vowel-kiss conflict with strength disregarded is due largely to the increase in number of compromise responses for the [i-!] subtype (Table 20). The $\underline{X}^2$'s for the first trial of vowel-kiss conflict and also for subtypes of vowel-vowel conflict were not significant. Similarly, non-significant $\underline{X}^2$'s were obtained in the test of the hypothesis that blocked responses would increase as response strengths approached equality and would vary directly with absolute strengths (Table 21).

Table 20

Number of Compromise and Blocked Responses on the First and Second Conflict Trials for Subtypes of Vowel-Vowel and Vowel-Kiss Conflicts

Type	Subtype	Conflict Trials			
		First		Second	
		Compromise	Blocked	Compromise	Blocked
Vowel-Vowel	[i-u]	21	11	23	9
	[u-ʌ]	18	14	22	10
	[i-ʌ]	16	16	18	14
		$\underline{X}^2 = 1.74$		$\underline{X}^2 = 1.94$	
Vowel-Kiss	[i-!]	14	18	23	9
	[u-!]	16	16	16	16
	[ʌ-!]	10	22	12	20
		$\underline{X}^2 = 2.40$		$\underline{X}^2 = 7.68^*$	

*Significant at .05 level.

Table 21

Number of Compromise and Blocked Responses on the First and Second Conflict Trials for Strengths of Vowel-Vowel and Vowel-Kiss Conflicts

Type	Strength	Conflict Trials			
		First		Second	
		Compromise	Blocked	Compromise	Blocked
Vowel-Vowel	SS	14	10	17	7
	SW	11	13	14	10
	WS	14	10	14	10
	WW	16	8	18	6
		$\underline{X}^2 = 2.17$		$\underline{X}^2 = 2.35$	
Vowel-Kiss	SS	11	13	14	10
	SW	8	16	11	13
	WS	8	16	12	12
	WW	13	11	14	10
		$\underline{X}^2 = 3.08$		$\underline{X}^2 = 1.13$	

Discussion

Demonstration of Conflict

Simultaneous arousal of vowel-vowel and vowel-kiss responses produced marked increases in response latency and duration with respect to both pre-conflict and post-conflict baselines. Furthermore, conflict scattered formant points for each of the three vowels outside of nonconflict polygons. All of these changes were statistically significant. Thus, simultaneous presentation of stimuli for two different vocal responses had effects comparable to such evocation of dissimilar spatial-manipulative responses.

Post-conflict latencies and durations tended to be larger than pre-conflict values of those response measures. However, only the latency difference was significant.

Hovland and Sears (12) classified spatial-manipulative responses in their conflict situation as single responses only, double reactions, compromise, or blocked. They obtained 57.5 per cent single responses only for approach-approach conflict and percentages ranging from 8.8 to 21.2 in the remaining three categories. Double reactions occurred 46.9 per cent of the time for approach-avoidance conflict with none of the other categories above 28.1 per cent. Avoidance-avoidance and double approach-avoidance conflict resulted in 46.2 and 72.5 per cent blocked responses, respectively. The highest percentage for the remaining categories was 28.8 per cent for compromise responses to

avoidance-avoidance conflict.

Vocal response resultants of conflict could be placed within these same categories. Double and blocked responses occurred most frequently in both vowel-vowel and vowel-kiss conflicts. On the first trial of vowel-vowel conflict blocked responses were slightly more frequent than double reactions while the converse occurred on the second trial. Blocked reactions were more frequent than double reactions on both trials of vowel-kiss conflict. Thus, the profiles of proportions of reactions for both vowel-vowel and vowel-kiss conflict were perhaps more similar to Hovland and Sears' three types which consisted of one or two avoidance responses than to their approach-approach type. However, blocked vocal responses occurred in higher proportions than was the case for approach-avoidance conflict. On the other hand, the proportion of compromise vocal reactions was higher than the proportion of such reactions for spatial-manipulative responses under avoidance-avoidance and double approach-avoidance types of conflict.

Several factors may account for this lack of a close parallel between category proportions for vocal conflict and such proportions for any one of Hovland and Sears' four types of conflict situation. One reason may be their use of spatially separate light stimuli in contrast to the contiguous semi-circles of this study. Differences in antecedent strengthening procedures may be a second factor. Also, Hovland and Sears' spatial-manipulative responses involved a somewhat different arrangement of

antagonistic muscle groups than was the case for either vowel-vowel or vowel-kiss conflict. Finally, although an attempt was made to keep defining characteristics as similar as possible, these differences in effectors may have precluded exactly congruent categories, particularly for compromise responses. Present data and knowledge, however, preclude a decision regarding which one or combination of these four reasons is responsible for discrepancies between category profiles for various types of human spatial-manipulative conflict and the two types of vocal response conflict.

Effects of Type, Subtype, and Strength of Conflict

Demonstration of conflict is preliminary to assessment of the effects of type, subtype, and strength of conflicting responses. Only type had significant main effects which took the form of longer latencies, shorter durations and relatively more blocked responses for vowel-kiss than vowel-vowel conflict during both nonconflict and conflict trials. Since the relative increases from nonconflict to conflict for these two types did not differ, the main effect of types cannot be interpreted as indicating that this condition had differential effects on latency and duration increases under conflict. Proportions of formant points outside of nonconflict polygons for the two types did not differ significantly.

On the first conflict trial vowel-kiss conflict resulted in proportionately more blocked and fewer compromise responses than vowel-vowel conflict. But the difference was no longer evident

on the second trial. Thus the results indicate type, subtype, and strength had no main or interaction effects on latency, duration, and formant changes. Because the effect of type on response categories failed to recur on the second trial it is doubtful that great weight can be given to this outcome.

Three interpretations of these differences can be advanced. One is that they reflect the presumed greater incompatibility between kiss effector patterns than among vowel effector patterns. The second is that the simultaneous and sequential tongue- and lip-placement movements of vowel vocalization have been practiced more frequently than component movements of the kiss response. If so, the former responses might be better integrated or chained than the latter. Finally, vocal vocalization and the kiss response could have different latencies and/or durations over and above any consequences of differential amounts of prior practice. This might be due to differences in somatic musculature of underlying neural processes between vocalizing vowels and making the kiss reaction.

Two interpretative conclusions can be drawn from the findings of a lack of influence on response measures of type and subtype of conflict. One is to accept the findings and, thus, to conclude that motor phonetic differences among the three vowels and the kiss sounds have no influence on degree of response change under conflict. Since the three vowels were selected to provide maximum motor phonetic differences, it seems doubtful that conflict reactions would be influenced by any other combi-

nations of vowels. The apparent difference between the motor phonetic aspects of vowel vocalization and the kiss response was probably greater than differences between saying vowels and consonants. Therefore, the more general conclusion is suggested that degree of vocal conflict between two more or less unitary sounds is independent of the anatomical-kinesiological characteristics of responses which produce those sounds.

Apparent degree of difference in motor phonetic patterns for the vowels and the kiss response was equated with extent of response incompatibility. Therefore, either incompatibility was not a factor, or it must be specified by criteria other than tongue-lip placements and movements. Since, as noted above, other vowels and consonants could be expected to yield similar results, introduction of an incompatibility factor in "equations" for conflict of unitary vocal responses may not be required. However, this factor might be necessary when more than two incompatible responses are evoked simultaneously. Or, specification of incompatibility by other criteria could prove more fruitful.

The second interpretation rests on two assumptions. One assumption - which will be elaborated below - is that strengths of responses among and within the four strength conditions were all close to asymptotic levels. If so, there is the further possibility that anatomical-kinesiological differences or incompatibility and associative strength interact in such a fashion that incompatibility has differential effects on only responses

of sub-asymptotic levels of strength. However, there is no evidence that such interaction occurs either with competing vocal responses or with antagonistic spatial-manipulative responses.

An alternative to this incompatibility-strength assumption is that incompatibility influences vocal conflict reactions only when the "chaining" of simultaneous and sequential muscle movements of sound-producing responses is at sub-asymptotic levels of strength; that is, when the responses have not yet become more or less "unitary." Asymptotic durations and minimum trial-to-trial variability in formant values are among the possible criteria for the "unitary" status of a response. Such data, however, have not been reported.

Both vowel and the kiss responses were probably at asymptotic levels with respect to chaining or integration of movement components. If so, granting the validity of the hypothesis of interaction of integration and incompatibility, no effect of type or subtype should have occurred. Again, however, lack of pertinent data makes this suggestion highly speculative.

Absolute and relative levels of strengths did not produce any differences in conflict reactions. Accordingly, no decision between sets of formulas which allow for both kinds of strength variation and sets which consider only relative levels was possible.

Neither absolute nor relative levels may effect the measures of vocal conflict employed. However, diverse sources of data (24,31) suggest that at least relative level does influence

resultant reactions to conflict. Therefore, a more tenable interpretation of the present findings may be that the learning-strengthening procedures used did not produce sufficient differences in absolute or relative strengths of the competing vocal responses for this condition to have measurable effects. More specifically, the paired-associate learning might have brought light-vowel or light-kiss associations to such high levels of strength that the additional four or 12 strengthening trials were simply not enough to produce stable and effective differences on relative and absolute levels of associative strengths. Little is known about paired-associate learning involving only two pairs and, also, with single well-integrated vocalization-responses rather than vocalizing syllables or spelling out three letters. However, given only two-pairs with dissimilar stimuli and unitary responses, it seems tenable that only a few trials may produce marked increase of strength. For this reason, further experimentation involving greater differences in associative strengths is desirable.

Summary

Conflict is a basic principle in explanations of various verbal learning phenomena (e.g., negative transfer, forgetting), psychoanalytic mechanisms (e.g., repression, suppression), and stuttering. However, most investigations of these phenomena have failed to meet one or more of three criteria: (a) identification of both conflicting responses with estimates of the extent of their incompatibility, (b) relatively precise denotation of critical stimulus antecedents of the conflicting responses, and (c) independent determination of the strength of association between stimulus antecedents and each of the conflicting responses.

This experiment was an attempt to approximate these criteria. Specifically, various measures of vocal conflict were investigated as functions of absolute and relative strengths of competing stimulus-response relationships, and of type and subtype of conflict.

Light stimuli elicited the conflicting effector patterns involved in vocalization of the vowels [i] as in b<u>ee</u>t, [u] as in b<u>oo</u>t, and [ʌ] as in b<u>u</u>t, and a "kiss" response. Vocalizing one vowel in opposition to saying a second vowel, vowel-vowel conflict, was one type. In the second type, saying each vowel was opposed by the kiss response.

Strengths of associations of stimuli and the competing responses were equal and weak, equal and strong, and one stronger

(weaker) than the other. In all, there were 24 combinations of type, subtype, and strength of conflict, to each of which eight Ss, a total of 192, were assigned.

Each S experienced the following sequence: (a) paired-associate learning of one vowel response to a semi-circle of light and of another vowel or of the "kiss" response to a second semi-circle of light, the mirror image of the first; (b) practice in responding to each semi-circle separately as rapidly as possible; (c) two pre-conflict baseline trials, one with each response; (d) presentation of a circle formed by the simultaneous lighting of the semi-circles - conflict; and (e) one additional presentation of each semi-circle alone.

The two responses just preceding conflict, responses on the two conflict trials, and responses to the additional presentations were recorded. These recordings were then transformed into sound spectrograms from which latencies and durations and also frequencies of first and second formants of the sounds were determined. Responses were also classified as single response only, double reactions, compromise, or blocked.

Latency and duration measures under conflict increased markedly in all 24 treatment combinations. Conflict scattered formant values beyond their nonconflict area. Although vocal reactions to conflict could be classified by means of Hovland and Sears' categories the profiles of proportions of vocal responses in those categories did not clearly parallel the profiles of any of their four types of conflict.

Type, subtype, and strength had no differential effects. Either type and subtype of vocal conflict did not influence reactions to conflict, or such effects were obscured by interactions of motor phonetic differences with strength of association between lights and vocal responses or with degree of chaining of components of those responses. The most likely interpretation of the failure of strengths to produce differences in reactions to conflict was that learning conditions were such that effector differences in response strength were not achieved.

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Appendix

Instructions

Vowel-Vowel

Sit Here.--Try to sit up straight and not lean over the microphone. This is an experiment to determine changes in voice frequency with progress in learning. We are also interested in measuring the extent of your reaction time to light stimuli.

When the task begins you will see a light in one half of the upper window. Shortly after this light has appeared, the corresponding half of the lower window will be illuminated and you will see a word. After both light and word have been exposed for a short while, both lights will go off, and then another semi-circle of light will appear in the upper window. After a short while this light will be accompanied by another word.

Your task will be to learn to say the vowel sound of the word which is paired with each semi-circle of light. To do this you are to guess or anticipate the vowel when the upper light alone is on and before the word is exposed. You should guess by pronouncing the vowel out loud as distinctly as possible and as soon after the upper light is exposed as possible. If you guess wrong, correct your guess by saying the correct vowel when the word is exposed.

After you have learned the vowels, the upper lights will be presented without the accompanying word. You are to continue pronouncing the correct vowel when the light is presented. If you stop, you will have to start over again.

Before the lights are presented and also after you have made your response you are to relax your lower jaw so that your tongue will be resting on the floor of your mouth (like this). In addition, you are to breathe through your mouth.

Remember, you will see semi-circles of light, each of which is paired with a different vowel sound. You are to learn to say the vowel for each semi-circle of light when the light alone is on and before the word is exposed. Try to respond as quickly and as distinctly as possible.

Vowel-Kiss

Sit Here.--Try to sit up straight and not lean over the microphone. This is an experiment to determine changes in voice frequency with progress in learning. We are also interested in measuring the extent of your reaction time to light stimuli.

When the task begins you will see a light in one half of the upper window. Shortly after this light has appeared, the corresponding half of the lower window will be illuminated and you will see a sound cue: either a word or a pin-hole of light. After both light and cue have been exposed for a short while, both lights will go off, and then another semi-circle of light will appear in the upper window. After a short while this light will be accompanied by another cue.

Your task will be two-fold: (1) you are to learn to say the vowel sound of the word which is paired with the light; and (2) you are to learn to make a kissing sound by pursing your lips and inhaling sharply (like this) in response to the light which is paired with the pin-hole. To do this you are to guess or anticipate the correct sound when the upper light alone is on and before the cue is exposed. You should guess by making the sound out loud as distinctly as possible and as soon after the upper light is exposed as possible. If you guess wrong, correct your guess by making the correct sound when the cue is exposed.

After you have learned the sounds, the upper lights will be presented without the accompanying cue. You are to continue making the correct sound (vowel or kiss) when the light is presented. If you stop, you will have to start over again.

Before the lights are presented and also after you have made your response you are to relax your lower jaw so that your tongue will be resting on the floor of your mouth (like this). In addition, you are to breathe through your mouth.

Remember, you will see semi-circles of light, each of which is paired with a different sound cue. You are to learn to make the correct sound (vowel or kiss) for each semi-circle of light when the light alone is on and before the cue is exposed. Try to respond as quickly and as distinctly as possible.

Latencies and Durations for 12 Treatment Combinations for Vowel-Vowel Conflict

[i-u]

Strengths	S	Pre-conflict				Conflict				Post-conflict			
		L		D		L		D		L		D	
		1*	2*	1	2	1	2	1	2	1	2	1	2
SS	PL	.42	.35	.45	.50	4.00	4.00	1.05	1.05	1.22	.47	.52	.53
	WT	.48	.56	.30	.30	1.59	1.00	.54	.55	.84	.53	.39	.41
	AL	.49	.55	.22	.40	2.61	1.29	.55	.48	.89	.78	.30	.39
	EY	.73	.52	.33	.30	1.07	.84	.61	.67	.83	.52	.31	.30
	PI	.34	.43	.38	.44	.77	4.00	.50	.87	.98	.41	.49	.28
	EB	.52	.46	.49	.51	2.47	.73	1.25	.69	1.00	.79	.65	.57
	RH	.59	.55	.27	.29	.85	.83	1.04	.94	.80	.84	.30	.31
	RP	.34	.29	.37	.23	4.00	3.45	.64	.25	.75	.56	.27	.33
SW	BS	.65	.58	.31	.42	1.61	2.02	.51	.37	1.02	.47	.30	.35
	ED	.79	.56	.42	.38	4.00	4.00	.80	.80	1.20	.65	.38	.35
	RW	.84	.69	.29	.27	4.00	4.00	.60	.60	1.23	.77	.28	.31
	RB	.43	.39	.38	.33	1.74	.65	.73	.53	1.14	.68	.45	.64
	WB	.65	.58	.28	.28	4.00	4.00	.57	.57	.51	.75	.27	.29
	RL	.43	.43	.15	.25	1.68	.60	.49	.50	.52	.95	.16	.30
	RD	.45	.41	.28	.21	1.71	1.13	.36	.61	.77	.95	.30	.28
	ED	.28	.27	.32	.23	2.24	.63	.45	3.97	.36	.63	.26	.32
WS	TH	.25	.44	.29	.33	2.10	1.08	.92	.48	1.06	.54	.26	.22
	AF	.35	.34	.19	.27	.84	.49	1.17	.47	.70	.79	.39	.34
	KK	.37	.39	.23	.22	1.75	.88	.39	.41	1.01	.46	.25	.19
	MC	.30	.36	.24	.32	4.00	4.00	.72	.72	.61	.46	.39	.33
	JO	.63	.64	.28	.28	4.00	2.35	.65	.65	.96	.67	.32	.33
	WT	.47	.45	.31	.40	4.00	4.00	.79	.79	1.09	.59	.39	.32
	LT	.72	.78	.24	.31	1.85	1.38	1.30	.33	.82	.86	.30	.34
	ES	1.01	.55	.31	.28	4.00	4.00	.66	.66	.88	.61	.25	.35
WW	PT	1.29	.41	.31	.32	2.75	.72	.69	.70	1.27	.62	.31	.30
	LD	.34	.43	.26	.25	4.00	2.07	.94	2.67	1.15	.51	.26	.22
	RJ	.78	.78	.31	.30	2.57	2.07	1.24	.91	1.17	.65	.30	.28
	RB	.39	.37	.58	.77	.91	.53	1.07	1.08	.64	.49	.66	.69
	TK	.68	.46	.23	.20	1.54	.77	2.03	.40	1.22	.62	.25	.20
	RH	.63	.46	.33	.24	1.41	1.21	.39	.43	1.15	.62	.24	.36
	MK	.84	.93	.47	.32	4.00	.98	.82	.09	1.47	.96	.35	.34
	JT	.65	.51	.26	.26	4.00	4.00	.57	.57	.97	.74	.28	.29

*Trials

[u-ʌ]

Strengths	S	Pre-conflict				Conflict				Post-conflict			
		L		D		L		D		L		D	
		1	2	1	2	1	2	1	2	1	2	1	2
SS	RC	.60	.40	.31	.33	4.00	4.00	.67	.67	.96	.58	.31	.34
	RV	.62	.42	.27	.35	.81	.80	.70	.66	.92	.73	.29	.30
	RE	.50	.38	.28	.27	1.31	1.12	2.57	.58	.98	.69	.27	.38
	CW	.34	.42	.26	.28	4.00	4.00	1.50	1.00	.69	.67	1.14	.36
	WM	.47	.32	.25	.18	7.20	1.53	1.18	.32	1.37	.37	.17	.15
	TD	.97	1.57	.29	.32	4.00	.78	.61	.53	1.11	1.11	.25	.27
	RL	.59	.38	.29	.19	4.00	1.03	.53	.58	1.15	.40	.23	.30
	JB	.77	.61	.54	.40	2.46	1.06	.88	.87	.98	1.02	.42	.51
SW	JB	.59	.47	.17	.18	2.01	2.16	1.58	.59	1.08	.53	.19	.18
	JS	.35	.34	.22	.28	4.00	2.16	.55	.41	1.06	.83	.24	.31
	RW	.51	.49	.12	.27	4.00	4.00	.59	.59	1.01	.52	.23	.26
	RS	.70	.51	.12	.15	4.00	4.00	.68	.68	1.98	.99	.19	.49
	PL	.65	.64	.30	.24	4.00	4.00	.57	.57	.71	.97	.33	.22
	ED	.70	.92	.31	.30	4.00	3.56	.63	1.19	.67	.89	.33	.21
	JN	.43	.47	.16	.16	2.35	4.00	1.21	.45	.71	.88	.27	.18
	JE	.61	.65	.31	.27	4.00	4.00	.59	.59	.72	.54	.32	3.61
WS	FP	.32	.44	.19	.16	2.43	1.28	.33	.24	.48	.51	.18	.19
	JF	.74	.48	.27	.29	2.15	4.00	.31	.73	.73	.87	.28	.35
	RG	.34	.31	.18	.14	3.73	4.00	2.13	.52	.90	.77	.24	.28
	RL	.30	.37	.16	.19	2.43	.45	.63	.36	1.09	.94	.16	.24
	PA	.54	.65	.33	.27	1.41	1.90	.34	.39	1.35	.60	.33	.29
	EC	.41	.59	.22	.16	4.00	4.00	.55	.55	.94	.89	.33	.22
	RW	.52	.45	.29	.20	4.00	4.00	.51	.51	1.09	.45	.31	.19
	ET	.50	.49	.18	.14	1.38	1.42	.42	.36	1.15	.75	.28	.19
WW	EB	.47	.57	.34	.40	1.14	.65	.49	.43	1.00	.99	.35	.37
	RB	.62	.43	.15	.18	2.06	1.83	2.62	3.72	1.20	.76	.65	.24
	DO	.46	.43	.58	.31	1.12	.61	.89	.67	1.11	.43	.42	.30
	RS	.54	.58	.49	.48	3.18	.66	1.51	.91	.69	.81	.50	.41
	MB	.77	.64	.38	.40	4.00	4.00	.78	.78	1.01	.76	.40	.29
	DL	.78	.69	.31	.37	4.00	4.00	.72	.72	1.28	.66	.43	.35
	RC	.60	.82	.30	.34	4.00	4.00	.66	.66	1.19	.82	.32	.32
	RH	.58	.41	.12	.16	2.73	.60	.47	.43	.85	.91	.19	.20

[i-A]

Strengths	S	Pre-conflict				Conflict				Post-conflict			
		L		D		L		D		L		D	
		1	2	1	2	1	2	1	2	1	2	1	2
SS	NG	.72	.73	.47	.45	1.98	.80	.77	.84	.79	.91	.46	.44
	TP	.42	.62	.22	.41	1.96	.59	.61	.62	.93	.77	.37	.36
	DG	.20	.27	.43	.55	.23	.71	1.66	.79	.63	.63	.60	.76
	DG	.79	.31	.50	.56	4.00	4.00	1.07	1.07	.95	.83	.56	.51
	LM	.62	.34	.22	.29	3.42	2.48	.42	1.26	.98	.41	.19	.22
	RT	.39	.51	.28	.18	4.00	4.00	.47	.47	1.21	.68	.17	.29
	TC	.61	.55	.30	.22	4.00	4.00	.59	.59	1.24	.77	.25	.34
	PM	.36	.36	.15	.22	2.26	.70	.51	.41	.61	.43	.30	.28
SW	BO	.51	.39	.16	.18	4.00	4.00	.37	.37	1.20	.70	.19	.16
	HC	.42	.64	.18	.30	2.60	.68	.55	.58	.80	.41	.38	.33
	GA	.36	.47	.27	.35	1.61	1.42	2.89	.83	1.18	.64	.31	.23
	RB	.79	.68	.22	.23	4.00	1.02	.51	.26	1.09	.84	.24	.27
	WH	.43	.48	.19	.16	.93	.52	.35	.31	.57	.56	.20	.18
	RL	.48	.49	.21	.20	1.66	.70	.51	.51	.88	.90	.21	.19
	SS	.52	.55	.23	.29	4.00	4.00	.72	.72	.60	.72	.42	.30
	LM	.46	.80	.30	.28	4.00	1.95	.63	1.87	.49	.76	.28	.33
WS	RR	.46	.65	.17	.12	4.00	4.00	.41	.41	.81	.60	.16	.24
	RS	.46	.29	.21	.23	2.42	.78	.68	.45	.57	.51	.21	.22
	LB	.60	.39	.38	.38	1.91	.49	.52	.59	.63	.50	.27	.30
	PM	.67	.45	.17	.25	1.30	.70	.58	.51	.81	.53	.26	.30
	NT	.76	.60	.24	.24	4.00	4.00	.63	.63	1.72	.84	.29	.34
	JT	.71	.55	.26	.25	4.00	4.00	.56	.56	1.06	.93	.31	.23
	RB	.62	.54	.30	.29	4.20	1.61	3.00	.57	.63	.59	.21	.27
	DB	.61	.53	.32	.18	3.45	1.49	.98	.72	.97	.81	.32	.24
WW	DB	.34	.41	.33	.26	1.29	.76	.57	.43	.91	.44	.32	.26
	MB	.35	.59	.32	.23	1.48	.69	.45	.52	.77	.35	.30	.25
	DB	.37	.41	.30	.15	4.00	3.54	1.35	1.79	.65	.48	1.05	.25
	MJ	.50	.34	.40	.29	.99	.79	3.76	1.01	1.21	.46	.28	.33
	LE	.73	.42	.27	.21	4.00	4.00	.51	.51	.39	.51	1.87	.24
	KM	.80	.57	.23	.29	1.89	1.26	.60	.42	1.07	.89	.36	.25
	WK	.78	.42	.23	.21	1.34	.88	.37	.31	1.18	.50	.22	.16
	RD	.52	.26	.15	.14	4.00	4.00	.37	.37	.85	.58	.22	.15

Latencies and Durations for 12 Treatment Combinations for Vowel-Kiss Conflict

[1-!]

Strengths	S	Pre-conflict				Conflict				Post-conflict			
		L		D		L		D		L		D	
		1	2	1	2	1	2	1	2	1	2	1	2
SS	RT	.56	.57	.18	.15	3.04	1.20	.32	.30	.73	1.15	.25	.25
	RL	.40	.57	.25	.26	4.00	1.01	.60	1.42	1.11	.30	.35	.21
	SL	.39	.53	.29	.22	2.48	.43	.21	.34	.41	.70	.21	.29
	GM	.87	.45	.26	.23	4.00	4.00	.69	.69	1.38	.62	.27	.42
	AJ	.43	.40	.25	.09	4.00	.86	.88	.88	1.91	1.01	.06	.55
	KT	.47	.54	.23	.08	2.77	.65	.50	.52	1.66	.49	.11	.22
	FI	.65	.28	.36	.21	4.00	4.00	.65	.65	.97	.66	.27	.38
	RA	.51	.46	.24	.05	1.91	.71	.53	.76	.67	.50	.05	.26
SW	DD	.47	.44	.22	.04	4.00	1.03	.42	.62	1.59	.92	.38	.04
	BH	.65	.39	.24	.04	1.39	.80	.39	.28	1.49	.73	.07	.03
	GD	.52	.53	.25	.09	4.00	4.00	.34	.34	1.63	.40	.24	.08
	JH	.90	.59	.28	.31	4.00	.74	.59	.93	1.16	.89	.25	.18
	FB	.58	.61	.03	.25	4.00	2.95	.46	1.71	.89	1.03	.18	.28
	RW	.39	.39	.04	.21	.79	.69	.48	.47	.60	.70	.05	.22
	JB	.65	.27	.06	.36	2.79	.58	.72	.73	.43	.37	.05	.45
	DM	.37	.38	.06	.39	.62	.83	3.48	.36	.71	.72	.04	.29
WS	DH	.41	.48	.21	.05	4.00	3.39	.33	1.17	1.18	.54	.27	.06
	GC	.93	.70	.21	.03	4.00	4.00	.31	.31	.85	.83	.24	.07
	RO	.31	.34	.37	.04	4.00	.90	.43	.60	.77	.51	.34	.06
	SE	.41	.59	.28	.02	4.00	4.00	.30	.30	.94	.47	.22	.02
	JS	.96	.32	.05	.54	4.00	1.23	.64	3.22	1.22	.57	.10	.47
	SS	.72	.72	.04	.33	4.00	3.24	.43	.68	1.29	.90	.10	.32
	LO	.43	.72	.04	.36	1.27	.58	.54	.64	1.18	.93	.07	.41
	RH	.81	.39	.14	.29	4.00	4.00	.52	.62	1.14	.62	.23	.28
WW	GW	.64	.88	.07	.25	2.25	.66	.47	.40	.86	1.25	.24	.08
	HK	1.06	.69	.19	.38	4.00	1.39	.67	.19	.69	.50	.40	.27
	RM	.74	.71	.04	.22	4.00	4.00	.28	.28	1.00	.77	.24	.04
	FP	1.00	.64	.20	.26	4.00	4.00	.49	.49	1.22	.94	.29	.14
	PF	.83	.55	.39	.23	2.18	1.11	.97	.72	.78	.90	.22	.43
	AM	.69	.34	.31	.05	4.00	4.00	.36	.36	.86	.59	.05	.31
	FS	.66	.22	.24	.29	1.93	.80	2.81	.56	1.03	1.02	.25	.35
	JM	1.00	1.21	.31	.10	3.34	1.35	.84	.84	1.45	1.34	.12	.31

[u-!]

Strengths	S	Pre-conflict				Conflict				Post-conflict			
		L		D		L		D		L		D	
		1	2	1	2	1	2	1	2	1	2	1	2
SS	DF	.86	.75	.39	.32	1.75	1.12	.40	.60	1.54	.81	.48	.40
	CI	.41	.46	.06	.19	3.40	.71	.94	.58	1.09	.46	.16	.10
	GP	.47	.37	.18	.27	2.87	.73	.63	.62	.86	.50	.31	.20
	GB	.58	.65	.20	.15	1.28	.65	.62	.75	.91	.78	.24	.20
	FA	.53	.65	.25	.23	4.00	4.00	.54	.54	.96	.58	.22	.31
	JT	.70	.41	.24	.05	4.00	4.00	.60	.60	3.53	.82	.27	.33
	RB	.61	.48	.53	.17	1.62	.65	1.06	1.09	.75	1.13	.12	.63
	RR	.47	.53	.18	.05	4.00	4.00	.28	.28	1.07	.69	.08	.20
SW	DR	.78	.40	.60	.26	4.00	4.00	.86	.86	1.10	.64	.56	.26
	RW	.90	.71	.30	.12	4.00	4.00	.46	.46	1.02	.71	.34	.04
	MC	.95	.43	.29	.12	4.00	3.08	.50	1.15	1.22	.49	.38	.06
	BM	.51	.62	.16	.05	1.62	1.14	1.09	.62	1.10	.97	.31	.04
	RM	.43	.70	.05	.21	4.00	4.00	.26	.26	.46	.78	.05	.21
	HH	.56	.62	.04	.20	4.00	4.00	.27	.27	.60	.48	.05	.22
	HW	.32	.89	.10	.26	4.00	4.00	.36	.36	.37	.51	.09	.23
	RH	.50	.71	.04	.26	2.70	1.17	1.13	6.61	.68	.89	.04	.92
WS	FL	.44	.38	.15	.04	.97	.78	.61	.72	.92	.42	.24	.05
	GG	.59	.36	.28	.21	4.00	.89	.40	.64	1.37	1.21	.29	.11
	RA	1.10	.44	.27	.06	1.47	.65	.89	.86	.96	.58	.41	.06
	WB	.58	.32	.19	.04	4.00	4.00	.29	.29	1.02	.47	.25	.02
	JL	1.38	.79	.03	.31	2.34	1.44	.69	.91	1.09	.94	.06	.34
	WM	.52	.47	.06	.22	4.00	4.00	.28	.28	1.18	.47	.04	.22
	RC	.87	.56	.08	.33	4.00	4.00	.72	.72	.92	1.06	.33	.39
	PC	1.04	.57	.09	.28	1.33	.75	.65	.37	.78	.76	.06	.33
WW	JK	.74	.57	.31	.16	1.08	.87	.62	.85	.95	.62	.12	.42
	RS	.76	.54	.34	.23	4.00	4.00	.57	.57	2.08	1.35	2.92	.33
	MC	.55	.31	.21	.08	1.23	.78	.84	.74	.85	.83	.05	.29
	RG	.73	.54	.29	.05	.91	.83	.30	.26	.42	.51	.04	.23
	NP	.55	.68	.17	.26	3.53	4.00	.31	.60	.81	.62	.29	.16
	PS	.62	.51	.10	.30	4.00	.86	.62	.95	.56	.86	.35	.27
	HA	.84	.80	.18	.24	4.00	4.00	.45	.45	1.12	1.38	.27	.10
	RC	.50	.24	.11	.18	4.00	4.00	.56	.56	.72	.38	.44	.12

[∧-!]

Strengths	S	Pre-conflict				Conflict				Post-conflict			
		L		D		L		D		L		D	
		1	2	1	2	1	2	1	2	1	2	1	2
SS	DB	.64	.92	.35	.30	4.00	4.00	.65	.65	.92	1.19	.28	.23
	AK	.57	.63	.31	.27	4.00	4.00	.58	.58	1.36	.61	.21	.18
	LH	.61	.49	.22	.27	4.00	4.00	.50	.50	1.00	.78	.28	.21
	DM	.57	.72	.22	.21	3.78	1.54	.71	.59	.41	.76	.27	.34
	GA	.65	.69	.26	.07	4.00	4.00	.33	.33	1.43	.95	.05	.25
	AK	.96	.53	.24	.30	4.00	.59	.60	.79	.67	.72	.36	.23
	ER	.36	.69	.22	.08	2.20	.68	.52	.47	.72	.74	.05	.16
	PB	.39	.38	.16	.06	4.00	4.00	.24	.24	.99	.89	.08	.15
SW	RD	.78	.89	.21	.06	4.00	4.00	.28	.28	1.08	.58	.22	.04
	AW	.57	.54	.13	.06	4.00	4.00	.26	.26	1.18	.54	.20	.04
	CS	.50	.43	.21	.11	4.00	4.00	.33	.33	1.25	.87	.22	.05
	AL	.34	.33	.12	.25	4.00	.69	.55	.80	1.57	.63	.30	.04
	WE	.91	1.08	.06	.20	4.00	4.00	.34	.34	.96	.95	.09	.25
	TD	.52	1.09	.09	.24	3.10	4.00	1.50	.35	1.14	1.40	.10	.25
	JM	.43	.46	.08	.18	4.00	.93	.66	.29	.62	.47	.11	.16
	DC	.34	.62	.05	.17	4.00	4.00	.31	.31	.73	.88	.08	.23
WS	RM	.66	1.04	.13	.04	4.00	4.00	.33	.33	1.30	.98	.18	.15
	JG	.90	.57	.16	.03	4.00	4.00	.19	.19	.68	.47	.13	.03
	RG	.42	.41	.19	.06	1.44	1.13	1.67	.44	1.36	.62	.20	.04
	CB	.26	.38	.12	.03	4.00	4.00	.19	.19	.69	.49	.13	.06
	CT	.95	.76	.08	.26	4.00	4.00	.34	.34	1.36	.72	.08	.22
	LR	1.03	.69	.09	.23	4.00	4.00	.54	.54	.77	1.28	.08	.45
	MJ	.75	.40	.06	.29	4.00	4.00	.85	.85	.61	.63	.42	.43
	JW	.76	.74	.02	.28	1.37	.88	.28	3.02	1.06	.46	.03	.17
WW	WY	1.21	.85	.53	.38	1.64	1.86	.54	.90	1.35	.76	.72	.87
	JC	.59	.39	.47	.05	1.75	.67	.56	.64	.69	.89	.05	.33
	RA	.88	.45	.21	.06	1.04	.59	.33	.32	1.33	.79	.07	.16
	RT	.68	.27	.37	.07	1.13	.92	.39	.58	.92	1.19	.07	.28
	RK	.64	.75	.16	.32	4.00	4.00	.54	.54	1.07	.95	.20	.22
	JA	.63	.55	.25	.45	4.00	4.00	.92	.92	.65	.37	.66	.26
	RH	.90	.72	.09	.35	2.99	1.21	1.16	.57	1.10	.91	.31	.14
	BM	.83	.61	.26	.31	4.00	4.00	.79	.79	.90	.92	.49	.30

Frequencies of First and Second Formants for Vowel-Vowel Conflict

Strengths	S	Pre-conflict				Conflict				Post-Conflict			
		[i]		[u]		1		2		[i]		[u]	
		1	2	1	2	1	2	1	2	1	2	1	2
SS	WT	200	2000	200	500	200	1900	200	1900	200	2200	200	500
						200	400	200	500				
	AL	200	1900	150	300	150	1900	150	2000	150	1800	200	500
						150	300	250	400				
	EY	150	1800	150	500	200	1900	200	1800	200	1800	200	550
						200	500	200	550				
	EB	200	2150	200	500	150	2300	200	2250	200	2250	200	500
						200	550	200	500				
	RH	200	1750	200	600	200	1750	200	1750	200	1750	200	700
						200	500	200	600				
	RP	200	2100	200	500	-	-	150	450	200	2100	200	500
SW	BS	200	1800	200	600	200	1800	200	1800	200	1800	200	600
						200	500	200	500				
	RL	200	2250	200	500	150	2250	200	2200	200	2300	200	500
						200	450	200	600				
	RD	200	1800	150	500	200	500	200	900	150	1800	150	400
	RB	150	1800	200	500	150	1700	200	1800	150	1800	150	450
						200	400	200	400				
	EO	200	2200	200	500	200	2200	200	2200	150	2300	200	500
WS	AF	200	1800	200	600	200	1800	200	1700	200	1800	200	500
						200	550	200	500				
	KK	200	1800	200	550	200	1800	200	1900	200	1800	200	500
						200	600	200	500				
	JO	250	1750	250	600	-	-	200	1750	200	1700	200	600
	LT	250	1800	200	700	300	1750	350	1750	250	1800	300	850
WW	PT	300	2200	300	600	200	2100	250	2200	300	2300	250	600
						200	600	300	600				
	RJ	250	1900	300	900	250	1800	250	1950	250	1800	300	750
						300	800	300	700				
	BB	250	2300	300	850	250	2300	250	2300	250	2300	300	800
						300	900	300	900				
	KK	250	2100	300	800	250	2100	250	2100	250	2000	300	850
						300	900	300	900				
	RH	250	1900	250	900	250	1800	250	1800	250	2000	300	900

Strengths	S	Pre-conflict				Conflict				Post-conflict			
		[u]		[^]		1		2		[u]		[^]	
		1	2	1	2	1	2	1	2	1	2	1	2
SS	RV	150	400	400	1100	400 150	1000 400	400 200	1000 400	150	400	400	1000
	RE	200	600	450	950	300 200	1000 600	400 200	1000 600	200	500	500	900
	WM	200	500	500	1000	-	-	300 300	800 600	200	600	400	900
	TD	200	500	300	800	-	-	400 200	900 500	200	550	350	800
	JB	200	500	400	1000	-	-	150	500	200	500	400	1000
	RL	150	500	500	1000	350 200	800 500	400 200	800 600	200	500	400	800
SW	JB	200	600	400	1000	400	900	-	-	200	600	450	1000
	JS	200	600	400	900	-	-	400 200	900 450	250	600	400	1000
	ED	200	500	300	850	-	-	400 200	900 500	200	500	400	900
	JN	200	600	400	1100	250	500	-	-	200	500	400	1100
WS	JF	200	700	500	1000	300	800	-	-	200	600	400	1000
	RG	200	600	450	1000	400 200	1200 550	-	-	200	600	400	1150
	RL	200	550	400	1000	400 200	950 500	400 200	1000 500	200	500	400	1000
	PA	200	500	500	1150	300	700	300	700	200	550	500	1000
	ED	200	500	400	1000	400 200	950 500	400 200	1000 500	200	500	400	1000
WW	EB	300	1000	400	1100	400 250	1100 1000	400 300	1000 900	300	1100	300	1000
	DO	300	800	600	1300	600 200	1300 650	600 200	1300 700	300	800	600	1300
	RS	300	700	600	1200	600 300	1250 700	600 300	1200 700	200	700	600	1200
	RH	300	600	350	900	400 300	900 600	400 300	900 600	250	600	350	850

Strengths	S	Pre-conflict				Conflict				Post-conflict			
		[i]		[^]		1		2		[i]		[^]	
		1	2	1	2	1	2	1	2	1	2	1	2
SS	NG	150	1800	400	800	150 300	1800 800	200 400	1600 800	150	1600	400	800
	TP	200	1900	300	750	150 400	1750 1100	150 400	1900 1000	200	1800	350	800
	DG	200	2000	300	800	-	-	200 300	1800 800	200	1800	300	700
	HM	200	1900	500	1000	200 500	1900 1200	200 500	1800 1250	200	2000	450	1100
SW	WH	200	2000	400	1100	200 400	2200 1200	200 400	2200 1200	200	2000	400	1100
	RL	200	1800	400	950	150 300	1700 1000	200 350	1800 1000	200	1800	400	1000
	HC	200	1900	400	1000	200 400	1900 1100	200 400	1800 1000	200	1900	400	950
	GA	150	2000	400	900	200 300	1500 600	150 400	1700 1000	200	2100	400	900
	RB	150	1900	400	1000	-	-	200	1800	150	1900	350	900
	LM	150	2200	300	800	-	-	150 300	2100 900	150	2200	300	850
WS	RS	200	2100	400	1100	200 400	2200 900	200 400	2000 950	200	2000	400	1000
	LB	200	1900	400	950	200 450	1700 1100	200 400	1750 1000	200	1800	400	1000
	PM	200	2100	400	1200	200 450	2200 1150	200 400	2100 1200	250	2100	400	1100
	RB	200	2000	400	900	- -	- -	150 400	1900 1000	200	1900	400	900
	WB	200	1750	400	1000	200 400	1750 900	200 400	1700 900	250	1800	400	900
WW	DB	200	2000	450	950	250 400	1800 1000	250 400	1750 950	250	2100	400	1000
	MB	250	2100	400	1000	250 400	2000 1150	250 400	2050 1200	250	2100	400	1050
	DB	250	1900	500	1200	-	-	300 300	1900 900	250	1800	450	1100
	MJ	250	2200	500	1200	250 550	2100 1200	250 500	2200 1000	250	2100	500	1200
	KM	250	1800	400	1000	250 400	1750 1100	250 400	1800 1200	250	1800	450	1100
	WK	200	1750	400	1000	200 400	1900 1000	200 400	1800 1100	250	1950	400	1000

Frequencies of First and Second Formants for Vowel-Kiss Conflict

Strengths	S	Pre-conflict [i] 1	Pre-conflict [i] 2	Pre-conflict [!] 1	Pre-conflict [!] 2	Conflict 1	Conflict 2	Conflict 1	Conflict 2	Post-conflict [i] 1	Post-conflict [i] 2	Post-conflict [!] 1	Post-conflict [!] 2
SS	RL	200	2200			-	-	300	1800	200	1900		
	SL	200	2000			200	600	200	600	200	2000		
	AJ	200	1600			-	-	200	1600	200	1600		
	KT	200	2100			200	2100	200	2200	200	2100		
	RA	200	2000			200	2000	200	2100	200	2000		
SW	FB	200	1750			-	-	150	1700	200	1800		
	DD	200	1650			-	-	250	1650	200	1650		
	RW	200	2000			200	2000	250	1900	250	2100		
	BH	200	1900			150	2000	200	2100	kiss			
	JB	200	2000			200	1900	200	1800	200	1800		
	DM	200	2000			150	2150	150	2200	200	2200		
	JH	200	1800			-	-	200	1800	200	1800		
WS	RO	200	1700			-	-	200	1850	200	1700		
	SS	150	1600			-	-	150	1700	150	1700		
	LO	200	1900			150	2000	200	2000	200	1900		
WW	GW	200	1800			250	1800	250	1700	200	1800		
	PF	300	2000			300	1900	200	1800	250	1900		
	FS	200	1800			250	1800	250	1800	250	1700		
	JM	200	1900			250	1900	250	1900	250	1900		

Strengths	S	Pre-conflict				Conflict				Post-conflict			
		[u]		[!]		1		2		[u]		[!]	
		1	2	1	2	1	2	1	2	1	2	1	2
SS	DF	200	600			200	700	200	600	200	600		
	CI	200	600			200	900	200	700	200	600		
	GP	200	800			200	600	200	700	200	700		
	GB	200	600			200	600	200	600	200	500		
	RB	200	550			200	800	200	550	200	500		
SW	BM	200	500			200	400	200	500	200	500		
	RH	200	500			200	500	200	500	200	500		
WS	FL	200	600			200	500	200	500	200	500		
	GG	200	600			-	-	200	500	200	500		
	RA	200	500			200	500	200	500	200	400		
	JL	200	500			200	600	200	600	200	600		
	PC	250	600			250	600	250	600	250	600		
WW	JK	200	600			200	700	200	600	200	600		
	MC	200	500			200	600	250	700	250	700		
	RG	200	600			200	600	200	600	200	600		
	PS	200	900			-	-	200	900	250	900		

Strengths	S	Pre-conflict				Conflict				Post-conflict			
		[^]		[!]		1		2		[^]		[!]	
		1	2	1	2	1	2	1	2	1	2	1	2
SS	DM	400	900			300	1000	300	1000	200	1000		
	AK	400	900			-	-	500	1000	400	900		
	ER	400	1000			400	1000	400	1000	400	1000		
SW	JM	400	1200			-	-	400	1100	400	1100		
	AL	400	1000			-	-	350	900	350	900		
WS	RG	400	800			300	800	350	800	400	850		
						300	900						
	JW	350	900			250	600	250	600	400	900		
WW	WY	400	900			400	600	400	800	300	900		
	JC	400	1000			400	1000	400	1000	400	1100		
	RA	400	1100			200	1700	200	1700	400	1100		
	RT	400	900			400	900	400	900	400	900		
	RH	400	1000			500	1200	500	1200	500	1100		

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