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ABSTRACT

To account for vowel alternations in forms such as divine-divinity, Chomsky and Halle propose the Vowel Shift Rule and other rules. This study experimentally assesses the psychological validity and generality of these rules by testing the productivity of vowel alternation. Subjects were required, in a meaningful sentence context, to produce a novel derived form by selecting one of two suffixes and affixing it to a base word (for example, maze + ic/ity, concrete + ify/ic). Items were presented aurally and, in some conditions, orthographically as well. Results were consistent: 90 percent of all responses showed no vowel change. Less than four percent exhibited the Chomsky and Halle predicted vowel changes. The validity of the Vowel Shift Rule is, therefore, highly dubious. (Author/RB)

August 1973

THE PSYCHOLOGICAL VALIDITY OF CHOMSKY & HALLE'S VOWEL SHIFT RULE

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ABSTRACT

To account for vowel alternations in forms such as divine-divinity, Chomsky & Halle (C&H) propose the Vowel Shift Rule (VSR) and other rules. This study experimentally assesses the psychological validity and generality of these rules by testing the productivity of vowel alternation. Subjects were required, in a meaningful sentence context, to produce a novel derived form by selecting one of two suffixes and affixing it to a base word, e.g., maze + ic/ity, concrete + ify/ic. Items were presented aurally and in some conditions, orthographically, as well. Results were consistent: 90% of all responses showed no vowel change. Less than 4% exhibited the C&H predicted vowel changes. The validity of the VSR is, therefore, highly dubious.

NOTE: Papers based on this article were presented at the summer meeting of the Linguistic Society of America in Ann Arbor, Michigan 1973, and at the annual convention of the American Psychological Association in Montreal, Quebec, August 1973.

THE PSYCHOLOGICAL VALIDITY OF CHOMSKY & HALLE'S VOWEL SHIFT RULE[1]

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In recent years the Chomsky and Halle analysis of English phonology has become the leading theory of the English sound system. Besides having a profound effect upon linguists, the theory is now influencing educators concerned with the teaching of reading and spelling (Wardhaugh, 1969; Carol Chomsky, 1970) and the teaching of English phonology (Schane, 1970). Despite the many compelling aspects of Chomsky and Halle's description of English, there is, however, reason to believe that certain important features of their phonological analysis, along with the inferences they make from that analysis regarding the nature of English orthography and the nature of the reading process, may not be valid. The principal aim of the research to be reported here is to assess empirically the validity of particular crucial aspects of Chomsky and Halle's phonological theory.

The investigations of Chomsky and Halle (1968) into the sound system of English have led them to posit certain highly abstract underlying phonological representations for lexical items, and to posit a set of phonological rules which assign a phonetic representation to these items. Some of the most important rules in the C&H system are those concerned with the vowel alternation of base and derived forms. Primarily because vowel alternations appear in a number of cases of such related words as divine-divinity, extreme-extremity, and grave-gravity,

and because this relationship can be specified with a Vowel Shift Rule (VSR) and certain other rules, C&H claim that speakers of English have internalized a VSR and operate in accordance with it in the production and understanding of lexical items.

Such a rule as the VSR plays an extremely important role in the C&H system of phonology. Since the VSR is regarded by C&H as a general rule, it applies to any lexical item having the requisite structural description, unless the item is marked as an exception. Underlying phonological representations (UPRs) are posited in order to accommodate the application of the VSR so that the expected phonetic representation will be generated. An invalid VSR would demand an extensive revision of a great many of the C&H underlying phonological forms.

According to the C&H analysis, phonetically different vowels in certain closely related words are derived from a common underlying abstract vowel. For example, the second vowels in the related words extreme and extremity are phonetically [ĪʸI] and [e], respectively. The abstract representation of both of these vowels is, however, the phoneme /ē/. In the case of extreme, the underlying /ē/ undergoes C&H's Diphthongization Rule (ē → ēʸ) and then their Vowel Shift Rule (ēʸ → ĪʸI). In the case of extremity, the underlying /ē/ undergoes a laxing rule (ē → e). The processes for other such pairs of words, e.g., divine-divinity, sane-sanity, are similar. For all of these, C&H posit abstract underlying representations which undergo the same rules that apply to extreme-extremity.

Whether English speakers have actually internalized such a rule as the VSR as C&H claim is somewhat questionable especially since contrary evidence has been collected by some investigators. Robinson (1967), in an unpublished Ph.D. dissertation, found that graduate students of English literature produced alternations but that Grade 9 students did not.[3] Unfortunately, in that study a group of non-language oriented adult speakers was not tested. More recently, Moskowitz (1972?), in a pilot study, reports that adult Ss rarely produce vowel alternation, as does Ohala (1973) in an unpublished paper. That so few experimental studies have been conducted to date concerning such an important hypothesis as the VSR is unfortunate. The present investigation attempts to improve this situation with a thorough and systematic study of the productivity of vowel alternation. Given a meaningful sentence context, subjects (Ss) were required to select one of two suffixes, e.g., -ic or -ity, attach it to a base word, e.g., maze, and then pronounce the novel derived form. If vowel alternation is a valid psychological phenomenon, we would expect Ss to produce a pronunciation of [mæzɪk] or [mæzɪtɪ]. A pronunciation of [mēɪzɪk] or [mēɪzɪtɪ] would raise serious doubts as to the validity and generality of that phenomenon, and also of the VSR, since there would be no alternation to be accounted for. The cases of alternations already in the lexicon would be exceptions which speakers may or may not deal with according to such a rule as the VSR.

In this research, two experiments were conducted. The first experiment presented materials auditorily only, while the second presented orthographic materials as well. Orthographic stimuli were included because given that C&H contend that the orthographical representation of lexical items in English generally represents the underlying phonological forms of those items, one may well consider the possibility that English orthography may in

underlying phonological forms of those items, one may well consider the possibility that English orthography may in some way affect ordinary speakers' pronunciation of the English vowels in derived forms. The effects of five different base vowels [ā^{v}], [Ī^{v}], [ē^{v}], [ō^{w}], and [ā^{w}] and five different suffixes -ic, -ical, -ify, -ity and -ish are investigated in these experiments.

METHOD

Experiment I

Subjects. The Ss were 12 male and 12 female native English speakers who were randomly selected from introductory psychology classes at the University of Hawaii. Participation in the experiment fulfilled a course requirement.

Materials and Task. C&H's analysis predicts that certain vowels occurring in the final syllable of a word will change when a derivation of that base word is formed by the addition of certain suffixes. Five of the base vowels which the C&H theory predicts would change were selected for investigation. These critical base vowels and their postulated alternations in derived forms are: [ā^{v}]--[i] as in divine-divinity, [Ī^{v}]--[e] as in extreme-extremity, [ē^{v}]--[æ] as in sane-sanity, [ō^{w}]-- [ɑ] as in verbose-verbosity, and [ā^{w}] --[ʌ] as in pronounce-pronunciation.

The five different suffixes selected for study were -ic, -ical, -ify, -ity, and -ish. All but the suffix -ish are predicted by C&H to trigger vowel alternation in derived forms. The -ish suffix was included in the materials to see if it also would result in changed derived forms since we do have the example of the Spain-Spanish alternation in English.

There were 26 base form items used in the experiment. Five

different ordinary English words were chosen as experimental items for each of the five different base form vowels thus providing a total of 25 items. One additional special item with [ā^{Y}] in the base form, the name Goldstein, was included at the suggestion of Bailey[4]. The C&H analysis predicts that the vowel in the second syllable would, with the suffix -ian, be realized as [ɪ] in the derived from, Goldsteinian, as in reptile-reptilian.

The 26 base words and suffixes used in the experiment are shown in Table 1. In that table the two suffix choices that

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TABLE 1 GOES HERE

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were presented to the Ss with each base word are also shown. It should be noted that only one of the two suffix choices is contextually appropriate, and further, that for each of the five words with the same target base vowel, a different suffix is appropriate to the context provided. In the table, the inappropriate suffix choice for the provided context is marked with an asterisk. While only one of the two suffixes yields the appropriate part of speech for the sentence context, nevertheless, the creation of a derived form with either suffix is predicted by the C&H theory to result in the same vowel change (except in the case of -ish.)

The task of choosing between two suffixes was presented to Ss so that they might not unduly focus their attention on the pronunciation of the derived form which they were to create. Ss were instructed that the purpose of the research was to gather

information concerning suffix preference.

The entire experiment was tape recorded and presented to the Ss wholly auditorily. The 26 items were arranged in a random order for presentation to the Ss. Each base word with its two suffix choices was introduced and presented to the Ss with a brief paragraph-like context. The last sentence in that context had a word deleted. The S was required to say that sentence aloud, filling the blank with a derived word that was to be created by adding one of the two suffixes to the base word. The following is what Ss were presented for the item maze:

-The word is maze. A maze is a confusing path. Say maze.

-Ready? [CLICK - a signal to S to respond aloud]

-One suffix is -ic. Say -ic.

-Ready? [CLICK]

-Another suffix is -ity. Say -ity.

-Ready? [CLICK]

-[Ss were required to repeat the base word and the suffixes as a check to determine whether the Ss actually did receive the intended stimuli and, further, to determine their pronunciation of the base word.]

-Fill the blank with the word maze plus either -ic or -ity:

-The city library used to be a maze of shelves. People had difficulty finding their way out once they got in. Then a new librarian improved things by arranging the shelves around attractive reading areas. The library was no longer BLANK.

-The word is maze. The suffixes are -ic and -ity. The

sentence is: The library was no longer BLANK.

-Ready? [CLICK]

-[The S was required to say the whole sentence aloud with the newly created derived form.]

Prior to the presentation of any of the 26 experimental items, Ss were presented a sample item and a practice item. On the sample item, which was the base word piano with the suffix choices *-er and -ist, the S listened to someone (on tape) make the response (pianist). On the practice item, which was the base word astronomy with the suffix choices -er and *-ist, the S himself was required to make the response (astronomer). The purpose of the sample and practice items is to familiarize the S with the test procedure and the requirements of the task.

The recorded experimental text consisted of five main sections: (1) Introductory Instructions, (2) Final Instructions, (3) Sample Item, (4) Practice Item, and (5) Experimental Items.

Procedure. Each S was tested individually and with the same experiment tape. The E, a graduate student, tested all of the Ss. After being greeted by the E, the Ss were seated at a table on which there was a microphone. The E took a seat at a table nearby, out of the view of the S, and played the experiment tape which ran about 40 minutes. All of the Ss' responses were recorded on tape. A brief post-experimental interview was conducted to determine if any of the Ss were aware of the true intent of the experiment, the observation of their pronunciation. None of the Ss indicated any such awareness.

Scoring. From the recorded tape of the Ss' responses, two

scorers independently transcribed the Ss' pronunciation of each base word, suffix, and derived word. The transcriptions obtained from each scorer were later compared. Any differences were settled by having the scorers replay, discuss and rescore the disputed items.

Experiment II

Subjects. The Ss were 8 male and 8 female native English speakers who were selected on the same basis as in Experiment I. The Ss were placed in one of two groups, 8 to a group, with an equal number of males and females in each. The two groups of Ss are henceforth referred to as the Condition 1 and the Condition 2 Ss.

Materials and Task. The materials and task were the same as that of Experiment I except for the addition of two types of supplemental materials, both of which were of an orthographic nature. Thus, Experiment II Ss were presented materials visually as well as auditorily.

The Condition 1 Ss received one card on which the base form and the two suffix choices were printed. For the item maze, the following card was presented:

MAZE	-IC -ITY

The Condition 2 Ss received two cards. The first card was the same card received by the Condition 1 Ss. On the second card, however, was printed the two possible derived words. For example, for the item maze, Condition 2 Ss received the following two cards:

MAZE	-IC -ITY

MAZIC MAZITY

The spellings of the derived forms followed this rule: Delete any final silent e of the base word, and then add the suffix. Thus, maze plus -ic became mazic, and house plus -ify became housify.

The recorded experimental text for Experiment II was the same as that for Experiment I except that the Final Instructions were varied to accommodate the supplemental presentation of cards. In those Final Instructions, Ss were informed that they would also see cards with words and suffixes printed on them. Ss were given a set of printed cards and were asked to turn over a card whenever a new item was introduced. Ss under Condition 1 were required to turn over one card while those under Condition 2 had to turn over two.

Procedure. The same as Experiment I except that one additional E, also a graduate student, was used to test Ss.

Scoring. The same as Experiment I.

RESULTS

Experiment I

Valid Responses. Since each of the 24 Ss made a response (the pronunciation of the created derived word) to each of the 26 experimental items, a total of 624 responses were made in all. Of the 624 responses, 504 responses (24 Ss X 21 items) were for the 21 items for which the context appropriate suffix choice was -ic, -ity, -ify, or -ical while 120 responses (24 Ss X 5 items)

were for the 5 items for which the context appropriate suffix choice was -ish. Since only one vowel change of any kind was produced out of all of the responses to -ish suffix items (an odd [ā^{ə}] was the target vowel given by one S for quagmirish), the presentation of results will solely be concerned with the non-ish suffix items. Of the 504 responses made to the group of non-ish suffix items, 50 were discarded for various reasons leaving a total of 454 valid responses. The analysis of results, which is presented following the section on discarded responses, will concern only the valid responses.

Discarded Responses. Responses were discarded if the derived word which was produced: 1) had an odd stress (7 cases), e.g., [grā^{w}ndíti], 2) had a syllable deleted (11 cases), e.g., [sné^{y}kəl], 3) had a syllable added (5 cases), e.g., [mē^{y}zé^{y}ək], 4) had a disjuncture, e.g., [hənikó^{w}m--əkəl], 5) had a fabricated suffix (4 cases), e.g., [sné^{y}kəbl], or 6) if the S gave no response (4 cases). A total of 41 responses were discarded according to these criteria. Approximately half of the discards (20) are attributable to three Ss. The other 21 discards were distributed over 10 other Ss.

In addition to these 41 discards, 9 responses of one S were discarded. All of these responses have a context inappropriate suffix affixed to the base word indicating perhaps that the S was not concentrating sufficiently on his task. Such a large number of inappropriate suffix selections was unusual in the experiment. (None of these discards had a change predicted by the C&H theory.)

Vowel Changes. Only 12 responses (2.6% of all responses) exhibited the vowel change that is predicted by the C&H theory. While 34 other vowel changes did occur (7.5%), these were not changes predicted by the C&H theory. A total of 408 responses (89.9%) showed no changes in pronunciation between the critical vowel of the base word and the target vowel of the derived word. These findings are shown in Table 2. In that table, "nature of change" indicates whether the target vowel in the derived form

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TABLE 2 GOES HERE

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has changed in accord with the C&H theory (C&H), whether the target vowel has changed but not according to the C&H theory (Other), or whether no change has occurred at all (None).

C&H Predicted Vowel Changes. The 12 responses which were made in accord with the C&H theory were distributed over 11 Ss. Thus, less than half of the Ss produced a derived word with a C&H target vowel change, and only one S provided more than a single instance of that change. The exceptional S produced two C&H changes, both [ā^{y}] - [i] alternations.

It is interesting to note that 10 of the 12 predicted C&H responses occurred when the critical vowel [ā^{y}] appeared in the base word. Ss produced the C&H predicted vowel [i] in the derived word responses for 3 of the 5 different items: sapphire (5 cases), tripe (3 cases), and Goldstein (2 cases). No C&H predicted vowel changes occurred in response to the items snide and termite. The other 2 responses which were predicted C&H

changes occurred in the derived forms of effete (predicted vowel [ɘ]) and snout (predicted vowel [ʌ]).

Non-C&H Predicted Vowel Changes. The 34 non-C&H target vowel changes (Other) occurred with items having 4 of the 5 different critical base vowels. No changes occurred for items having the critical vowel [o͞ʷ] in the base word.

Over half (18) of the target vowel changes occurred in response to base items having the critical vowel [ɪ͞ʸ]. The data shows that 12 of the 18 changes for the [ɪ͞ʸ] base items appeared in response to one item, effete, and that in all cases the vowel produced in the derived form was [i]. That same target vowel [i] was the only one which appeared in the derived words for the other 6 items with the critical base vowel [ɪ͞ʸ], centipede (2 cases), concrete (2 cases) and kerosene (2 cases). A relatively large number of responses (8) was also given in response to two items with the critical vowel [ɛ͞ʸ] in the base word. The items were sapphire (5) and Goldstein (3). Table 3 (upper half) lists the

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TABLE 3 GOES HERE

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nature and the frequency of all of the non-C&H predicted changes and identifies the items to which such responses occurred.

Experiment II

Valid Responses. Since each of the 16 Ss made a response to each of the 26 experimental items, a total of 416 responses were made in all. The 8 Ss under each of the two conditions provided 208 responses. Of the 208 responses in each condition, 168 responses (8 Ss X 21 items) were to the 21 items for which -ish

was not the context appropriate suffix choice while 40 responses (8 Ss X 5 items) were to the 5 items for which -ish was the context appropriate suffix choice. Since only one vowel change was produced (a C&H predicted vowel change, [i], for the item quagmire) out of all of the responses to -ish suffix items, the presentation of results will solely be concerned with the non-ish suffix items.

Of the 168 responses made to the non-ish suffix items of Condition 1, 3 were discarded leaving a total of 165 valid responses. Of the 168 responses of Condition 2, 13 were discarded leaving a total of 155 valid responses. Discards were made according to the same criteria used in Experiment I. The analysis of results will concern only the valid responses.

Condition 1

Only 7 responses (4.2%) exhibited the vowel change that is predicted by the C&H theory. There were 3 responses (1.8%) which were vowel changes not predicted by the C&H theory. A total of 155 responses (93.9%) showed no change in pronunciation between the critical vowel of the base word and the target vowel of the derived word.

The 7 responses made in accord with the C&H theory were made by three Ss, mainly in response to base words with the critical vowel [$\bar{a}^{Y}$] (sapphire, termite, and Goldstein). The 3 Other vowel changes which occurred, all occurred in response to base items with the critical vowel [$\bar{I}^{Y}$]. The 3 responses (1.8% of all responses) were made by 3 different Ss. Two of the responses were to the item effete, one was to kerosene. In all cases it

was the [ɪʸ] - [i] alternation which occurred.

Condition 2

Only 8 responses (5.2%) exhibited the vowel change predicted by the C&H theory. There were 14 responses (9.0%) which were vowel changes not predicted by the C&H theory. A total of 133 responses (85.8%) showed no change in pronunciation between the critical vowel of the base word and the target vowel of the derived word. A comparison of the distributions of responses for Condition 1 and Condition 2 on the basis of the C&H, Other and None categories shows a statistically significant difference, $\chi^2 = 8.63$, $p < .02$. This effect is primarily due to the relative number of Other responses for the Conditions. Table 2 shows the distribution of responses for these Conditions and that for Conditions 1 and 2 combined, for Experiment I, and the distribution for Experiments I and II combined.

The 8 C&H predicted vowel changes occurred in response to two critical base word vowels, [āʸ] (sapphire, termite, snide) and [ōʷ] (trombone, honeycomb). These responses were distributed over 5 Ss. The 14 Other vowel changes which occurred were distributed over 7 Ss. Table 3 (lower section) lists the frequency and kind of change, and identifies the items to which such responses occurred. Of the 14 changes, 8 occurred in response to base items with the critical vowel [ɪʸ], and 3 to items with vowel [āʸ], 2 to [ōʸ], and 1 to [āʷ]. 5 of the 8 [ɪʸ] responses were made to the item effete, and all three of the [āʸ] responses were made to the item sapphire.

Experiments I & II Combined

The distribution of responses for both Experiments I and II may be combined to provide an overall assessment of effects; especially since the difference between the distribution of responses for Experiment I and for Experiment II combined (see data in Table 2) is not significant, $\chi^2 = 3.56$, df = 2.

Vowel Changes. Of the total of 774 responses, 27 (3.5%) are vowel changes in accord with the C&H theory and 51 (6.6%) are changes not in accord with that theory. There were 696 responses (89.9%) which showed no change whatsoever. Both the number of C&H and Other responses are significantly less than the number of None responses. For the difference between C&H and None, $\chi^2 = 619.03$, $p < .001$, and for Other and None, $\chi^2 = 556.93$, $p < .001$. The trend of no change in the vowels of the derived words is clearly the predominant one.

A tabulation of the frequency of target vowel changes in the derived words by critical base vowel and nature of change is shown in Table 4.

TABLE 4 GOES HERE

The suffix which is listed is the contextually appropriate one for the base item. In reading the table, the results for the base item mundane, for example, indicate that regarding the pronunciation of the target vowel for the derived form (mundanity): 36 of the 37 Ss did not change their pronunciation, 1 S changed in a way not predicted by C&H, and no S changed in

accord with the C&H theory.

C&H Predicted Vowel Changes. Of the 27 responses predicted by the C&H theory, 20 were given in response to base items with the vowel [$\bar{a}^{Y}$]. The frequency of 20 [$\bar{a}^{Y}$] responses is significantly greater than that for any of the other base vowels. For the difference between the zero [$\bar{e}^{Y}$] responses, $\chi^2 = 20.00$, $p < .001$, between the 1 [$\bar{a}^{W}$] response, $\chi^2 = 17.19$, $p < .001$, between the 2 [$\bar{I}^{Y}$] responses, $\chi^2 = 14.73$, $p < .001$, and between the 4 [$\bar{o}^{W}$] responses, $\chi^2 = 10.67$, $p < .01$.

Of the 20 [$\bar{a}^{Y}$] responses, 9 were given to sapphire, 4 to tripe, 3 each to Goldstein and termite and 1 was given to snide. The largest difference, that between sapphire and snide is significant, $\chi^2 = 6.40$, $p < .02$. All other differences are not significant.

Non-C&H Predicted Vowel Changes. Of the 51 Other vowel change responses, 29 were given in response to base items with the vowel [$\bar{I}^{Y}$]. The 29 [$\bar{I}^{Y}$] responses is significantly greater than the frequencies for any of the other base vowels. For the difference between the zero [$\bar{o}^{W}$] responses, $\chi^2 = 29.00$, $p < .001$, between the 5 [$\bar{e}^{Y}$] responses, $\chi^2 = 16.94$, $p < .001$, between the 6 [$\bar{a}^{W}$] responses, $\chi^2 = 15.11$, $p < .001$, and between the 11 [$\bar{a}^{Y}$] responses, $\chi^2 = 8.11$, $p < .01$. The frequency of 11 [$\bar{a}^{Y}$] responses, of 6 [$\bar{a}^{W}$] responses, and of 5 [$\bar{e}^{Y}$] responses is each significantly higher than the frequency of zero [$\bar{o}^{W}$] responses, where $\chi^2 = 11.00$, $p < .001$, $\chi^2 = 6.00$, $p < .02$, and $\chi^2 = 5.00$, $p < .05$, respectively. No other difference is significant.

Suffix Differences. A summary of the target vowel changes in derived words by context appropriate suffix and critical base vowel for C&H changes and Other changes is shown in Table 5. With regard to the C&H changes, the -ic suffix total is highest

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TABLE 5 GOES HERE

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with a frequency of 13. While the difference between -ic (13) and -ical (5) is not significant, the difference between 13 -ic and the 3 -ity and 3 -ify totals is significant, $\chi^2 = 6.25$; $p < .02$ in both cases.

The significant suffix differences apparently are not due to an effect of the -ic suffix alone because most of the -ic responses occurred mainly in conjunction with one base vowel, [ā^{y}]. The frequency of [ā^{y}] base item responses is much higher than that of any of the other base item vowels. (The frequency of 17 [ā^{y}] base item responses is significantly higher than the zero responses for the base vowel [ī^{y}], $\chi^2 = 17.00$, $p < .001$, than the 1 response for [ā^{w}] and [ē^{y}], $\chi^2 = 14.22$, $p < .001$ in both cases, and than the 3 responses for [ō^{w}], $\chi^2 = 9.80$, $p < .01$) The significant suffix differences may, therefore, be due to an interaction effect of the -ic suffix with the base vowel [ā^{y}]. However, because all 9 of the -ic responses in the [ā^{y}] vowel category were in response to but a single item, sapphire (there was only this one experimental item which both had an [ā^{y}] critical base vowel and took an -ic suffix), the possibility remains that the observed differences are due instead to the effect of

some idiosyncratic feature of that particular word.

With regard to the Other target vowel changes, the -ity and -ic suffix items received the highest number of responses. The difference between the frequencies for the -ity (20) and the -ic (14) suffix responses is not significant, as are the differences between the frequencies of the -ical (8) and the ify (6) responses with that of the frequency of the -ic respones. However, the differences between the 20 -ity responses and both the 6 -ify and the 8 -ical responses are significant, $\chi^2 = 7.54$, $p < .01$, and $\chi^2 = 5.14$, $p < .05$, respectively.

Here, too, as was noted for the C&H predicted changes, the significant suffix differences apparently are not likely due to the effect of certain suffixes alone, for, 19 of 20 -ity responses were made to but one base word with the vowel [ɪʏ], effete, and 12 of the 14 -ic responses were to two items sapphire (7) and snout (5). Again, the possibility of an effect due to some idiosyncratic feature of the base word cannot be ruled out.

Sex Differences. No significant difference in the performance of males and females was found to obtain in any aspect of either experiment.

DISCUSSION

Validity of VSR and Allied Rules. The results show that the C&H predicted vowel alternation seldom occurs. The differences between and within experiments show no change in the critical vowel from the base to the derived forms for 90% of

the responses. Overall, only 3.5% of the responses affirm the C&H prediction. It is interesting to note that 20 of the 27 C&H predicted vowel change responses were given to base words with the critical vowel [ā^{y}]. The item sapphire + ic produced most of these changes. That only the [ā^{y}-i] alternation is productive to any extent indicates the possibility that a vowel specific rule is operating here for some individuals. It is also worth noting that of the non-C&H predicted vowel changes, most were in response to one item with the critical vowel [ī^{y}] and the -ity suffix, to effete + ity. Again, it is possible that a vowel specific laxing rule is operating here for some individuals. Such a rule, if it were valid, would be one that operates on the phonetic representation of the base form to provide a corresponding lax vowel in the phonetic representation of the derived form.

Besides clearly indicating that vowel alternation seldom occurs, the findings show that laxing both in the Trisyllabic environment (base forms taking the -ify, -ity, and -ical suffixes) and in the suffix-specific environment (base forms taking the -ic suffix), also seldom occurs. Since C&H's VSR can be a general rule only to the extent that laxing is a general rule (according to C&H, the underlying representation must be laxed in order for the predicted derived form to be realized), further evidence against the generality of the VSR is provided. It is evident that C&H's claim that the VSR is a psychologically real and general rule is one that is highly dubious.

C&H's contention that the VSR is a psychologically real and general rule is based on the judgement that derived forms with vowels that alternate are regular while forms which do not alternate are irregular. Thus, the derived forms obscene-obscenity, meter-metric, and nation-national are viewed as regular while obese-obesity, scene-scenic, phoneme-phonemic, vocation-vocational, and transformation-transformational are viewed asirregular. Since the findings of this study indicate that vowel

alternation is largely non-productive, it must be admitted that such rules as the VSR account at best for exceptions, exceptions to the creative pattern of no vowel change in derived forms. Thus, just as C&H have regarded verbs such as keep-kept as irregular but those such as seep-seeped as regular so, too, must derived forms with alternating vowels be regarded as irregular. Clearly, the productivity of a rule--the creative aspect of language use--is a deciding factor in the judging of regularity.

That the criterion of productivity is assigned so critical a role in the determination of the validity and generality of a rule such as the VSR should not be surprising. Productivity is essential for distinguishing, as Maher (1971) neatly puts it, between generative phonology (the creative generativity of living language) and etymology. Sapir (1921) cautions against being "misled by structural features which are mere survivals of an older stage which have no productive life and do not enter into the unconscious patterning" [p. 140], as does Marchand (1969) who states, "Productivity of a derivative type therefore cannot be overlooked in a correct description of a linguistic system, and the linguist who neglects this particular factor [productivity] will be counting 'dead souls' as live people." [p. 5]

Because vowel alternation in derived forms seldom occurred, there is some question as to whether alternations already in the language are to be accounted for by rule at all. It is possible that no rule is involved and that simply representations of both the base and the derived forms are what is listed in the lexicon. (See Steinberg, 1973 and Hsieh, 1972 for details concerning such

a proposal.) However, allowing that speakers may have such rules as the VSR to account for vowel alternations, it must be admitted that these rules account only for exceptions, i.e., exceptions to the creative pattern of no vowel change in derived forms. Since such rules are based on a non-productive exceptional phenomenon, there is little basis for the C&H claim that these rules are "general." To complicate the whole of English phonology simply to accommodate some exceptions is hardly justifiable. If rules are to be used in the generation of these exceptional lexical items, it would

seem far more reasonable to mark such items in the lexicon to undergo special rules which would generate the alternations. (See Krohn, 1972a and 1972b for such a proposal.)

Perhaps a word should be said about some objections which might be raised with respect to our conclusions. If, for example, one wished to argue that the VSR and other allied rules do not operate for the novel derived forms produced in this experiment because such a form, e.g., mazic, is not regarded as a meaningful whole word by Ss, then it should be pointed out that this study provides two pieces of evidence to the contrary: (1) Ss generally selected the context appropriate suffix. Only 18 context inappropriate choices were made in the entire study. (2) Ss generally assigned normal stress to novel derived forms. They even shifted primary stress from the initial syllable of all multisyllabic base forms to the pre-suffix syllable in the derived form. Thus, hóneycomb, quágmire, Góldstein, sápphire, kérosene, cóncrete, and céntipede which received primary stress on the first syllable, had their stress shifted to the last syllable before the suffix, in their derived forms honeycómbical, quagmírish, Goldstéinian, sapphíric, kerosénical, concrétify, and centipédic. Such a shift, by the way, is predicted by Halle & Keyser's (1970) Main Stress Rule of English. In the very few cases where such a shift did not occur, other errors, most commonly the loss of one or more syllables (e.g., térmify) were also involved; even in these cases the Main Stress Rule appears to be operating. Such evidence strongly indicates that Ss did regard the novel derived forms as meaningful whole words.

Another possible objection, one that might be raised by proponents of the C&H analysis is that such an analysis can account for the results of this investigation by taking into account boundary markers.[5] It could be said that the alternation or nonalternation of vowels is simply a matter of whether a (non-formative) word boundary (#) appears between the base form and the suffix whenever the Laxing Rule is supposed to operate.[6] It might be argued that because novel derived forms such as mundan#ity are not already in the S's lexicon, such forms would not be subject to the (not formalized) C&H rule that hanges a # boundary to a + (formative) boundary,[7] and th t since the Laxing Rule operates on the base form plus suffix when a + boundary is present and not when a # boundary is present, then if the # boundary is not removed for novel derived forms, the application of the Laxing Rule would be blocked. In such a case the resulting derived forms would not alternate but would have the same vowel as the base form. Such an outcome would be in accord with the findings of this study and at the same time would preserve the validity of the VSR, Laxing Rule, etc. This solution might be thought to be a viable one until it is realized that the Main Stress Rule would also be blocked from shifting the primary stress in derived items by the presence of the # boundary. Since, as was noted previously, stress did indeed shift as predicted in the experiments, it then appears that the # boundary was removed by the Ss. If that is the case, and the Laxing Rule (which is ordered after the Main Stress Rule) could have applied, why didn't alternation occur? Again, it seems necessary to conclude

that the set of rules which C&H posit to account for vowel alternation is not a valid one.

Validity of the C&H UPRs. In the C&H analysis, the rules governing the vowel alternation phenomenon provide a major part of the link between UPRs and the corresponding phonetic representations. Without the VSR and allied rules, lexical items with tense vowels in their phonetic representation, vowels such as [Iʸ, ēʸ, āʸ, ōʸ, āʷ, ūʷ, ōʷ], cannot be generated from the C&H UPRs. Consequently, the finding that C&H's VSR is virtually nonproductive and thus cannot be a general rule of English renders invalid most of their underlying phonological representations for lexical items. What is required therefore is the postulation of UPRs that are considerably less abstract, i.e. closer to the phonetic level of representation, than they are in the C&H analysis. Proposals pertaining to such representations have been offered by Krohn (1972b) and Steinberg (1973).

UPRs and Dialect Variation. The necessity for a major revision of C&H's UPRs renders less credible their rather extravagant claim (Chomsky & Halle, 1968) that, "It is a widely confirmed empirical fact that underlying representations are fairly resistant to historical change, which tends, by and large, to involve late phonetic rules." [p.49] It is based on this claim that C. Chomsky (1970) asserts that a UPR based orthography would be adequate for "both British and American English, and the vast range of English dialects that exist within each country and around the world." [p.295] Despite the C&H

assertion that it is a "widely confirmed empirical fact" that UPRs are resistant to historical change (one which Kiparsky (1968:187) does not share since he postulates different UPRs for two closely related Swiss-German dialects), this study offers reason to believe that this view is erroneous. The invalidation of the VSR as a general rule, with the consequence that underlying forms must be represented at a level closer to the phonetic level, leads one to expect that the UPRs of lexical items will vary considerably from dialect area to dialect area.

Optimality of Current English Orthography. C&H maintain that current English orthography is near optimal. For C&H this means that the orthography is "rather close" to the UPR (Chomsky & Halle, 1968:184n). According to this view, the alternating vowels of, say, extreme-extremity are not represented by separate symbols in the orthography since their different phonetic realizations are accounted for by general rules. However, since according to the experimental evidence the rules posited by C&H to account for the vowel alternations are not general rules, and since most of C&H's UPRs of lexical items are of dubious validity, the C&H claim about English spelling being optimal is without foundation. No orthography based on C&H's UPRs of lexical items could be optimal (according to C&H's notion of optimality), for such UPRs do not represent a phonological level that is psychologically real for English speakers (see Steinberg, 1973 for further details).

The C&H View of the Speech and Reading Processes. In what is essentially an elaboration of the C&H position on language

performance, C. Chomsky (1970) comments as follows: ". . . In the course of acquiring his language he [a speaker] has internalized the rules of his phonological system, and as a mature speaker he operates in accordance with them both in speaking and in comprehending the spoken language." [p.291] She goes on to discuss the suitability of current English orthography for reading: "Consider . . . the common items of words such as courage/courage-ous, or anxi-ous/anxi-ety, or photograph/ photograph-y/ photograph-ic. Although the phonetic variations are considerable, they are perfectly automatic, and the lexical spellings can ignore them. They will be introduced by the phonological component. Of course, the conventional orthography ignores them as well. These are good examples of cases where the conventional orthography, by corresponding to lexical spelling rather than phonetic representation, permits immediate direct identification of the lexical item in question, without requiring the readers to abstract away from the phonetic details, and presents the lexical item directly, as it were." [p. 291-2]

According to this view, the conventional English spelling of lexical items, which is close to the C&H UPRs, facilitates the reading process because it permits a reader to recover the meanings of the lexical items rather directly. Conventional orthographical representations are thought to provide an input to an internalized underlying representation, thereby obviating the need to use phonological rules in the recovery of meaning. However, given the dubious validity of the C&H

VSR and UPRs, Halle and the Chomskys' views on how English spelling facilitates reading seem highly implausible.

Implications for Teaching Phonology and Reading. Because the learner must first know the phonological rules which relate phonetic representations to UPRs before he can learn a C&H UPR-based orthography, children would ordinarily be halfway through grade school by the time they would be ready to begin to master such an orthography. For, according to Halle and the Chomskys, " . . . full knowledge of the sound system that would correspond to the [UPR] orthography is not yet possessed by the child of six or seven, and may indeed be acquired fairly late." [C. Chomsky, 1970:301] C. Chomsky's solution to this problem of late acquisition of phonological rules is to accelerate the child's normal rate of language acquisition by teaching them more lexical items. With regard to the acquisition of the VSR, she advocates the teaching of a rather sophisticated vocabulary in the early grades. She proposes that "Extending the child's vocabulary to include Latinate forms and polysyllabic derived forms is one of the best ways to provide him with the means of constructing the phonological system of his language more fully as he matures. He ought to become familiar with word groups such as industry-industrial, major-majority, history-historical-historian, wide-width, sign-signature, etc., and have their relationships made explicit for him." [C. Chomsky, 1970:302] However, given the questionable validity of Chomsky and Halle's VSR, other allied rules and UPRs, it is evident that educators need not concern themselves with the problem of having students

acquire such rules and representations. Proposals of teaching materials and techniques which are based on such aspects of the C&H phonological analysis of English are clearly not well motivated.

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FOOTNOTES

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3. We are grateful to John B. Carroll for informing us of this reference.

4. Personal communication from Charles-James N. Bailey.

5. We are indebted to Frederick Jackson for his originality in articulating this argument.

6. According to C&H (1968 :368) the # boundary is one that is "automatically inserted at the beginning and end of every string dominated by a major category, i.e., by one of the lexical categories 'noun,' 'verb,' 'adjective,' or by a category such as 'sentence,' 'noun phrase,' 'verb phrase,' which dominates a lexical category."

7. Unless it can be shown that it has independent support, the rule is subject to the criticism of being ad hoc, i.e., of being motivated solely by the desire to get the derivation to come out right, or by the need to protect the C&H analysis from experimental verification or falsification.

TABLE 1

EXPERIMENTAL ITEMS GROUPED BY CRITICAL BASE WORD VOWEL

BASE[a]	SUFFIX CHOICES[b]		BASE	SUFFIX CHOICES	
[ēʸ] - [æ]			[ōʷ] - [ā]		
maze (N)	-ic	*-ity	trombone (N)	-ic	*-ity
mundane (A)	-ity	*-ical	overgrown (A)	-ity	*-ical
drape (N)	-ify	*-ic	stone (N)	-ify	*-ic
snake (N)	-ical	*-ify	honeycomb (N)	-ical	*-ify
jade (N)	-ish	*-ity	chrome (N)	-ish	*-ity
[īʸ] - [e]			[āʷ] - [ʌ]		
centipede (N)	-ic	*-ity	snout (N)	-ic	*-ity
effete (A)	-ity	*-ical	ground (A)	-ity	*-ical
concrete (N)	-ify	*-ic	house (N)	-ify	*-ic
kerosene (N)	-ical	*-ify	trout (N)	-ical	*-ify
Crete (N)	-ish	*-ity	mouse (N)	-ish	*-ity
[āʸ] - [ɪ]					
sapphire (N)	-ic	*-ity			
snide (A)	-ity	*-ical			
termite (N)	-ify	*-ic			
tripe (N)	-ical	*-ify			
Goldstein (N)	-ian	*-ity			
quagmire (N)	-ish	*-ity			

[a]The phonetic symbols indicate the critical vowel of the base word and the C&H predicted vowel in the derived word, respectively. N = Noun, A = Adjective.

[b]The asterisk indicates the contextually inappropriate suffix choice.

TABLE 2

SUMMARY OF RESPONSES BY EXPERIMENT AND NATURE OF CHANGE

EXPERIMENT	No. Ss		C&H	Other	None	Total
I	24		12	34	408	454
		%	2.6	7.5	89.9	100.0
II Cond 1	8		7	3	155	165
		%	4.2	1.8	93.9	100.0
II Cond 2	8		8	14	133	155
		%	5.2	9.0	85.8	100.0
II Cond 1 & 2	16		15	17	288	320
		%	4.7	5.3	90.0	100.0
I & II	40		27	51	696	774
		%	3.5	6.6	89.9	100.0

TABLE 3

FREQUENCY OF NON-C&H PREDICTED RESPONSES (OTHER)

BY CRITICAL BASE VOWEL FOR EXPERIMENTS I AND II.

Experiment I (Total = 34)

ALTERNATION		f	ITEM
Base	Derived		
ɪʸ	i	18	effete (12), centipede (2), concrete (2), kerosene (2)
ā ʸ	æ	3	sapphire (3)
ā ʸ	ɪʸ	3	Goldstein (3)
ā ʸ	ā	1	sapphire
ā ʸ	e	1	sapphire
ā ʷ	ā	5	snout (5)
ē ʸ	i	2	mundane (1), drape (1)
ē ʸ	ɪʸ	1	snake

Experiment II Condition 1 (Total = 3)

ɪʸ	i	3	effete (2), kerosene (1)

Experiment II Condition 2 (Total = 14)

ɪʸ	i	8	effete (5), kerosene (2), concrete (1)
ā ʸ	ā	1	tripe
ā ʸ	e	1	sapphire
ā ʸ	æ	1	sapphire
ā ʷ	ā	1	house
ō ʸ	i	1	snake
ō ʸ	ɪʸ	1	drape

TABLE 4

EXPERIMENTS I & II COMBINED.

RESPONSES BY CRITICAL BASE VOWEL, BASE WORD AND NATURE OF CHANGE. N = 40

Base	Suffix		C&H	Other	None	Total
maze	ic		0	0	38	38
mundane	ity		0	1	36	37
drape	ify		0	2	38	40
snake	ical		0	2	32	34
			0	5	144	149
		%	0.0	3.4	96.6	100.0
centipede	ic		0	2	34	36
effete	ity		2	19	14	35
concrete	ify		0	3	31	34
kerosene	ical		0	5	33	38
			2	29	112	143
		%	1.4	20.3	78.3	100.0
trombone	ic		3	0	37	40
overgrown	ity		0	0	37	37
stone	ify		0	0	40	40
honeycomb	ical		1	0	34	35
			4	0	148	152
		%	2.6	0.0	97.4	100.0
snout	ic		1	5	32	38
ground	ity		0	0	36	36
house	ify		0	1	39	40
trout	ical		0	0	38	38
			1	6	145	152
		%	.7	3.9	95.4	100.0
sapphire	ic		9	7	24	40
snide	ity		1	0	31	32
termite	ify		3	0	29	32
tripe	ical		4	1	31	36
Goldstein	ian		3	3	32	38
			20	11	147	178
		%	11.2	6.2	82.6	100.0
	Grand Total		27	51	696	774
	Percentage		3.5	6.6	89.9	100.0

TABLE 5

EXPERIMENTS I & II COMBINED.

C&H AND OTHER RESPONSES BY CRITICAL BASE VOWEL AND SUFFIX.

CHOMSKY & HALLE CHANGES

Base Vowel	Suffix ic	ity	ify	ical	ian	Total
ēy	0	0	0	0	--	0
Īy	0	2	0	0	--	2
ōw	3	0	0	1	--	4
āw	1	0	0	0	--	1
āy	9	1	3	4	3	20
Total	13	3	3	5	3	27

OTHER CHANGES

Base Vowel	Suffix ic	ity	ify	ical	ian	Total
ēy	0	1	2	2	--	5
Īy	2	19	3	5	--	29
ōw	0	0	0	0	--	0
āw	5	0	1	0	--	6
āy	7	0	0	1	3	11
Total	14	20	6	8	3	51