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On the Acquisition of the Vowel Shift Rule<sup>1</sup>

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1.0 Introduction. One of the most fundamental assumptions of generative phonology and the more current lexical phonology is that the lexicon is made up of entries which contain not only semantic and syntactic information, but also particular phonological forms. Morphemes which have different pronunciations in different morphological environments are represented by only one lexical entry, and the various surface pronunciations are then derived by phonological rules. In representing the allomorphs of a morpheme as derived by ordered phonological rules from a single lexical representation with a specific phonological shape, this theory sets out a potentially formidable task for the language learner: to abstract from surface forms the correct mental representation of each set of allomorphs, and to abstract the appropriate rules, in the right order, which would assign the conventional pronunciation to each surface form.<sup>2</sup>

No one would claim that very young children, who have a simple vocabulary which probably does not include many alternating allomorphs, will have begun in spite of this to set up abstract phonological representations in their lexical entries. The most straightforward hypothesis about young children's representations is that they are isomorphic with their pronunciations. A generativist scenario for developing lexical entries would proceed as follows: First, the child begins to learn more and more of the relevant vocabulary, and recognizes that words with alternating allomorphs are related, both semantically and phonologically. Second, the child begins to recognize, probably unconsciously, recurrent phonological alternations occurring in different sets of allomorphs. Because it is assumed that the human mind is designed to minimize memorization and maximize the amount of information that can be consigned to rules, the child will now begin to extract these patterns of alternation, formulating them into rules. At this point the child will need to perform a major restructuring of his or her mental lexicon, since the formulation of these rules will allow a number of entries which were previously stored separately to be collapsed into one; this sort of collapsing represents a new and very different hypothesis for the child about how the lexicon can be structured overall. Note that this theory makes two important assumptions: first, that the child can and will automatically perform this restructuring, and second, that the source of the restructuring of the lexicon is as described above: learning new lexical items, noticing recurrent phonological patterns in related allomorphs, and abstracting out the appropriate lexical forms and rules.

The question to be asked in this paper is the following: Is there any psychological evidence that the above scenario for setting up abstract phonological representations is in fact

followed by language learners? Because of the importance of the Vowel Shift Rule (hereafter VSR) in generative and lexical phonology, and the growing body of experimental evidence about its psychological reality, this study concentrates on evidence relating to the acquisition of phonological representations for English vowels, which crucially depend on this and concomitant rules to generate their surface pronunciations. In the first part of the paper I present data from a three-year-old child, looking for evidence as to whether she has begun to set up abstract phonological representations for vowels and to abstract the VSR. In the second part of the paper I review evidence from experiments with older children and adults which show that certain aspects of the VSR do have some psychological reality. In the third part of the paper evidence is presented which bridges the gap between the three-year-old and the older children, and I show that both the time that the VSR begins to develop some psychological status and the source of this status can be pinpointed exactly; I demonstrate, however, that the development of knowledge of VSR does not follow the scenario outlined above, but in fact can be attributed to a very different source. In the final section the theory of abstract lexical representations is briefly evaluated in light of the evidence presented here.

**2.0 The Vowel Shift Rule.** Before turning to the data, I will summarize the relevant facts about the Vowel Shift Rule. In *Sound Pattern of English*, Chomsky & Halle (1968; hereafter C&H) proposed a core set of rules for deriving surface vowels in English, of which the VSR was the central member; these rules were claimed to be crucial to the synchronic phonology of English. In this theory, two related words with different surface vowels were derived from the same underlying form; for many pairs, the VSR (along with a diphthongization rule and various backness and rounding adjustments) derived the surface tense vowels, and a Laxing Rule derived the surface lax vowels. The six pairs of vowels derived by this core set of rules are shown in Table 1.

Because *Sound Pattern* was published 18 years ago, it might seem somewhat out of date to be concerned about specific claims made therein. However, in Halle & Mohanan's (hereafter H&M) 1985 article 'Segmental phonology of modern English', written in the

**Table 1**

Vowel pairs participating in the Vowel Shift Rule: (C&H 1968).

| Underlying Vowel | Surface Reflexes | Examples            |
|------------------|------------------|---------------------|
| /i/              | [ay-ɪ]           | divine-divinity     |
| /ē/              | [iy-ɛ]           | serene-serenity     |
| /æ/              | [ey-æ]           | sane-sanity         |
| /ū/              | [aw-ʌ]           | profound-profundity |
| /ō/              | [uw-a/ɔ]         | lose-lost           |
| /ɔ/              | [ow-a/ɔ]         | verbose-verbosity   |

framework of Lexical Phonology, the VSR and its concomitant set of rules continues to be a central part of the analysis. In this paper they argue that

...our study confirms the central role of Vowel Shift in the phonology of English. Vowel Shift has been shown to interact with various kinds of lengthening and shortening rules...as well as with Velar Softening...and the ablaut rules of the "strong verbs"...Though this evidence does not constitute proof that Vowel Shift is part of the synchronic phonology of modern English, the facts adduced are of a complexity and variety that would make it extremely difficult to propose an alternative treatment without Vowel Shift. (Halle & Mohanan 1985:103-4)

In H&M's treatment of English Vowels, there are several changes from *Sound Pattern* as to which vowel pairs are related by VSR; their set of eight vowel pairs related by VSR are shown in Table 2. Otherwise much of the analysis of English vowels is unchanged from the *Sound Pattern* version.

### 3.0 Is the VSR learned by young children? A case study.

**3.1 Introduction.** Let us now turn to some actual data from a child in the process of learning English. The data to be presented are taken from an intensive longitudinal study which I performed with my daughter Anna from the time she was six months old until she was three and one half. At the time of the current study she was three years two months old (3.2); she was somewhat advanced linguistically, and her pronunciations were almost identical to the adult model she heard most often. She easily produced long, complex sentences, and was particularly aware of language, often volunteering information on her intuitions about word meanings, rhyming, and so on.

The purpose of looking at these data is to help identify the earliest age at which language learners might begin to do the restructuring discussed above: that is, begin to abstract rules such as the VSR and set up unitary phonological representations for alternating allomorphs. In order to see whether Anna could have begun this restructuring, I will ask the following questions

**Table 2**

Vowel pairs participating in the Vowel Shift Rule: (H&M 1985).

| Underlying Vowel | Surface Reflexes | Examples            |
|------------------|------------------|---------------------|
| /ɪ/              | [ay-ɪ]           | divine-divinity     |
| /ē/              | [iy-ɛ]           | serene-serenity     |
| /æ/              | [ey-æ]           | sane-sanity         |
| /ī/              | [aw-ʌ]           | profound-profundity |
| /ā/              | [uw-ʌ]           | reduce-reduction    |
| /ū/ or /ū̄/      | [ɔy-ʌ]           | destroy-destruction |
| /ō/              | [uw-a/ɔ]         | lose-lost           |
| /ō̄/             | [ow-a/ɔ]         | verbose-verbosity   |

with reference to her data: First, has she begun to notice that there are words which are related, either morphologically or semantically? Second, do these words contain the appropriate alternations, such that she could have begun to abstract out the VSR? It is only if these two conditions are met that she would have the appropriate input to begin the restructuring process.

**3.2. Derivational morphology.** In the first part of this study I scanned journal entries for a year, from the time Anna was 2.2 to 3.2, looking for evidence that she considered any pairs or sets of words to be related, which for adults are related by derivational morphology, including compounding. Furthermore, I made up a list of over 100 pairs of such words related by the VSR, and checked whether there were any pairs of which she knew both members. Evidence that she considered words to be related consisted of both covert and overt types. An example of covert evidence would be the utterance: "Jump, jump, jump. We are jumping over a moon. What a good jumper!" spoken at age 2.2; this was taken as evidence that she considered 'jump,' 'jumping,' and 'jumper' as related. More overt evidence came from statements such as "Mommy, 'apple' and 'apple juice' begin to rhyme" (said at 3.1, meaning they begin with a rhyme), or the following interesting observation, showing that she thought that 'air conditioner' was related to the names of some family friends, 'Eric 'n' Lorell': "Mommy, turn on the air conditioner; you know, like Eric 'n' Lorell; 'ditioner' means you get cold". Based on evidence such as this I compiled a list of words related by derivational morphology or compounding which Anna considered related; this list is shown in Table 3.

It is clear from this list that Anna definitely had the idea that words can be 'related' in some way. However, in scanning the list it can be seen that she knew *no* pairs of words in which there is a shift in the vowel from one member to the other. The derivational morphemes which Anna used are all of the type which do not trigger shifting (and of course compounding does not trigger shifting either). Anna's ability to consider two words related seemed to be constrained by how similar they are in both form and meaning; furthermore, English words related by derivation and containing some vowel shifting are for the most part a more advanced vocabulary than one would expect a three-year-old to know. From these data it can be hypothesized that children this young can clearly have the idea that words can be 'related'; however, their limited vocabulary and concrete expectations about the closeness of the semantic and phonological match-up between related words makes it unlikely that any abstract analyses of the mental representation of these words has begun.

**3.3 Inflectional morphology.** It is perhaps not surprising that a three-year-old does not have the vocabulary which exhibits Vowel Shift alternations in derived pairs of words, since most of these words, as mentioned above, are part of the Latinate, learned vocabulary of English. Kiparsky and Menn (1977) argue that it is through alternations contained in strong verbs, such as 'feed-fed' or 'bite-bitten', that children first begin to develop knowledge

**Table 3**

Word pairs related by derivation or compounding, treated as related by S from age 2.2 to 3.2.

- A. Pronouns: you-your-you's; my-mine-mine's.
- B. Comparatives  
 1) good-best (suppletive)  
 2) big-bigger, little-littler, small-smaller, tall-taller, fast-faster. ([ð] comparative)  
 3) strong-strongest, best-bestest. ([-ɪst] superlative)
- C. Agentive [-ə]  
 jump-jumper, help-helper, paint-painter, cut-cutter, bake-baker, sing-singer, dance-dancer.
- D. Instrumental [-ə]  
 dry-dryer, ham-hammer
- E. Diminutive [-i]  
 1) dog-doggie, no-noie, up-uppie, down-downie, off-offie, popcorn-popcornie, tape-tapie, etc.  
 2) blanket-blankie, breakfast-breakfie, chocolate-chocklie (etc., with deletion of rime of final syllable).
- F. Adjectival [-i], [ɪʃ]  
 1) sun-sunny, scream-screamy, scared-scarey, rain-rainy, bubble-bubbly.  
 2) stripe-stripish.
- G. Adverbial [-li]: quiet-quietly, nice-nicely.
- H. Nominal -ion  
 cooperate-cooperation, decorate-decoration
- I. Noun-Verb (zero derivation)  
 dress, drink, paint, cover
- J. Compounds  
 1) wash-washing machine, swim-swimming pool, wrap-wrapping paper, stare-starecrow (i.e. 'scarecrow'), poke-Pinocchio ([p'owkijow]). (V-N)  
 2) bath-bathtub-bathroom, belt-seat belt, table-tablecloth, tea & cup-teacup, apple & juice-applejuice, paint & brush-paintbrush, tooth & brush-toothbrush, pillowcase-suitcase, grapefruit-grapejuice, fire-pacifier. (N-N)
- K. Other forms considered to share morphemes  
 antelope-cantaloupe, seagull-eagle, serpent-sherbet, jungle-juggle, bran muffin-brand new, pretzle-pencil, syrup-catsup, chipmunk-monkey, air conditioner-Eric 'n' Lorell.

of Vowel Shift alternations. In order to test whether strong verbs were a possible source of incipient knowledge of the VSR for the child in this study, I performed an experiment to see which pairs of strong verbs containing vowel alternations she knew both the present and past tense or past participle of, and she considered related. At the time of the study she was going through a stage in which she produced nearly all verbs with regular past tense endings; however it was clear that she understood many irregular past tense forms, and therefore it could be hypothesized that she had some mental representation for them. In this study I told her a story, in the past tense, and asked her to act it out; as she performed the various requested actions, I asked her questions about what she was doing, which she answered in the present tense. She was scored on both her actions and her verbal responses. The following interaction, for example, was taken as evidence that she knew the forms 'dive-dove', and knew that they were related:

M: Yesterday Anna went to the swimming pool and she dove in.

A: (pretends to dive)

M: What are you doing?

A: I'm diving into the pool!

In this way Anna was tested for her knowledge of a total of 143 pairs of verb forms; the list of verbs was taken from Bloch 1947.

The results of this experiment are shown in Table 4. This table shows the number of vowel pairs in the verb forms that Anna showed evidence of knowing, organized by both specific vowel alternation, and class of vowel alternation: VSR, Lax-Lax, Non-VSR Tense Lax, and Tense-Tense. Further, this table contains, under the 'adult' heading, a count of the number of pairs in the original list of 143 which have each of the vowel alternations. It can be seen from this table that Anna knew 71 pairs of verbs with vowel alternations in their present-past or present-past participle forms; of these, only 14, or 20%, contain VS alternations, and only three of the VS alternations contain more than one exemplar. There are in fact 27 different types of vowel alternations in her data, and only five are of the VSR type. It seems clear from this tabulation that Anna's knowledge of related verb forms gives her no basis from which to extract any particular regularities in vowel alternation patterns. More importantly, *the same can be said for the adult pattern as a whole*. Although VS alternations are the second most frequent pattern type for adults, only two of the VS alternations have substantial numbers of exemplars: [iy-ε] and [ay-ɪ]; three alternations have no exemplars. In general the number of different possible alternations involved in strong verb inflections is such that it would be unrealistic to expect that speakers will extract some particular regularities out of the pattern, specifically the VSR or H&M's lowering and backing ablaut rules, and consider others exceptions. Furthermore, Table 5 shows that words with VSR type alternations have the lowest frequency of any of the verbs in this study.

**Table 4**

Number of verbs known by S at 3.2 containing specified vowel alternations in present vs. past tense or past participle, and number of irregular verbs with each vowel alternation in English ("Adult"; taken from Bloch 1947). "Vowel Shift" includes the 8 pairs from Halle & Mohanan 1985.

| <u>Vowel Shift</u> | <u>Child</u> | <u>Adult</u> | <u>Lax-Lax</u> | <u>Child</u> | <u>Adult</u> |
|--------------------|--------------|--------------|----------------|--------------|--------------|
| [iy-ε]             | 6            | 24           | [i-æ]          | 9            | 13           |
| [ey-æ]             | 0            | 0            | [i-a]          | 2            | 2            |
| [ay-i]             | 3            | 10*          | [i-ʌ]**        | 9            | 22           |
| [ow-a/ɔ]           | 1            | 1            | [ε-a]          | 2            | 4            |
| [uw-ʌ]             | 1            | 1            | [æ-u]          | 2            | 3            |
| [aw-ʌ]             | 0            | 0            | [æ-a]          | 1            | 1            |
| [uw-a/ɔ]           | 3            | 4            | [æ-ʌ]          | <u>2</u>     | <u>2</u>     |
| [ɔy-ʌ]             | <u>0</u>     | <u>0</u>     |                | 27           | 47           |
|                    | 14           | 40           |                |              |              |
| % of total         | 20%          | 28%          |                | 38%          | 33%          |

**Non-VS**

| <u>Tense-Lax</u> | <u>Child</u> | <u>Adult</u> | <u>Tense-Tense</u> | <u>Child</u> | <u>Adult</u> |
|------------------|--------------|--------------|--------------------|--------------|--------------|
| [iy-a]           | 1            | 5            | [iy-ey]            | 1            | 1            |
| [ey-ε]           | 1            | 1            | [iy-ow]            | 3            | 6            |
| [ey-u]           | 2            | 3            | [ey-ay]            | 2            | 2            |
| [ey-i]           | 1            | 1            | [ey-ow]            | 2            | 2            |
| [ey-ʌ]           | 1            | 1            | [ey-uw]            | 0            | 1            |
| [ay-a]           | 1            | 2            | [ay-æw]            | 2            | 4            |
| [ay-ʌ]           | 0            | 1            | [ay-ow]            | 4            | 10           |
| [ow-ε]***        | 4            | 8            | [ay-uw]            | 1            | 1            |
| [uw-i]           | <u>0</u>     | <u>1</u>     | [ow-uw]            | 4            | <u>6</u>     |
|                  | 11           | 23           |                    | 19           | 33           |
| % of total       | 15%          | 16%          |                    | 27%          | 23%          |

\* Mainly past participles, e.g. drive-driven.

\*\* Includes hear-heard, i.e. [iɪ-ɛ].

\*\*\* Includes four tokens with vowels [ɔr-εɪ], e.g. torn-tear.

**Table 5**

Frequency Data (from Carroll, Davies & Richman 1970). Average frequencies of past tense forms of strong verbs with indicated vowel alternation types; figures are for number of instance per million words of text.

| <u>Non-VS</u> | <u>Tense-Lax</u> | <u>Tense-Tense</u> | <u>Lax-Lax</u> | <u>Vowel Shift</u> |
|---------------|------------------|--------------------|----------------|--------------------|
| 1878          |                  | 427                | 357            | 333                |

Again it must be concluded that Anna knew many pairs of present/past tense strong verb forms, and knew that they are related to each other. But the heterogeneity of the vowel alternations present in those words is so great as to argue against the possibility that she could have begun to develop any rules to account for them. Therefore it is most likely that she was storing the alternating forms separately in the lexicon, with some sort of semantic link between them. Combined with the findings of the first part of this study, I conclude that at this point in her development, age 3.2, Anna stored her entire vocabulary in forms identical to her pronunciations.

**4.0 Do adults know the Vowel Shift rule?** I now turn to data from experiments with older children and adults. A great deal of experimentation has been done to test the psychological status of C&H's VSR; most of these studies have been summarized in Table 6. Only the most important findings of these studies are discussed here, but for thorough reviews see Jaeger 1984 and Wang 1985.

Experiments testing the productivity of the VSR have found that for the most part it is not productive in spoken English; when asked to derive an existing or a nonsense adjective with a nominal suffix such as *-ity*, which should trigger Vowel Shift, most subjects produce the derived form with the vowel unchanged. In Wang's (1985) study he forced his Ss to shift the vowel; under these conditions the alternations [ey-æ], [iy-ε], [ay-ɪ] and [ow-ɔ] showed significant strength, but all other VSR alternations showed none (he was testing the eight pairs from H&M). The frequency with which Ss responded with a particular shifted vowel correlated positively with the frequency with which the lax vowel occurs in existing words before the suffix *-ity*. In a further study, Wang presented Ss with nonsense present tense verbs, and had them give a 'strong' past tense, with a shifted vowel. He gave another group of Ss nonsense nouns, and had them form a plural with a shifted vowel. In the verb condition, Ss preferred past tense responses with [æ] or [ow], regardless of the vowel in the present tense form; in the noun condition Ss preferred responses with [iy]. In both cases these are the vowels which occur most frequently in past or plural forms respectively; VSR alternations, or H&M's backing and lowering ablaut rules showed absolutely no psychological strength. This is not surprising, given the heterogeneity of alternations in these forms discussed above.<sup>3</sup>

When the unsuccessful productivity experiments were reported in the literature, it was argued, notably by Kiparsky (1975), that VSR is most likely a "partially productive" rule, which might figure in learning and memory but not be actively productive. In order to test this, Cena (1978) performed an experiment in which Ss memorized nonsense adjective-noun pairs, some with VSR alternations and some with non-VSR alternations. Four of the VS pairs did show significant strength in facilitating Ss' memorizations, but the fifth pair tested, [aw-ʌ], showed no psychological

**Table 6**

Summary of experiments on VSR with adults and older children.

- A) Steinberg & Krohn (1975): Productivity exp. with adults, using adjectives and nouns in -ity. Results: VSR is not productive in spoken English; Ss derive new words without shifting vowel.
- B) Ohala (1974): Productivity experiment with adults. Results: VSR is not actively productive in spoken English, though some shifting, both according to VSR and in non-VSR patterns, can be elicited through presenting models.
- C) Myerson (1976): Three experiments with children, grades 3 through 12. Results: VSR is not actively productive; Ss show slight preference for VSR-related pairs of words with alternations [iy-ε, ey-æ] over phonetically related [iy-ɪ, ey-ε]; Ss learn and remember pairs of nonsense words with these two VSR pairs better than those with the phonetically related pairs.
- D) Armbruster (1978): Series of experiments with adults. Results: Some Ss can be induced to shift vowel in productivity exp. when shown written models, but likelihood of doing so is positively correlated with Ss' level of education and verbal S.A.T. scores. In a preference test, Ss' prefer pairs with identical vowels, but when shown written nonsense nouns in -ity will read them with lax vowel. Conclusions: Spelling is crucial.
- E) Templeton (1979): Productivity experiment with children 11-16; usually do not shift vowel, but do so most often when presented in written sentence context.
- F) Moskowitz (1973): Concept-formation exp. with children 9-12. Results: Ss most easily form and productively use concept of VSR-related (as opposed to non-VSR) alternations (tested only front vowels). Conclusion: source is knowledge of spelling rules.
- G) Cena (1978): Learning experiment with adults, memorizing pairs of nonsense words with VSR and non-VSR alternations. Results: Ss learned VSR pairs [ey-æ, iy-ε, ay-ɪ, ow-ɔ] faster and with fewer mistakes than non-VSR, but [aw-ʌ], behaved like non-VSR pair.
- H) Jaeger (1984): Concept formation exp. with adults. Results: Ss can learn concept 'Pairs of words related by VSR' based on the pairs [ey-æ, iy-ε, ay-ɪ, ow-ɔ]; when given opportunity to extend it to new pairs, Ss include [uw-ʌ] in the category, and exclude [aw-ʌ]. Conclusion: This set of 5 vowel alternations has special psychological status only because they are those taught as the 'long and short' versions of the vowel letters A, E, I, O, U.
- I) Wang (1985): Series of experiments with adults. Results: When forced to shift vowel in a productivity experiment with nonsense adjective-noun pairs, only some VSR pairs show strength; these are related both to spelling, and the frequency of each vowel pair in existing words. In strong verb present/past pairs, Ss answered with [æ, ow] for past tense regardless of present vowel; in irregular noun plurals, Ss preferred [iy]; these results are totally explained by frequency. Jaeger's CF test replicated with broader range of Ss and vowel pairs, and same results obtained.

strength. Cena concluded that the VSR is psychologically real, but did not try to explain the aberrant behavior of this latter pair of vowels. A similar experiment was performed by Myerson (1976) on children, grades 3-12, but she only tested (and got positive results for) the vowel pairs [ey-æ] and [iy-ε].

McCawley (1979) pointed out that a major problem with all of the VSR experimentation being done was that it assumed that the particular set of vowels designated by C&H was the correct group which belonged together in a psychologically real set. Jaeger (1980, 1984) noticed that the vowel pairs which showed psychological strength in Cena's experiment, as well as all previously reported experiments, were just those pairs which are taught in school as being the 'long and short' versions of the vowel letters 'A, E, I, and O'. Building on the conclusions reached by Moscovitz (1973), based on a concept formation experiment performed on 9-12 year old children, Jaeger performed a concept formation experiment with adults. She tested the hypothesis that if indeed Ss' knowledge of spelling was shaping their performance in these VSR experiments, then Ss would consider the alternation [uw-ʌ] to be a member of the set of vowel pairs just mentioned, because it is the pair of vowels taught as the 'long and short' pronunciations of the vowel letter U. If, however, it was C&H's VSR which was guiding Ss' performance, then Ss' should consider [aw-ʌ] to be the fifth member of the set. Ss' categorizations upheld the spelling-rule prediction, in that they clearly considered [uw-ʌ] a member of the set, and they uniformly rejected the pair [aw-ʌ]. Wang (1985) replicated Jaeger's study with a larger sample of Ss, systematically testing all the alternations said to belong to the VSR-governed group in H&M, and got identical results: the VS pairs which Ss' grouped together into a set were the five pairs designated by the five vowel letters of English. Both Jaeger and Wang argue that most of the results of the experiments discussed here can be explained with reference to speakers' knowledge of orthography; Wang further shows that the residue can be explained by frequency, as described above. None of the experiments give any support to the psychological reality of the particular sets of vowels indicated in either C&H or H&M, and therefore they give no support to the psychological existence of the VSR as formulated in either theory.

**5.0 Transition into knowledge of VSR.** It is one thing to claim that adults' knowledge of VSR reflects their knowledge of spelling rules; but it is a much stronger claim to argue that spelling rules are the *original source* of this knowledge. In the studies reviewed here, we have looked at one articulate three-year-old who gives no evidence of knowing the VSR, and we have seen evidence (from the Myerson and the Moskowitz studies) that elementary school-aged children do show knowledge of those VS alternations which are reflected in spelling. These studies clearly flank the critical time period in which children develop this knowledge, and they also flank the time period in which children learn spelling

conventions. An important question remaining to be asked is whether or not children actually begin to develop some knowledge of VSR before they learn to spell. If so, their knowledge of spelling may serve only to reinforce a rule they have already worked out; the fact that it does not coincide with the set of alternations posited to be linked by the VSR may be due to the spelling conventions overriding the psychological status of some previously included alternations, especially [aw-ʌ].

There is strong evidence from children learning to spell that children go into this process with no knowledge of VSR. Ehri (1986) has divided the process of learning to spell into three stages. In the first, 'semiphonetic' (from pre-kindergarten to the middle of the first grade), children use the names of letters to create spellings. For the vowels, children use the vowel letter whose name is the closest phonetically to the vowel sound. Table 7 shows the letter-sound groupings documented by Read (1971) for American English speaking children in this stage; notice that all the vowels spelled by the same letter are phonetically similar to each other.

The second of Ehri's stages is called 'phonetic', since children at this point work on the principle of associating one letter with every sound, according to the segmentation conventions of their language; this stage begins during the second half of first grade. The most important and most difficult task of this stage is learning to associate the 'short' vowel sounds with the appropriate vowel letter. Children show that they are concentrating on this task by completely ignoring the 'long' vowel pronunciations of the letters for the duration (which are, of course, the same as the name of the vowel letter, so were learned during stage 1); this indicates that for them the association of these particular tense and lax vowels, i.e. those designated by VSR for the most part, is very unnatural and can only be accomplished by setting the tense versions aside while the lax versions are committed to memory.

The third stage in Ehri's analysis is the 'morphemic' stage. It is at this stage that children actually begin to learn some of the derivational vocabulary with alternating vowels, and they begin to learn that related words are often spelled the same although pronounced differently. (Note that children do not begin to learn the relevant derivational vocabulary until after they

Table 7

Children's spontaneous spellings of English vowels (Read 1971).

| <u>Letter Used</u> | <u>Vowel Sounds Represented</u> |
|--------------------|---------------------------------|
| A                  | [ey, ɛ, æ]                      |
| E                  | [iy, i, ɛ]                      |
| I                  | [ay, a, ʌ]                      |
| O                  | [ow, ɔ]                         |
| OW, U, OO          | [u]                             |

have already memorized the spelling-rule pairings for vowels.) However, research cited by Ehri shows that children essentially begin to memorize the correct spellings, rather than extracting some principles about spelling and word relatedness.

In sum, it has been shown that pre-literate children have no knowledge of VSR, and that literate children and adults show knowledge of only those VS alternations that are associated with the vowel letters. This, combined with the evidence that children find learning to associate VS pairs with a particular letter one of the most difficult tasks involved in learning to spell, strongly supports the hypothesis that spelling is indeed the source of English speakers' knowledge of VS alternations.

**6.0 Conclusions.** The last question to be asked here is: so what? Showing that even as central a rule as the VSR does not have the psychological status previously claimed does not invalidate the entire theory. Perhaps not, but it does raise some serious questions about morpheme-invariant lexical representations.

There is a great deal of evidence from perception and production experiments that speakers do in fact store their entire vocabulary in surface forms. In this paper it has been demonstrated that pre-literate children store *only* surface forms, and that it takes the extremely strong force of literacy to get them to view certain vowel relationships in a way different from simple phonetic groupings. But the fact that they learn this marginal, unproductive, spelling-related rule does not mean that they have done any restructuring in their lexicon because of it. Again the most straightforward hypothesis is that speakers continue to store most of their lexicon in surface forms (or perhaps Sapirian phonemes; see McCawley 1986), and develop a set of linking rules, such as this Vowel-Spelling rule, indicating various interrelationships among words.

In fact generativists since at least Halle 1973 have acknowledged that all surface forms are *also* stored in the mind, and are accessed for production and perception. Abstract lexical entries and rules are claimed to have the function of characterizing speakers' knowledge about their language, but they do not function in performance. This claim raises at least three important problems: First, it shows that one of the basic justifications for setting up morpheme-invariant lexical entries, which is that the mind prefers little memorization and much rule-governed variation, has been totally undermined and abandoned. Second, it continues to beg the all-important but perpetually unresolved question about the relationship between speakers' knowledge and performance. Third, it ignores the fact that any number of simpler possibilities for characterizing speakers' knowledge could be and in fact have been suggested, which do not depend on the elaborate abstract formalisms developed in generative theories (see, e.g., Derwing 1973, Vennemann 1974, Hooper 1976, Linell 1979, Wang 1985, McCawley 1986). An obvious theory would be the one indicated above: speakers store words in

surface forms, and have a set of linking or redundancy rules, characterizing phonological and semantic relationships. These sorts of theories deserve more attention than they are currently receiving.

My main point is this: there is very little psycholinguistic evidence supporting the existence of abstract phonological representations and complex rule systems such as the one the VSR is an integral part of. If the purpose of generative and lexical theories is to describe most simply, economically, and thoroughly, all the interrelationships among words which a linguist can ascertain, then the lack of psycholinguistic evidence is acceptable, and the theory can be said to be following in the illustrious but non-psychological footsteps of Leonard Bloomfield and other structuralists. If, however, the purpose is to characterize the knowledge speakers have about their lexicon, in a form which reflects the form in which speakers store this knowledge, then these theories need to be more sensitive to evidence from psycholinguistic and language acquisition studies such as those presented in this paper.

#### Footnotes

1. This is a condensed and somewhat revised version of a paper entitled 'On the acquisition of abstract representations for English vowels', which will appear in *Phonology Yearbook*, V. 3, 1986, and is being published here with the permission of Cambridge University Press. I wish to thank John Ohala, Bruce Derwing, and Linnea Ehri for useful discussions of this research.
2. Many of the claims made by generativists about the innateness of specific linguistic structures and processes have been developed to support the claim that children can and do perform this task. However, as the existence of these innate capacities has yet to be convincingly demonstrated, the difficulties involved in acquiring abstract phonological representations cannot be explained away by 'innateness'.
3. There are only nine nouns in English which form plurals by (at least) changing the vowel, and only one contains a VSR alternation; four contain the vowel [iy] in the plural form.

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