A limited analysis of alternative approaches to phonemic-level word attack instruction is provided in this document. The instruction segment begins with training in letter-sound correspondences for which mastery of certain skills is assumed. Instruction ends with the decoding of novel items having a consonant-vowel-consonant construction. Contents outlined consist of the following: preliminary assumptions, terms and definitions, associative training items, rules and hypotheses, instructional paths, and training-testing item universes. (JM)
ABSTRACT

A quasi-formal model explicates a number of factors underlying investigation of effectiveness of alternative segmentation-blending rules in preliminary phonemic-level word attack instruction. Being taxonomic, the model does not predict; rather it reveals conditions to which segmentation-blending hypotheses of potential interest reference.
WORD ATTACK MODEL

A limited analysis of alternative approaches to phonemic-level word attack instruction is provided below. The segment of instruction considered begins with training referenced to letter-sound correspondences; certain entry skills underlying this training are assumed. It ends with the child required to decode novel CVC items, thus revealing 1st-order generalization skill referenced to a segmentation-blending rule and appropriate training. The model is quasi-formal; it better reveals the conditions to which hypotheses reference than would a typical study proposal; however, it is less explicit and rigorous than a formal model would be.

1. Preliminary Assumptions

1.1 The instructional domain is that of preliminary phonemic-level word attack skills. The child enters instruction able to match written constructions of forms L, VC and CVC (grapheme, written vowel-consonant, written consonant-vowel-consonant) and also spoken constructions of forms /L/, /VC/, and /CVC/ (phoneme, spoken-blended vowel-consonant, spoken-blended consonant-vowel-consonant). While writing skill is not assumed the child on entry can achieve "written spellings" using Scrabble-like graphemic materials suitably arrayed.

1.2 Criterion response forms, of equal instructional value, are:
   a) Articulation-pronunciation of words and word elements presented to the child in written form. b) Construction of "written spellings" of words and word elements presented in spoken form.

1.3 Correct responses to instructional exemplars (0th-order generalizations based on associative instruction) are important and required; however, the larger objective of phonemic-level word attack instruction is to secure correct rule-based generalization of at least 1st order to novel items that are consonant with earlier instruction.

1.4 The system of letter-sound correspondences for English is many: 1 (or 1:many). In time, the child will be required to deal with the many:1 characteristics of the system. However, the effectiveness of preliminary instruction will not be optimal unless the system is interpreted as 1:1 at the outset. (As with many important word attack issues, the literature is inconclusive regarding the assumption.)

1.5 Many of the "statements" of word attack instruction are non-generalizable statements because one term of the statement is specific rather than general.
1.51 Such statements as "c is a member of C" and "r is a member of C" are nongeneralizable unconditional statements, to be rote-learned in consequence of associative training. (The comprehension of such statements is required in that the child must demonstrate ability to classify a set of letters into consonant and vowel classes.)

1.52 Such statements as "r = /r/, or r/P = r/Q" assert that a specific term (r) realized as P (written) entails that term realized as Q (spoken) and vice versa. These are nongeneralizable conditional statements, to be rote-learned in consequence of associative training.

1.6 $\text{CVC} = /C+/VC/ = /CVC/$ illustrates a segmentation-blending rule. Such rules are generalizable conditional statements because all terms are general or class terms. Such rules are taught by exemplarization—e.g., mid = /m/=/Id/ = /mId/, kid = /k+/Id/ = /kid/. (Given a set of letter-sound consonant correspondences are learned along with their classification, then such items as bid, did, /lId/, /rId/ test for 1st-order generalization.)

1.7 Generalization referenced to the vowel class may occur; however, instruction will be most effective and efficient if only generalization referenced to the consonant class is solicited and evaluated.

2. Terms & Definitions

2.1 $L_i$ denotes an $i$th member of the grapheme set—e.g., a, b, c. An $i$th member of the vowel subset of $L$ is denoted $V_i$; of the consonant subset, $C_i$. $/L_i$/ is the phonemic equivalent of $L_i$; $/V_i/ \text{ of } V_i /C_i/ \text{ of } C_i$.  

2.2 The symbol $+$ between phonemes denotes segmentation. Thus, $/V/+C/$ denotes a segmented vowel-consonant construction. Such a construction may represent a stimulus that entails response $/VC/$ or $VC$ or a response to a stimulus $/VC/$ or $VC$. An equivalent construction at the CVC level is $/C+/VC/$. 

2.3 When two phonemes are unseparated—e.g., $/VC/$—their proximity denotes blending. Such a construction may represent a stimulus that entails response $/V+/C/$ or $VC$ or a response to a stimulus $/V+/C/$ or $VC$. An equivalent construction at the CVC level is $/CVC/$.  

2.4 Constructions such as $/C+/VC/$ are mixed.
2.5 The symbol = denotes a symmetrical relation; thus, \(L_i = /L_i/\) signifies both that \(L_i\) entails \(/L_i/\) and vice versa. The same holds at VC and CVC levels, consonant with Assumption 1.2.

3. **Associative Training Items**

3.1 Nongeneralizable unconditional statements. For illustrative purposes, these will be taken as:

- 3.11 \(a \in V\), 3.12 \(i \in V\), 3.13 \(u \in V\), 3.14 \(b \in C\), 3.15 \(g \in C\), 3.16 \(e \in C\), 3.17 \(p \in C\), 3.18 \(s \in C\), 3.19 \(t \in C\).

3.2 Nongeneralizable conditional statements.

- 3.21 \(a = /a/\), 3.22 \(i = /I/\), 3.23 \(u = /a/\), 3.24 \(b = /b/\), 3.25 \(g = /g/\), 3.26 \(n = /n/\), 3.27 \(p = /p/\), 3.28 \(s = /s/\), 3.29 \(t = /t/\).

3.3 Consonant with Assumptions 1.2 and 1.5, these statements will be associatively trained and evaluated for 0th-order generalization. Instruction that follows is contingent upon the child's reaching near-perfect criterion performance referencing to the items of Content Statements 3.1 and 3.2.

4. **Rules & Hypotheses**

4.1 Rule: \(VC = /V/+/C/ = /VC/\).

Hypothesis 4.1: If Rule 4.1 is exemplarized during training using the pair \(VC_i, VC_j\) (same \(V\), different \(C\)), then the response to the novel item \(VC_k\) will reveal rule generalization; that is, the response will be correct.

Note: An incorrect response would indicate one of the following: a) Insufficient training trials referencing to the exemplars used. b) Gaps in prerequisite training. c) Inaptness of the rule as an expression of an effective word attack strategy. d) Inaptness of the training strategy on some other basis—e.g., number of exemplars used. e) Inaptness of the rule at the maturational level evaluated. f) A combination of these factors. Rejection of any such hypothesis that is, acceptance of the null version of the hypothesis—merely signifies the need for additional analysis and consequent reevaluation.

4.2 Rule: \(CV = /C/+/V/ = /CV/\).

Hypothesis 4.2: If Rule 4.2 is exemplarized during training using the pair \(CV_i, CV_j\) (different \(C\), same \(V\)), then the response to the novel item \(CV_k\) will reveal generalization.
Note: While one can define CV constructions on short vowels for purposes of preliminary instruction, later morpho-
phonemic-level word attack instruction usually will have the vowel long—CV. Like the preliminary 1:1 assumption, pre-
liminary instruction that defines CV constructions on short vowels signals a requirement for later repair work.

4.3 Rule: \( \text{CVC} =\ /C/+/\text{VC}/ = /\text{CVC}/. \)

**Hypothesis 4.31:** If Rule 4.3 is exemplarized during training using the pair \( C_1\text{VC}, C_2\text{VC} \) (different \( C_1 \), same \( \text{VC}_2 \)), then the response to the novel item \( C_k\text{VC} \) will reveal rule generalization.

4.4 Rule: \( \text{CVC} =\ /\text{CV}/+/C/ = /\text{CVC}/. \)

**Hypothesis 4.41:** If Rule 4.4 is exemplarized during training using the pair \( \text{CVC}_1, \text{CVC}_j \) (same \( C_1\text{V} \), different \( C_2 \)), then the response to the novel item \( \text{CVC}_k \) will reveal rule generalization.

4.5 Hypotheses 4.12 and 4.22, featuring exemplarization consonant with vowel-referenced generalization, are alternatives to Hypotheses 4.11 and 4.21, featuring exemplarization consonant with consonant-referenced generalization. The alternatives 4.11-4.12 and 4.21-4.22 exemplarize tests of Assumption 1.7.

4.6 Hypotheses 4.31 and 4.41 reflect potential alternatives to segmentation-blending instruction at the CVC level, although the instructional strategies characterizing both hypotheses could turn out effective.

4.7 Rules and hypotheses can be extended to CCVC and CVCC constructions in consequence of a modest augmentation of the set of definitions: e.g., though addition of \( d =/d/\), \( l = /l/\), and \( r = /r/\). Some rule alternatives at this level are:

4.71 \( \text{CCVC} = /\text{CC}/+/\text{VC}/ = /\text{CCVC}/. \)

4.72 \( \text{CCVC} = /C_1/+/C_2\text{VC}/ = /\text{CCVC}/. \)

4.73 \( \text{CCVC} = /C_2/ \) inserted at \( X \) of \( /C_1X+\text{VC}/ = /\text{CCVC}/ \), where \( C_1\text{VC} \) is previously taught

4.74 \( \text{CCVC} = /\text{CV}/+/\text{VC}/ = /\text{CCVC}/ \), where \( \text{VCC} = /\text{VC}/+/C/ = /\text{VCC}/. \)

4.75 \( \text{CVCC} = /\text{CVC}/+/C/ = /\text{CVCC}/ \), where \( \text{CVC} = /C/+/\text{VC}/ = /\text{CVC}/. \)
4.76 CVCC = /CV/+CC/ = /CVCC/.

4.77 CCVC and CVCC constructions will not be considered further in this paper.

5. Instructional Paths

5.1 All possible instructional paths through phonemic-level instruction terminating at the CVC constructional level share the following components leading up to rule-referenced instruction: a) Entry skills reflected in Assumption 1.1. b) Classificatory skill referenced to the statements of Content Statement 3.1. c) Skill in responding to the lefthand or righthand term of the statements of Content Statement 3.2. Paths can diverge thereafter.

5.2 Alternative paths that may prove of interest are:

5.21 Training-testing consonant with H4.11, followed by training-testing consonant with H4.31 when criterion is met at the lower constructional level.

5.22 The same for the pair H4.21, H4.41.

5.23 Training-testing consonant with H4.11 and H4.21, followed by training-testing consonant with H4.31 when criterion is met at the lower constructional level.

5.24 The same for the triplet H4.11, H4.21, H4.41.

6. Training-Testing Item Universes

6.1 The foregoing descriptions of training conditions assume that two exemplars will be used to illustrate each application of each rule. Although perhaps not a first question for segmentation-blending investigations, it is conceivable that number of exemplars will interact with the different training strategies reflected in the diverging segments of the instructional path, sketched in Section 5. Based on the set of letter-sound correspondences presented in Content Statement 3.2, the following training-testing pairs of items are available. Training items appear above the line, testing items below.

6.2 VC Construction

ag ip ut
an ig up
6.3 CV Construction

ta  bi  gu
sa  pi  nu
ga  si  pu
na  gi  tu

6.4 CVC Construction

bag  nan  gap  pat  pig  bin
sag  tan  sap  nat  tig  sin
gag  ban  nap  sat  big  pin
nag  pan  tap  bat  sig  tin
nip  pit  tug  nun  sup  but
tip  sit  pug  bun  gup  sut
pip  bit  sug  pun  tup  nut
sip  nit  bug  gun  pup  gut

6.5 CVC\_i Construction

nan  sat  pig  sin  sun  bup
nap  sag  pip  sit  sug  bug
nag  sap  pin  sig  sup  bun
nat  san  pit  sip  sut  but

6.6 The test items are for lst-order generalization. The exemplars themselves are test items for 0th-order generalization. Presence of two exemplars and two lst-order generalization test items permits 0th- and lst-order testing of the child once each for responses to spoken and written items for each rule application.
6.7 If one trains only certain of the rule applications reflected above, then the items of the nontrained rule applications can be used to test for 2nd-order generalization (see TM-1-71-2). This suggests one more question or possible interest: 'How many rule applications referenced to 1st-order generalization must occur before appreciable 2nd-order generalization is a consequence? The question probably is defective in that the answer may turn in part on certain characteristics of the child.