Few linguists could claim no curiosity about the psychological reality of their linguistic descriptions. Some have even employed the notion as a formal criterion for distinguishing types of rules. In the past, a number of claims have been made concerning the relationship between psychological reality and writing systems. King maintained, for example, that, free from a strong, nonnative orthographic influence, scribes will devise symbols for the underlying, systematic phonemic segments of their language. This was attributed to the fact that the autonomous phonemic level has no place in the representation of a speaker’s competence and therefore no psychological reality. The purpose of this article is to provide evidence that certain generative analyses and psychological reality as revealed by writing systems are not isomorphic.

The evidence comes from the experiences of several groups of native teachers of Iroquoian languages. Realizing the cultural and social value of their languages at a time when their children are no longer learning them, the teachers have devoted considerable energy to the construction of workable national orthographies and effective language curricula. One group of Mohawk teachers from Caughnawaga and Oka, Quebec, has spent the past six years systematically studying general linguistic theory, the structure of Mohawk, and language pedagogy, in order to accomplish their goals. Their successes and failures in acquiring a conscious understanding of the structure of their language are revealing.

Their first priority was the establishment of an acceptable orthography. Several varieties of spelling systems, originally devised by French missionaries, were already in existence, but because of unsystematic underdifferentiation, speakers could neither write with confidence nor read. Written texts could do little more than serve as mnemonic devices, as for the recitation of Scripture. The Mohawk communities needed an orthography which could be written with no arguments and learned easily by both native and nonnative speakers. It could not be based on memorization, since there will never be a large enough body of literature to provide speakers with lengthy, daily exposure to written Mohawk. With these restrictions in mind, the teachers began studying articulatory phonetics and basic phonological theory. They then attempted to learn to write Mohawk at various levels of abstraction, in order to determine the optimal level of representation for their needs.

All members of the group, completely literate in English, learned to transcribe
Mohawk at a broad phonetic level with relative ease. Transcription at this level is shown below.

1. [naʔdúzayohswáthaʔneʔ]
   *it got bright again*

2. [yogwi:rodeʔ]
   *standing tree*

3. [džyóhdú]
   *nine*

4. [góhr]
   *Paul (man’s name)*

Slight difficulties with this level of transcription occurred in two areas. Predictably, the teachers had trouble with distinctions they were unused to noting when writing English, namely, glottal stop, preconsonantal h, stress, vowel length, and tone. Perhaps less predictably, the Mohawk teachers also encountered difficulty distinguishing the voicing of stops. In all of the Iroquoian languages, voicing is automatically conditioned for obstruents.

Voicing of stops:

\[
\begin{array}{c|c|c}
  t & d & g \\
\hline
  k & g & d \\
  s & z & s \\
\end{array}
\]

where $\$ = syllable boundary.

5. /yokwi:roteʔ/ > [yogwi:rodeʔ]
   *standing tree*

The teachers, all good speakers and spellers of English, often failed to perceive the nondistinctive voicing differences in Mohawk.6

6. This name is borrowed from French. Since Mohawk had no original labials, the p was adopted as a labio-velar k*, which became k before o. The French l became r at Caughnawaga.

6. It could be argued that this perceptual difficulty was the result of experience with the missionary systems, which lack voicing distinctions. The Oneida, Seneca, and Cayuga teachers provide good control groups for this factor, however. Although the only spelling experiences these teachers had ever had were with English, and they believed, for this reason, that a good orthography should distinguish voicing, they still encounter difficulty hearing the nondistinctive voicing differences in their own languages.

They next attempted to record their language at a traditional, autonomous phonemic level, with immediate success. They found this much simpler both to read and to write than phonetic transcription. The rules necessary to convert these representations to surface forms involve the automatic voicing of obstruents, palatalization of alveolars, and spirantization of resonants.

Spirant voicing:

\[
s \rightarrow z/\{V\} \rightarrow V.
\]

7. /naʔtúzayohswáthaʔneʔ/ > [naʔdúzayohswáthaʔneʔ]
   *it got bright again*

Palatalization:

\[
s \rightarrow ñ/h \rightarrow j \\
d \rightarrow dž/ \rightarrow j
\]

7. /ohsi:taʔ/ > [ohsi:daʔ]
   *foot*

8. /tyóhtu/ > [džyóhdú]
   *nine*

Preaspiration, devoicing, and spirantization:

\[
\begin{array}{cc}
  0 & \rightarrow h/V \rightarrow R \{\#[\h]\} \\
\end{array}
\]

\[
R = n, r, w, y (i.e., \{+sonorant\})
\]

\[
\begin{array}{cc}
  R & \rightarrow R/\{\#[\h]\} \\
\end{array}
\]

R = voiceless, spirantized resonant.

9. /kór/ > [góhr]
   *Paul*

10. /kanhóha/ > [gahŋóha]
    *door*

11. /táshaw/ > [dáshahf]
    *bring it*

The third level the Mohawks attempted to learn to represent was that of intermediate derivations incorporating regular, phonologically conditioned rules which
would appear in any grammarians description of the language. These rules are the following.

First, stress falls regularly on the penultimate syllable in Mohawk, and stressed, open syllables are automatically lengthened.

(12) akwekū → akwé:kū > [agwé:gū] all

(13) tyohtū → tyóhtū > [džyóhdū] nine

Epenthetic vowels cannot bear stress, however, nor do they enter into the syllable count for stress placement. Mohawk exhibits extensive vowel epenthesis. Epenthetic e is inserted to break clusters of obstruents plus resonants or glottal stop.6 Epenthesis:

\[ \emptyset \rightarrow e/\{t\} \quad \{n\} \quad \{r\} \quad \{w\} \]

\[ \emptyset \rightarrow e/k \quad \{n\} \quad \{r\} \]

(14) tni:kāh > teni:kāh you and I see it

(15) swā:kāh > sewā:kāh you all see it

(16) wa?khehsrēhsū > wa?khehserēhsū? I chased her

(17) wā:krē > wā:kerē? I filled it

This rule is partially opaque in that surface sequences of obstruent-e-resonant have two possible sources: the medial e may be either underlying or epenthetic.

(18) yā:ke? = yā:ke? (underlying e) I go there

(19) à:rak? > à:rake? (epenthetic e) for him to eat

Mohawk also exhibits another type of epenthesis. A stem joiner a is inserted between consonant-final, incorporated noun roots and consonant-initial verb roots. Examples of this epenthetic a are:


(21) onūhsatokāhti > onūhsatokihtii o + nūhs + tokāht + i it house holy stative church

This epenthesis rule is also partially opaque. Surface a following incorporated noun roots can come from two sources: the epenthetic stem joiner referred to above or a-initial verb roots, as in:

(22) okwirə:rate? o + kwir + akərat + ? it tree at the top of stative in the treetop

(23) kanūhsakā:yū? ka + nūhs + akayū + ? it house old stative (the) house is old or (the) old house

With no more information than these surface forms, it is impossible to determine whether the verb stems are -kayū? and -kərat?, respectively, or -akayū? and -akərat?.

Speakers' attempts to record preepenthes forms met with no success whatsoever. They simply have no conscious idea which surface vowels are epenthetic and which are underlying. In most cases, they would not have to look far to discover the difference. Recall that stress is penultimate and that epenthetic vowels cannot bear stress. Stress placement precedes epenthesis. In cases of posttonic epenthesis, as in

6 An apparent counterexample to the first epenthesis rule is the existence of morpheme-internal clusters like the -sw- in the noun root -ra?sw- luck: rotera?swi:yo his luck is good. A plausible explanation for these relatively rare sequences is the presence of a phonetically undetectable h before the resonant, as in -ra?shw-.
(24) and (25), the number of epenthetic vowels is obvious from inspection.
(24) kahn̩hsoʔe < kahn̩hsoʔ standing house
(25) kahn̩hsakʔ < kahn̩hskʔ inside (the) house
Since Mohawk does not contain epenthetic o or ü, the epenthetic vowels above must be e and a. Even in such nonopaque cases, speakers do not detect epenthesis.

The second type of phonologically conditioned rules involves the loss of laryngeals. Posttonic h disappears before single resonants, leaving falling tone.

\[ \overline{Vh} \rightarrow \overline{V} : \__ \text{RV.} \]
Posttonic ? disappears before any single consonant, also yielding falling tone.

\[ \overline{V?} \rightarrow \overline{V} : \__ \text{CV.} \]

Examples of this are:
(26) okáhra? > okáʔraʔ eye
(27) rakahraʔke > rakahraʔke on his eye

Inspection of the two rules reveals partial opacity: a surface long, falling-toned syllable before a resonant could be derived from either of two underlying sources, h or ?. Interestingly, Mohawk speakers, when questioned, are quite surprised at the idea that something is missing, although glottal constriction is often still present. Once they are sufficiently linguistically sophisticated to recognize the symptoms of the loss, they still have absolutely no idea which laryngeal has disappeared. Even more interesting, in the nonopaque cases, where falling tone is followed by a non-resonant consonant, they still have no conscious access to the underlying form. With some difficulty, they can learn to examine the environment visually, once the word is written, to detect the non-opaque cases, but after years of sincere effort, they still forget the procedure. They can learn to add a suffix to the word in question, thus shifting the stress to the right, in order to recover the lost laryngeal, but again, this technique is successful only with pencil and paper and is most often forgotten. Speakers simply do not have conscious access to even these shallowly underlying forms.

Attempts to eliminate several other automatic alternations from the orthography also met with failure. Some alternations involving s can be described in terms of two underlying sources, and instances of surface ʔ are clearly the result of underlying a + i. Speakers could not learn to recognize the appropriate underlying forms. After considerable effort on everyone’s part, it became clear that only by completely controlling sophisticated analytical techniques could speakers recover intermediate derivations; they could not retrieve them from their intuition. Since even these highly motivated teachers could not remember the necessary techniques for very long, and since the orthography was destined for use by speakers, not Iroquoian linguists, this level of representation was judged inappropriate for their needs.

To pursue their experiment, the Mohawks undertook the task of learning to record their language in classical generative underlying forms, like:

(28) nwtesohswath?? > [na?qəzayohswathàʔneʔ]
\[ \text{n + w + t + s + o + hswath + ?} + ? \]
partitive + aorist + dualic + iterative + it + bright + inchoative + punctual aspect
it got bright again
(29) wtklir > [waʔdəkdaʔneʔ]
\[ \text{w + t + k + k + t} + ? + ? \]
aorist + dualic + I + stand + inchoative + punctual aspect
I stopped

By this time, the Mohawks had had
considerable experience with morphological analysis of their language, a tool they considered crucial to the creation of effective language lesson plans. Because of the morphological complexity of Mohawk, one could never be an effective or even acceptable speaker without controlling the productive morphological processes of the language. To develop language lessons and language teachers capable of instilling the ability to generate new words, the Mohawks realized that they must understand it consciously themselves. It was thought that the awareness of morphophonemic processes might facilitate the usage of a more abstract level of representation.

Speakers could not begin to interpret underlying forms from this level, even after concentrated effort at memorization of the basic shapes of morphemes. Neither could they begin to write at this level. The task was completely hopeless.³

The orthography finally settled upon by the Mohawks has proved very successful. Official spelling systems are almost never developed in a vacuum. Their acceptance hinges on complex social, political, and historical factors, which only members of the linguistic community can fully appreciate. This case was no exception. Although impractical, the missionary orthographies had become synonymous with traditional Indian spelling. Any innovations were bound to be considered heretical. The Mohawks dealt with this problem by retaining all of the traditional symbols, with systematization of their functions, and keeping new symbols small. Glottal stops are written with apostrophes, length with colon, stress and tone with accent marks. The resulting written material does not look much different from older texts.

The new orthography is basically an autonomous phonemic representation. It employs thirteen letters, three diacritics, and has been taught successfully to speakers in less than half an hour. It is more abstract than a true autonomous phonemic system by a measure of two rules, necessitated by the adoption of the missionaries’ symbols. First, /i/ and /y/ are not distinguished in spelling. The letter i is simply pronounced as a vowel before consonants and as a glide before vowels.

³The experiences of the teachers studying morphology are also interesting. They quickly grasped the basic principles of morphological analysis and learned to segment and classify morphemes in English and other languages. It soon became clear, however, that they had no special knowledge of the morphological patterning of their own language. It was not until sets of words could be carefully compared visually, in a sufficiently explicit transcription, that they could apply the principles they had learned and identify morphemes. Experience with the techniques did not render undiscovered morphemes any more accessible to their consciousness, however. After years of concentrated study, native speakers still forget where morpheme boundaries lie and which morph corresponds to each meaning. They still make mistakes, equating dissimilar morpheme partials. The striking difference between their consciousness of English and Mohawk morphology suggests a link between literacy and morphological awareness, perhaps more a visual than an aural phenomenon.
With a small number of exceptions, contiguous vowels do not appear in Mohawk. The successful utilization of these two rules is an indication that Mohawk speakers are not unwilling to handle abstraction. To identify the phonemically contrastive sounds correctly, readers must consult their surface contexts. What is significant is that the types of abstraction they do handle are just those for which they do not require access to underlying forms.

The experiences of the Mohawks in selecting their orthography are relevant both to linguistic theory and its applications. Speakers simply do not have conscious direct access to underlying forms, neither as conceived in the classical framework of Chomsky and Halle nor in many more recent generative approaches. The distinction of phonologically and morphologically conditioned rules does not appear to be reflected in a sharp difference in psychological reality, if this is to be judged in terms of accessibility of competence. One might suspect that the opacity of rules would affect their conscious learnability and thus their accessibility. Nonopaque rules have proved as inaccessible as opaque ones.

Consciousness of linguistic levels is of course not the only evidence for their reality. It is certainly not impossible that linguistic knowledge is simply not accessible to speakers in the form in which it is stored. The lack of this access does, however, place an extra burden of proof on those who would claim any more than descriptive efficiency for their analyses.

\[31 \langle\text{ë:neken}\rangle = /\text{ë:nek}/ [\text{ë:neg}]\]

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