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Volume 35(2)

2004
(December)

DEPARTMENT OF LINGUISTICS
UNIVERSITY OF HAWAIʻI AT MĀNOA
HONOLULU 96822

An Equal Opportunity/Affirmative Action Institution

DEPARTMENT OF LINGUISTICS FACULTY

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VISUAL WORD RECOGNITION IN HAWAIʻI CREOLE ENGLISH: BIDIALECTAL EFFECTS ON READING*

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This paper reports on an experimental study investigating the visual word-recognition process in speakers of Hawaiʻi Creole English (HCE). Its aim is to explore the effects of different orthographic and phonological systems as factors in visual word recognition by comparing the reaction patterns of 18 bidialectal English speakers from Hawaiʻi to those of 18 monolingual/monodialectal English speakers from the Continental U.S. in naming stimuli words. The experiments consist of a naming task, a lexical decision task, and a memory test. HCE-orthography items as well as loanwords, nonwords, and Standard English (SE) control items were presented. For the HCE-orthography items, two different orthographies of HCE were tested—the phonology-based Odo orthography and an etymological orthography based on English spelling rules. The experimental results suggest an inhibitory effect of bidialectalism for the processing of unfamiliar visual forms: significantly longer reaction times for bidialectal speakers were observed for unfamiliar visual forms, although the two groups reacted very similarly to familiar visual forms. Bidialectal speakers arguably have more complex orthography-to-phonology mappings from the dual phonological systems (HCE, SE) they command. The results are consistent with the theoretical position that the bilingual language-processing system is nonselective in nature and that bilingual speakers activate stored knowledge from both languages in recognizing the targeted language (Dijkstra et al. 1999). I argue that the effect of language-nonselective activation is also observed in visual word recognition in bidialectal speakers. The implications of the results are discussed in the context of several fields, such as pidgin and creole linguistics, literacy and bidialectalism, and visual word recognition.

1. INTRODUCTION. Hawaiʻi Creole English[1] (henceforth HCE), the English lexifier creole spoken in Hawaiʻi, is phonologically different from Standard English (SE). It has no widely recognized orthography of its own (Romaine 1994), although two spelling systems exist: a phonology-based orthography (known as the Odo orthography), used primarily in linguistics, and an etymological orthography based on English orthographic rules, used in local literature. Although neither of the HCE orthographic systems is familiar to most speakers of HCE, words spelled in either system could be decodable to some extent. The Odo orthography has a structure somewhat similar to the spelling systems of Hawaiian or Romanized Japanese, with which many people brought up in Hawaiʻi are assumed to have some familiarity. For instance, *later* is spelled as *leita* in the Odo orthography, which contains identical letter strings with the Hawaiian word *lei* 'flower wreath' and the Japanese word *ita* 'board'. The etymological orthography utilizes the spelling conventions of SE. When read according to SE spelling rules, the items in the etymological orthography should sound like words in HCE pronunciation. An example of the etymological orthography is

* This study was supported by The Charlene Junko Sato Endowed Memorial Fund. My deepest thanks go to Dr. Amy Schafer and Kent Sakoda for their helpful advice and encouragement, and Dr. Jeff Siegel for many helpful comments on the earlier version of this paper. I also thank the East-West Center for supporting my PhD study at the University of Hawaiʻi at Mānoa, and all the participants in the experiments. I am also grateful to the members of Da Pidgin Coup (Fall 2002-Spring 2004) for valuable input and encouragement. Needless to say, any remaining errors are my own.

[1] Hawaiʻi Creole English is known as "Pidgin" within Hawaiʻi; however, it is technically a creole, for it is the native language of most of its speakers.

correck for the word *correct*, reflecting the reduction of the final consonant cluster in HCE phonology, as compared to SE phonology. For people who are familiar with SE orthography, it seems plausible that it would activate the SE spelling *correct* to some extent because of the visual similarity as a whole word. Specifically for a bidialectal SE-HCE speaker,[2] the fact that *correck* reflects HCE phonology might play an additional role in activating the SE form *correct*. When bidialectal SE-HCE speakers are presented with the item *correck*, and are asked to pronounce it, do they activate the word *correct*? If they do, is that because of the orthographic similarity of this item to the written form *correct*, or is it because they pronounce it as [korék], which is a phonetic form of *correct* in HCE? Does it make any difference if the item is presented in the Odo orthography as *korek*? What about an item such as *pris* (another example of the Odo orthography for the word *priest*), which does not seem to activate the corresponding SE word as easily as *correck* does? Because of the different degree of orthographic similarity to the corresponding SE forms and because of the likelihood of such items to generate the HCE phonology, the two HCE orthographies might have different effects on word recognition. The effect of these two unfamiliar HCE orthographies in visual word recognition was explored by comparing the performance of bidialectal HCE-SE speakers with that of monolingual SE speakers.

Such a bidialectal situation is not specific to HCE, but may also be observed with other bidialectal situations in which one of the dialects has no conventional orthography. In these situations, bidialectal speakers are assumed to be somehow integrating dual phonological systems with one orthographic system in their mental lexicon. For example, *mouth* is one lexical item that changes its phonological form across the two dialects (SE-HCE). There are several logical possibilities for integrating dual phonological forms of this item with one written form. It is possible that the both the SE phonological form /mauθ/ and the HCE phonological form /maut/ are equally associated with the written form *m-o-u-t-h* in a bidialectal speaker's mental representation. Likewise, it is also possible that the HCE phonological form is not directly associated with the written form, or the association of the HCE phonological form with the written form is not as strong as that of the SE phonological form. Does such a situation have any effect on the general reading pattern of the bidialectal speakers? In the present study, visual word-recognition experiments were conducted to answer the following questions concerning the bidialectal situation in Hawai‘i: (1) Do bidialectal HCE speakers react differently to different HCE orthographies? (2) Do bidialectal HCE speakers have the same general word-recognition pattern as monolingual SE speakers? In the experiments, HCE-SE bidialectal speakers' performance on SE control items, nonwords, experimental orthography items, and loanwords, was examined and compared with the performance of monolingual SE speakers.

The questions investigated in the present paper may be of interest to people working in several disciplines. First, the effect of the two HCE orthographies may have some implication for the choice of orthography in linguistic situations involving pidgins and creole languages. As for HCE, Romaine (1994) discussed how the use of a particular orthography

[2] Although HCE is a legitimate variety of language with its own systematic grammar that differs from the lexifier language, i.e., SE, the speakers of HCE often do not recognize HCE as a separate variety, and rather consider it to be a degenerated version of the lexifier language due to the similarity of HCE to SE and the stigma on HCE (Siegel 2003). Since the purpose of this study is to explore the speakers' reaction in a word-recognition experiment with psycholinguistic methodology, speakers' perception of the HCE-SE relationship is more relevant to the issues discussed in this study than the linguistic definition of HCE. In this paper, I will use the term "bidialectal" rather than "bilingual" to refer to the HCE-SE relationship in Hawai‘i.

might influence the status of HCE as a literary language. The issue of orthography choice for creole languages such as Haitian Creole and Jamaican Creole has been discussed broadly in the context of language policy and language ideology by scholars working in sociolinguistics and pidgin and creole linguistics (for instance, Schieffelin and Doucet 1998). There has long been a debate between proponents of phonology-based orthographies and proponents of etymological orthographies. Their arguments differ both in the functional aspect of orthography and in its relationship to the lexifier language. However, how native speakers process different types of orthographies and whether there are psycholinguistic effects of using one type of orthography over another have not been widely discussed. The present study attempts to shed light on the aspect of native speakers' cognitive processing regarding the issue of orthography selection.

Second, bidialectal speakers' performance in visual word recognition may be of interest to psycholinguists who study the word-recognition process in bilinguals. In the domain of bilingual word-recognition studies, how bilinguals recognize words in different languages has long been an issue of discussion. One hypothesis, the language-selective-access hypothesis, holds that incoming sensory information is directed only to the lexicon of the targeted language (Scarborough, Gerard, and Cortese 1984). In contrast, the language-nonselective-access hypothesis, the mainstream position, claims that stored knowledge of another language affects recognition of the target word (Grainger 1993, Dijkstra, Van Jaarsveld and Brinke 1998). Although bilingual situations and bidialectal situations differ in many aspects, the fundamental paradigm involving two linguistic systems is common, and the dispute concerning the language selective/nonselective hypothesis can be applied to the bidialectal situation to some extent.[3] To date there has been no research that has specifically investigated the effects of bidialectalism on visual word recognition.[4]

Finally, the implication of the second research question, bidialectal speakers' general word-recognition patterns, may attract the attention of those who are interested in the effects of bidialectalism in educational contexts. If bilingual HCE speakers have different general reading patterns from monolingual SE speakers, what causes the difference? Many discussions of bidialectalism and literacy have focused on the acquisition of literacy by urban minority children who speak African American Vernacular English, largely in terms of its different morphosyntactic system and phonological conditioning (Labov 1995, Labov et al. 1998, Labov 2001). The issue of how words are represented, stored, and accessed has been questioned in the context of acquisition of literacy by bidialectal children (Labov 2003). The results of the present study of the reading patterns of adult bidialectal speakers may shed light on the issues of acquisition of literacy by bidialectal children.

2. SOUND SYSTEMS AND SPELLING SYSTEMS OF HCE.

2.1 SOUND SYSTEMS IN HCE. As Bickerton and Odo (1976) stated, HCE speakers and their speech styles can be placed on a phonological continuum that ranges from basilectal varieties that have the most non-SE features to acrolectal varieties that sound almost, but not quite, the same as SE. The difference between the two extremes is claimed to be due to the frequency of the features used in speech, rather than to the categorical presence or absence of particular features (Bickerton and Odo 1976:58). It is reported that of the eight major

[3] The arguments regarding the language selective/non-selective hypothesis will be discussed in §4.

[4] However, for the auditory lexical decision task there is a study on the comparison of standard Dutch and the Maastricht dialect (Woutersen et al. 1994).

Hawaiian islands, the island of O‘ahu is where the most acrolectal varieties are spoken (Romaine 1994:531). Four of the features listed in §2.2[5] of Bickerton and Odo 1976 were selected to test in the present experiments. (1) SE consonant /θ/ is in free variation with /t/ in HCE (realization of /θ/ as /t/) and it is not phonetically conditioned (ibid.:64). (2) When /l/ and /r/ follow a vowel in the same syllable, they become semisyllabic offglides, or more vowel-like in quality (vocalization or deletion of liquids), as opposed to their nonsyllabic consonantal characteristic when they precede a vowel in the same syllable (ibid.:74). (3) Obstruent clusters in which the sequence is spirant plus stop (e.g., [st], [ft]) or stop plus stop (e.g., [pt], [kt]) are often represented without the final stop (reduction of word-final consonant cluster). Examples are [lɛf] ‘left’, [bas] ‘bust’, [æs] ‘ask’, [lav] ‘loved’, and [rab] ‘rubbed’ (ibid.:72). (4) The final sequence [nd] is often simplified (nasal-cluster simplification). Examples are [spɛ̃n] ‘spend’ and [stæ̃n] ‘stand’ (ibid.:73). Many of the phonological alternations observed in HCE are also found in other varieties of American English (ibid.:88). For instance, the four features above are also reported as phonological features of African American Vernacular English (Rickford 1999:4).[6] Therefore, the findings obtained in this study may contribute to the understanding of the visual word-recognition process for the other English varieties as well.

2.2 SPELLING SYSTEMS IN HCE. HCE is rarely written as a language in its own recognized orthography. As with most creole languages, the use of HCE has been speech-based. Since HCE has never been employed as a language of education, nor of religion, there was no pragmatic impetus to provide it with an orthography[7] (Romaine 1994:531). Although Bickerton and Odo (1976) developed a phonemic orthography, it has been used primarily by linguists and has no wider recognition (Romaine 1994:528). Today there is still no official orthography for HCE. However, despite the lack of written norms and standardization for HCE, some local writers have attempted to use it as a medium for poetry, short stories, and drama, adapting English spelling rules to represent features characteristic of speech varieties in Hawai‘i. Etymological HCE orthographies conform to the general rules of SE orthography; in other words, these somewhat variable systems represent aspects of HCE pronunciation by employing SE orthographic rules. In etymological HCE orthographies, a number of the phonological features specific to HCE have been represented, e.g.: *da* ‘the’, *dat* ‘that’, *moa* ‘more’. As pointed out by Romaine (1994:540), writers have employed English spelling conventions in different ways, and some items have been spelled differently by different writers. /bambai/ (one of the common HCE adverbs of time which can mean ‘later, eventually, finally, after a while’ [Sakoda and Siegel 2003:43], originally from English *by and by*) is a good example of such spelling variation. Murayama (1959) spelled it as *by-’n’-by*, whereas Tonouchi (2001) spelled it as *bumbye*. Local media (newspapers, TV news headlines, cartoons, and advertisements) occasionally employ an etymological orthography in order to add “local” flavor. However, its use is mostly limited to certain noticeable features of HCE with certain words that are recognized as typical and representative of HCE (e.g., *da* for ‘the’, *kine* for ‘kind’), and it is assumed that not many of

[5] Section 2.2 is a segmental phonology of the speech of one HCE informant who occupies a fairly central position in the HCE continuum.

[6] In Rickford 1999, nasal cluster simplification is discussed together with the reduction of word-final consonant clusters (p. 4).

[7] *Da Jesus book: Hawaiian Pidgin New Testament* (2000) translated by Wycliffe Bible Translators is an exception to this trend.

the HCE speakers are familiar with the orthographies as comprehensive systems. In the present experiments, the conventional use in Tonouchi 2001 was employed as the "etymological HCE orthography" with slight modifications. In contrast, the Odo orthography employs its own consistent spelling system. In this orthography, the representation of consonants is quite similar to SE spelling, and the representation of vowels is similar to that in Romance orthographies, with the exception of the symbol 'æ' or 'ae' for /æ/. Although the Odo orthography is somewhat different from the HCE etymological orthography, there is some overlap between them.[8] When we compare the Odo orthography and the etymological orthography with SE orthography, the two HCE orthographies are both closer to HCE speech in terms of the phonological representation they realize, although people in Hawai'i are not familiar with either of them as a visual representation.[9] Examining the reaction times of the HCE speakers to the two different HCE orthographies might indicate their familiarity with different orthographic conventions (the etymological orthography with SE spelling rules; the Odo orthography with Hawaiian or Japanese type of spelling rules). Comparing the reaction times of the two speaker groups for the two HCE orthographies might clarify the role of phonology in word recognition, as the phonological forms generated by the items are familiar to the bidialectal HCE speakers, but not to monolingual SE speakers.

3. BACKGROUND ON VISUAL WORD RECOGNITION. Word-recognition research has attracted much attention in cognitive psychology and psycholinguistics because words are relatively well defined minimal units that carry many of the interesting codes of analysis (i.e., orthography, phonology, semantics, syntax) and processing distinctions (e.g., automatic vs. attentional) (Balota 1994:305). Word recognition has also been discussed frequently in education circles with regard to the development of word-recognition skills. As Seidenberg et al. (1994) state, the task of reading words and nonwords aloud has played a central role in the development of various theoretical models of word recognition. Current models of visual word recognition differ in their assumptions about how knowledge concerning the correspondences between the orthographic and phonological forms of words is acquired, represented, and used (Seidenberg et al. 1994). Dual-route models (Coltheart 1978, Coltheart et al. 1993) generally assume that separate lexical and nonlexical procedures are involved in generating pronunciations. Coltheart (1978) assumes that knowledge of the correspondences between orthography and phonology is represented in terms of rules translating graphemes into phonemes and converting a string of letters into a string of phonemes. The rules are used in naming "regular" words. Grapheme-to-phoneme correspondence (GPC) rules also allow the reading of pronounceable nonwords. "Exception" (irregular) words such as *pint* and *have* must be pronounced by means of the other, lexical mechanism (whole-word representation). On the other hand, connectionist models assume that there are not two distinct lexical and nonlexical routes, but rather that these are parallel components of the same interactive processing system. The model in Seidenberg and McClelland 1989—a

[8] Two test items (*ting* for SE 'thing' and *sked* for SE 'scared') were the same in the conventionalized orthography and the Odo orthography. This reflects the orthographic overlap between the two systems.

[9] The items tested in this study are not meant to cover the whole range of the orthographic conventions. More specifically, Odo orthography symbols that are not used in SE orthography (such as the diagraph 'æ') were intentionally excluded from the stimuli for the reason that they might affect the participants' "word" or "nonword" judgment in the lexical decision task. Such symbols were deemed very likely to attract attention and distort the results.

three-layer feed-forward network using distributed representations, weighted connections between units, and error-minimization learning algorithms—can encode both "rule-governed, regular" cases and "exceptions." More specifically, the spelling and pronunciation of a word are represented by patterns of activation across units encoding orthographic and phonological information. Although the same units are used for processing both words and nonwords, the pattern of activation across these units changes for different items. The weights of the connections between orthographic and phonological units get adjusted with experience, and constitute the knowledge of the spelling-to-sound correspondences. In this model, the processing of a letter string activates in parallel both phonological and semantic information, but phonological activation is slower.

However, my purpose here is not to assess whether either of the models provides a better account of bidialectal word recognition. The connectionist and the dual-route model developed by Coltheart and associates (Coltheart et al. 1993) explain many of the same phenomena, and the differences between them are not critical for the issues discussed here. What is relevant and crucial for our discussion may be summarized as the following three points: (1) in either theory, orthographic information and phonological information constitute important elements in the mechanism of visual word recognition, and (2) both theories assume some kind of mapping with and without the mediation of the phonological information—namely, the direct orthography-to-meaning mapping and the orthography-phonology-meaning mapping. Finally, (3) both theories predict that high-frequency words should be recognized quickly without the mediation of phonological information, regardless of the orthographic regularity of the word, because of the extensive exposure a reader would have to such words.

4. BILINGUAL WORD RECOGNITION. A major issue in the domain of bilingual word-recognition studies has long been how bilinguals activate words of different languages they know when they recognize a word in a target language (Dijkstra et al. 1998). The language-nonselective-access hypothesis holds that words from both languages of the bilingual are activated when a word is presented, while the language-selective-access hypothesis assumes that only words of the language targeted in the communicative setting are considered (Dijkstra et al. 1998:51). Several recent empirical studies support the theoretical position that the bilingual language-processing system is nonselective in nature: stored knowledge about another language affects recognition of the target (Dijkstra et al. 1999). However, whether this effect is also observed in bidialectal situations has not been investigated extensively. Bidialectal word recognition is similar to bilingual word recognition in that two different systems of linguistic knowledge are involved. For instance, different syntactic and phonological systems are involved in the SE-HCE bidialectal situation. We can see the parallel of the issue to bidialectal situations: namely, do bidialectals activate stored knowledge from both dialects when a word is recognized, or do they activate only a targeted dialect? On the other hand, bidialectal situations differ from bilingual situations in several respects. First, frequently one of the dialects has no strongly conventional orthography, as in the case of HCE-SE bidialectalism. In the study of bilingual word recognition, effects of storing two different orthographic systems are often discussed as factors affecting recognition performance. For example, Altenberg and Cairns (1983) report a case where transfer of orthographic knowledge was observed in German-English bilinguals. In an English lexical decision task, bilinguals were faster with words that are orthographically legal only in English (e.g., TWIN) compared to their reaction to words that are legal in both English and

German (e.g., FLAG). Considering that the performance of the monolinguals was equivalent for either category, this study suggests that stored orthographic knowledge of German affects the performance of bilinguals in a targeted lexical-decision task in English. In a bidialectal situation such as the SE-HCE situation in Hawai‘i, however, only one recognized orthographic system is involved. We can assume that it is not plausible that any direct orthographic effect of one of the dialects (such as orthographic transfer) is playing a role in bidialectal word recognition. This does not mean that there is no effect of a conventional orthography lacking in one of the dialects. Because there is only one orthographic system involved with two linguistic systems, we can assume that the way bidialectal speakers integrate their knowledge of two systems with one orthographic system should be complex. In addition to the effect of the lack of a conventional orthography, what complicates the bidialectal situation is the effect of considerable overlap across the two linguistic systems due to the typological closeness of the two systems. Contrary to the bilingual situation, where ordinary adult speakers are conscious of the fact that they are dealing with two linguistic systems, bidialectal speakers may not be as conscious of the difference between the two systems. In spite of the syntactic and phonological differences from SE, HCE is not considered as an "independent linguistic system" by most native speakers. Unlike bilingual word recognition, such as with German-English bilingual speakers, it may be the case that plural linguistic modes are not involved at the conscious level in bidialectal word recognition. The present study investigates the effects of different orthographic and phonological systems as factors in visual word recognition by bidialectal speakers. Because of the specific characteristic of bidialectalism, where two phonological systems are integrated into one orthographic system and two linguistic systems are integrated into one language mode, studies on the bidialectal situation may contribute to the field of general word-recognition theories as well as bilingualism/bidialectalism.

5. EXPERIMENTS: NAMING TASK AND LEXICAL DECISION TASK WITH HCE SPELLING WORDS AND MEMORY TEST. The experiment consisted of two parts: In Experiment 1a, a naming task and a lexical decision task were conducted, and in Experiment 1b, a memory test was conducted. In Experiment 1a, participants presented with a visual word or pronounceable nonword were instructed to name as quickly as possible the stimulus they saw and then judge whether it was a "word" or "nonword." The stimuli consisted of both items that were specific to linguistic experiences in Hawai‘i, and items that were not specific to them. Full lists of stimuli appear in the Appendices. In Experiment 1b, participants listened to a recorded form of the stimuli from Experiment 1a, produced in SE by a monolingual speaker, as well as fillers, and judged whether or not they had received them in Experiment 1a. Participants spent a few of minutes between the two experiments filling out a questionnaire about their linguistic and nonlinguistic backgrounds. The whole session took approximately 30 minutes. It was expected that the different linguistic backgrounds would cause different performances in the experiments. Since participants who were born and raised in Hawai‘i are familiar with the phonological form of HCE, they might react differently to some of the items specific to Hawai‘i in their reaction times for the naming task and their judgments in the lexical decision and memory tests. I predicted that the people from Hawai‘i would judge some of the items in the two HCE orthographies and loanwords as "words," while people from the Continental U.S. (hereafter referred to as the "Mainland") would judge them as "nonwords." I also expected that the people from Hawai‘i would show different reaction times to the words in the two types of HCE orthographies and loanwords

than the people from the Mainland. As for the naming latencies (reaction times, or RTs) to the items that are not relevant to the linguistic experience in Hawai‘i, namely, nonwords and SE control words, both speaker groups were expected to react similarly, suggesting that they are similar populations in terms of their general reading pattern.

In the memory test, people from Hawai‘i were expected to judge some of the words they saw in HCE orthographies in the lexical decision task as "received" when they listened to those words in SE pronunciation. There are two reasons they were expected to make such a judgment. First, orthographic information in stimuli in HCE orthographies is likely to cause some activation of the corresponding SE item. Some of the stimuli in HCE orthographies share some graphemes with the equivalent SE words. For example, as pointed out in §1, *correck* is an etymological HCE spelling for the SE *correct*. Since the two words have 6 out of 7 letters in common and look similar, when the participants saw *correck* in Experiment 1a, it might activate SE *correct*. Since monodialectal SE speakers from the Mainland may also share this process, it is possible that some of them would also judge them as "received." Second, HCE phonology that is associated with the two HCE orthographies might play a role in activating the corresponding SE items. This could affect stimuli that are not similar in appearance to the SE equivalents, along with stimuli that have an orthographic overlap with SE equivalents. HCE phonology may possibly be generated in two different ways. It may be generated sublexically by decoding the grapheme-to-phoneme correspondence. It may also be generated lexically subsequent to the naming by hearing their own voice pronounce the whole part of a word. Sublexical decoding is likely to involve SE grapheme-to-phoneme correspondence rules, and thus this type of decoding could happen more in recognizing stimuli in the etymological orthography. For example, the stimulus *preece*, which corresponds to *priest* in SE, may well be decoded into [pri:s] by employing SE grapheme-to-phoneme correspondences. It is also plausible, however, that sublexical decoding can take place via the Hawaiian and Japanese type of grapheme-to-phoneme correspondence rules developed by everyday exposure to Hawaiian place names and Japanese proper nouns in recognizing stimuli in the Odo orthography. For instance, since the Odo orthography does not employ as many SE grapheme-to-phoneme correspondences, many of the items written in this system look very different from the equivalent SE words. *Pris*, which corresponds to *priest* in SE in the Odo orthography, is one example of such an item. It does not seem to activate *priest* simply by its orthographic information. However, when the participants try to pronounce it, it is possible that what they pronounce has the HCE form [pris] by employing the Hawaiian/Japanese type of grapheme-to-phoneme correspondence rules, which might activate or enforce the activation of the concept carried both by *pris* and *priest*. Since HCE speakers are familiar with HCE phonology, the generation of HCE phonology may lead to the activation of the equivalent SE forms. In contrast, HCE phonology does not seem to play an essential role for monolingual SE speakers who are not familiar with HCE phonology. With all these logical possibilities to activate SE equivalent forms taken into consideration, the visual and auditory information presented by HCE orthographies in Experiment 1a is likely to cause more activation of the lexicon for HCE speakers than for SE speakers. Therefore, HCE speakers might be more likely to judge them as "received" in Experiment 1b as a consequence of the greater chance of activation of the SE forms in Experiment 1a.

5.1 METHOD

PARTICIPANTS—EXPERIMENT 1A. Participants in this experiment were 89 members of the University of Hawai‘i at Mānoa community who responded to announcements posted on

campus. Seventy-one undergraduate students participated in this experiment as a part of an introductory linguistics class, and 18 people participated for compensation of $5. The ages of the participants ranged from 18 to 53. Participants were divided into two groups, depending on their linguistic background. Group 1 consisted of people who were brought up on the Mainland and who have lived in Hawai‘i less than seven years (henceforth the M group). The other group consisted of people from Hawai‘i (henceforth the H group). Due to the constraints on the subject pool, the experiment was open to speakers of various linguistic backgrounds. In order to exclude the data from speakers whose linguistic backgrounds were not appropriate for the present study, the data from 16 people were removed.[10] 24 people from Hawai‘i who had prior exposure to HCE orthographies were also excluded.[11] Additional data from 13 people were also excluded in order to have equal numbers of participants in the M and H groups and equal numbers in each of the presentation lists. The criterion for the last exclusion will be further discussed in §5.2, along with the report of the results. As a result, 18 people in the M group and 18 people in the H group were left in the analysis. The participants' familiarity with HCE was assessed with a questionnaire. 13.04% of the participants from the Mainland (M Group), and 81.13% of the participants from Hawai‘i (H Group) reported they sometimes spoke "Pidgin," as HCE is generally called in Hawai‘i. In addition, 39.13% of the participants from the Mainland, and 84.9% of the participants from Hawai‘i reported that people around them (family, friends, co-workers) frequently spoke to them using "Pidgin." Although not all the people who were brought up in Hawai‘i are necessarily speakers of the basilectal HCE with distinctive grammatical creole features, it is assumed that the population in H group have had a substantial experience—either active or passive—with HCE. Considering the fact that the variety called HCE currently comprises a speech continuum which ranges from a basilectal HCE on the one end to a (regionally) standard variety of English at the other end, it is extremely difficult to decide who is a HCE speaker and who is not. Since the purpose of this study involves phonological characteristics rather than syntactic characteristics of HCE, which are observed even with acrolectal HCE, this paper considers the population in H group as "HCE speakers."

MATERIALS—EXPERIMENT 1A. Four sets of items were tested. Set 1 consisted of 24 words that change pronunciation between SE and HCE. These items tested the hypothesis that familiarity with the phonological features of HCE would cause different performance in recognizing HCE orthographies between the participants from Hawai‘i and the Mainland. They also tested the effects of different HCE orthographies for bidialectal HCE speakers. The items in Set 1 were very high-frequency English words in three kinds of orthographies: SE orthography, an HCE etymological orthography,[12] and the HCE Odo orthography. The

[10] The data from six nonnative speakers of English were excluded. The data from eight participants were excluded as well because they had spent an equal amount of time on the Mainland and in Hawai‘i, or because they were born and reared outside North America. Regarding performance, one participant was excluded because the participant had failed to follow the instructions in Experiment 1b. Also, one participant's data were excluded because the participant lacked normal hearing.

[11] More precisely, the participants were asked in a questionnaire whether they had ever read stories written by local authors such as Lee Tonouchi, Lois-Ann Yamanaka, or Darrell Lum, who have used etymological HCE orthography in their books. Although there are other local authors who employ the etymological HCE orthography, I chose these three authors because they are widely read throughout the state. As for the Odo orthography, Lee Tonouchi is the only local author who has used it (and only in one short story).

[12] As mentioned in §2.2, the HCE etymological orthography is based on the spelling that the local author Lee Tonouchi employs. Here I slightly modified the spelling conventions used in *Da word* (Tonouchi 2001).

items of Set 1 with three types of orthographies were presented in a Latin Square design (items were rotated through categories across participants). Therefore, each participant received one-third of the orthography items in SE orthography, one-third in the HCE etymological orthography, and one-third in the Odo orthography. The orthography items were chosen so as to represent four distinctive phonological features of HCE. (1) Realization of [θ] as *t*, as in *tink* for SE *think*, (2) Deletion or vocalization of *r* after a vowel, as in *paypah* for SE *paper*, (3) Reduction of word-final consonant clusters, especially those ending in *t*, as in *ress* for SE *rest*, and (4) Nasal cluster simplification, as in *bline* for SE *blind*. These four distinctive phonological features were chosen to form a small set of features that are representative of HCE phonology. The other consideration in selecting the features was whether they were appropriate to accommodate the purpose and the design of the experiments; the features had to be familiar to local people through their frequency in everyday conversation and literature.[13]

All the experimental items contained at least one HCE phonological feature in various positions of the words (word-initial position, as in *tink* for SE *think*, word-medial position, as in *smat* for SE *smart*, and word-final position, as in *preece* for SE *priest*). There were some changes in orthography other than those caused by the experimental phonological features. For example, in *laytah* for SE *later*, the experimental feature is the deleted or vocalized *r* after a vowel in the coda position of the second syllable, which is mapped with *h* in the etymological HCE orthography. Besides this experimental alternation, the nucleus diphthong [ei] in the first syllable, which is mapped with *a* in SE orthography, is mapped with *ay* in the etymological orthography. There is also an alternation of *e* in SE orthography and *a* in the etymological HCE orthography for the nucleus of the second syllable.

Overall, the M group and the H group were expected to behave similarly to the items in SE orthography, but differently to the items in the two HCE orthographies. The two groups were expected to name SE stimuli equally quickly, for they were very high-frequency items in familiar SE orthography. For items in the two HCE orthographies, the two speaker groups might behave differently. For the M group, both the etymological and the Odo orthography stimuli were visually unfamiliar items and likely to cause slower naming latencies compared with items in SE orthography. For the H group, they were also visually unfamiliar items. However, since the H group was familiar with the phonological forms that may be generated by these stimuli, their naming latencies were expected to show a different pattern from the M group. Their naming latencies could be even slower, due to the competition of the activated phonology and the unfamiliar orthographic information. Or they could be quicker than the reaction times (RTs) of the M group if the phonological information played a facilitatory effect for the H group. Moreover, within the H group, the RTs to the etymological orthography and the Odo orthography were predicted to show a different range of naming latencies. Since the etymological orthography conforms to SE spelling rules, it might look familiar to the participants. The different attributes of the two HCE orthographies led us to forecast longer latency for the Odo orthography items than for the etymological HCE orthography items.

[13] According to the BNC World Edition database, the average frequency for the 24 orthography items in Set 1 is 12879.42 (0.01575%) out of 100 million words, which is very frequent. As for the frequency of these items in HCE, a native speaker and linguist, Kent Sakoda, confirmed that their familiarity in HCE is very high.

TABLE 1. Examples of the orthography items (4 experimental categories in 3 orthographies) in Set 1 (24 items).[14] Each subject sees 1/3 of the words in each orthography.

Sound change	Standard English orthography	The etymological HCE orthography	The Odo HCE orthography
1. realization of *th* as *t*	think	tink	tingk
	mouth	mout	maut
2. deletion/vocalization of *r* after V	later	laytah	leita
	smart	smaht	smat
3. word final consonant cluster reduction	dialect	dialeck	daialek
	priest	preece	pris
4. nasal cluster simplification	plenty	plenny	pleni
	county	cowny	kauni

Once the participants pronounced the items in the HCE orthographies, it was highly plausible that naming the HCE items would result in articulating the items in HCE pronunciation, especially for the etymological orthography. Their own naming performances might activate the concept or semantic entity the items carry. As a result of the activation, participants might categorize some of the items as "word" and also activate the items in memory as recognized. Therefore, the participants from Hawai‘i (H group) who were familiar with HCE were expected to show different ranges of latency in the naming task and to judge some of the HCE items as "word" in the lexical decision task.

Set 2 consisted of 16 SE fillers. These items included both rule-governed "regular" words such as *slow* and "irregular" words such as *pint* and varied in frequency.[15] They do not change in pronunciation between SE and HCE. Originally, these items were intended to cross regularity with frequency, with 4 items in each cell. Due to experimenter error, only 3 items were possible in each cell in the data analysis.[16] After the exclusion process, the average frequency for high-frequency words was 3138.5 (0.003867%) out of 100 million words, and the average for low-frequency words was 68.66 (<.0001%) according to the BNC World Edition (2001) frequency list.[17] They served as controls, along with the nonwords in Set 3. Since they were not specific to the linguistic experience in Hawai‘i, the RTs to these items were used to verify whether or not the participants in each group were generally similar populations. They also served to test whether the tasks in Experiment 1a were sensitive to the characteristics of items such as high and low frequency. It was expected that the M group and the H group would perform similarly for the items in Set 2: relatively quickly to the high-frequency words and more slowly to the low-frequency words, with some errors in the judgment of the low-frequency items in the lexical decision task.

[14] All the stimuli used in Experiment 1a are provided in Appendix A.

[15] Since *pint* in HCE pronunciation contains word-final nasal cluster [nt], logically a nasal-cluster simplification rule is optionally applicable to this item, resulting in a different pronunciation in HCE. However, a native HCE speaker consultant, Kent Sakoda, believed that nasal-cluster reduction rarely occurs with this lexical item (p.c. 03/11/2004).

[16] Two of the items were mislabeled for orthographic regularity.

[17] Other databases, such as CELEX2 (Baayen et al. 1995) and Kuçera and Francis 1967, showed a similar pattern for the frequency of the items in Set 2.

TABLE 2. Examples of high-frequency and low-frequency English control words in Set 2 (16 items—12 items after the exclusion). Each subject sees all items.

	High frequency		Low frequency	
	Regular	Irregular	Regular	Irregular
Words that don't change pronunciation between SE and HCE	shampoo	pint	cutlass	ravine
	slow	sign	terse[18]	covet

Set 3, another set of control items, consisted of difficult and simple pronounceable nonwords such as *nost* and *thwee*. The items in Set 3 were included in order to serve as a control to see if the RTs to the items would be in a similar range as experimental items in HCE orthographies. Since they were not specific to the linguistic experience in Hawai'i, the performance for nonwords was also used to verify whether or not the participants in each group were generally similar populations or not, along with the SE items in Set 2. The nonwords were selected from a list of 590 nonwords tested in Seidenberg et al. 1994. They also served to test if the tasks in Experiment 1a were sensitive to the characteristics of items such as "simple" and "difficult" as observed in Seidenberg et al. 1994. The simple nonwords were chosen from the nonwords whose average reaction time was in the range of 550 ms to 610 ms in Seidenberg et al.'s (1994) study (the mean naming latency was 595.875). The difficult nonwords were chosen from the nonwords whose average reaction time was in the range of 780 ms to 960 ms (the mean naming latency was 816.375). The 32 nonwords let participants experience rejecting many items by labeling them "nonword."

TABLE 3. Examples of simple and difficult nonwords in Set 3 (32 items). Each subject sees all the items.

Nonwords	Simple nonwords		Difficult nonwords	
Nonwords but pronounceable in terms of SE orthography	binch	blan	chence	cleash
	disp	drust	druile	freamt
	toal	wompt	thwee	zuct

Set 4 consisted of high-frequency and low-frequency loanwords from substrate languages of HCE—Hawaiian and Japanese (e.g., *mahea*, *ume*). They were chosen from stories written by local authors and two glossary books of HCE. The judgment of the frequency of the items in Set 4 was collected from Kent Sakoda, a linguist who is a native speaker of HCE. Set 4 was included so as to activate the participants' knowledge about HCE in the rather formal, test-like setting of the experiments, as well as to check the correlation between the knowledge of HCE loanwords and performance on the experimental items in two HCE orthographies. It is worth mentioning that the items in Set 4 are not necessarily considered as "loanwords" by the local population. These words are sometimes referred to as "slang."

TABLE 4. High-frequency and low-frequency loanwords in Set 4 (8 items). Each subject sees all items.

Loanwords	High-frequency		Low-frequency	
Loanwords from Japanese & Hawaiian	akamai	ume	mahea	hanawai
	hemo	manapua	pio	kotonk

[18] Although *terse* contains post-vocalic *r*, it is pronounced because in HCE post-vocalic *r* is always pronounced when it follows schwa or [ɜ] in stressed syllables (Kent Sakoda p.c. 10/11/2004, also see Sakoda & Siegel 2003:22-26).

Overall, 80 items were tested: 24 orthography items (8 items in SE orthography, 8 items in the etymological HCE orthography, 8 items in the HCE Odo orthography), 16 SE items that do not change pronunciation in HCE (8 high-frequency items and 8 low-frequency items; half of them were words with regular spelling, and half of them were words with irregular spelling), 32 nonwords items (16 simple nonwords and 16 difficult nonwords), and 8 loanword items (4 high-frequency items and 4 low-frequency items). Out of the 80 items, 24 items (16 experimental items in the etymological HCE orthography and the Odo orthography, plus 8 loanwords) are specific to the participants' linguistic experiences in Hawai‘i. For these 24 items, different patterns were expected for the M group and H group in reaction times for the naming task and the numbers of items they judged as "word" in the lexical decision task. On the other hand, all the participants were expected to behave similarly for the remaining 52 items.

PROCEDURE—EXPERIMENT 1A. The experiment was conducted on a Power Macintosh G4 running PsyScope with a button box as a timing device. The participants were tested individually in a sound-attenuated booth. The participants went through a short practice session (8 trials) to confirm that they understood the task. The participants were presented with a series of possible words and nonwords on a computer screen, one word at a time in a pseudo-randomized order, and were instructed to pronounce each word as quickly as possible. The stimulus items were presented on a monitor in 48-point black Chicago font against a white background. The presentation order of the test materials was the same for all of the participants. A high-sensitivity microphone connected to a button box was used to trigger the timer of PsyScope and to record the response latencies. Each trial was initiated by the presentation of the prompt saying "Waiting . . . " (for the duration of 1500 ms) in light blue font, followed by the presentation of stimuli. The participants had to name the stimulus aloud as quickly as possible. The latency of the response was recorded as described above, and the verbal response was recorded for further analysis with a lavaliere microphone connected to a Sony MD recorder. If the participants did not react within 4000 ms, a warning saying "You didn't respond in time" appeared. As soon as the participants pronounced the stimulus, or timed out, a direction to make a lexical decision appeared which said "Press 'yes' if word, 'no' if it wasn't," and the participants made a word/nonword forced-choice decision. If they did not react within 4000 ms, a warning saying "You didn't respond in time" appeared.

PARTICIPANTS—EXPERIMENT 1B. Participants in experiment 1b were the same population who participated in Experiment 1a.

MATERIALS—EXPERIMENT 1B. Participants were presented with an audio recording of 95 items. They consisted of the 48 real-word items in Experiment 1a plus 47 fillers that had not appeared in Experiment 1a. The items in Experiment 1a that were also used in Experiment 1b, were: 24 orthography items (Set 1 in Table 1), 16 SE control items (8 high-frequency items and 8 low-frequency items, Set 2 in Table 2) and 8 loanwords (4 high-frequency items and 4 low-frequency items, Set 4 in Table 4). As for the 24 orthography items, it was expected that the performance of the M group and the H group would differ for the 16 items they received in HCE orthography in Experiment 1a, although a similar performance was expected for the 8 items they received in SE orthography. As for the 16 non-varying English words, a similar performance was expected for the two groups of the participants. As for the 8 loanwords, the participants in the H group were expected to judge more items as "received"

than those in the M group. Although the participants saw the written forms and named them in Experiment 1a, they might not have been able to recognize them by listening to the audio forms if these loanwords were not in their mental lexicon.

Fillers consisted of 39 English words and 8 loanwords used in Hawai‘i. The stimuli were recorded sound files in SE pronunciation, produced by a native speaker of English who had training in phonetics. Filler words and the items from Experiment 1a were almost equal in number as well as in loan/non-loan proportion. In addition, the fillers were chosen so as to have more or less the same frequency and same semantic category as the 48 items in Experiment 1a that were also used in Experiment 1b. All of the participants were expected to judge that they did not receive the filler items in Experiment 1a. All items appear in Appendix B.

PROCEDURE—EXPERIMENT 1B. After Experiment 1a, the participants were asked to come out of the sound-attenuated booth and to fill out the demographic questionnaire, which included a self report on the use of HCE by the participants and the people around them. It took them less than five minutes to complete the questionnaire. When they completed the questionnaire, the participants returned to the sound-attenuated booth for Experiment 1b. The participants went through a short practice session (three trials) to confirm that they understood the task and also to adjust the volume of the sound stimuli if necessary. Each trial was initiated by the presentation of the prompt saying “waiting . . . ” (for the duration of 1500 ms) in blue font, followed by the sound stimuli. The pseudo-randomized presentation order of the test materials was the same for all the participants. They were instructed to say whether or not they had received the word in Experiment 1a by pressing the Yes or No button on a button box. They heard the words over headphones and they could adjust the volume if they wanted. The latency of the response was recorded by means of a timer on the button box. Although the participants were instructed to decide as quickly as possible, there was no feedback about the response time, and they could take as much time as they wanted to make a decision. There was no feedback as to whether the answer was correct or not.

5.2 RESULTS. Since the purpose of this experiment was to compare the behavior of the H group with that of the M group, there needed to be equal numbers of participants with equal numbers for the three presentation lists in the M and H groups. In addition to the 40 participants who were excluded based on their linguistic background and performance (see §5.1 for the details), the data of 13 participants were removed in the data analysis. The selection of 13 participants for exclusion was based on their error rates in lexical decision and deviant values in naming latency. First, those with more than 9 errors out of 48 items in the word/nonword forced-choice decision for control items (16 SE items, 32 nonwords) were removed. Then, those with extreme latencies (both short and long) were removed until there were equal numbers of participants for all the groups and lists. Since there were more participants from Hawai‘i than from the Mainland, most of the exclusions were made for H group. In addition, as explained in §5.1 (on Set 2 materials for Experiment 1a), 4 SE control items (out of 16) were excluded from the analysis due to errors concerning regularity.

Table 5 and Figure 1 below show the mean naming latencies and standard deviations (SD) for the four sets of stimuli. The fact that the naming times for orthography items in SE orthography and high frequency SE control items were similar shows that the two groups were very similar populations in terms of their ability to recognize familiar visual forms. There was a difference between the two groups for the latencies of naming HCE orthographies: the Hawai‘i group was slower in naming items in both the Odo and the

etymological orthographies. Unexpectedly, this pattern was also observed in the naming latencies for nonwords. Also, although it is not as clear as for the HCE items and nonwords, a similar pattern was observed in terms of low-frequency loanwords and low-frequency SE control items as well. The latencies of the H group were numerically shorter, in contrast, for the high-frequency loanwords. The different behavior of the two groups for the nonwords and high frequency and low frequency control words went against my predictions.

TABLE 5. The mean naming latencies and SD in Experiment 1a (in ms).

	Orthography items			Loanwords		Nonwords		SE control	
	SE	Odo	Etym.	High	Low	Difficult	Simple	High	Low
M	671.99	813.78	811.14	803.43	823.97	880.82	738.81	767.30	770.21
SD	105.19	165.96	161.92	201.07	151.15	161.49	120.30	170.94	166.06
H	685.26	895.89	925.06	784.23	859.80	1047.45	833.29	729.30	833.52
SD	138.00	228.36	262.85	223.98	231.77	284.14	195.34	97.05	184.26

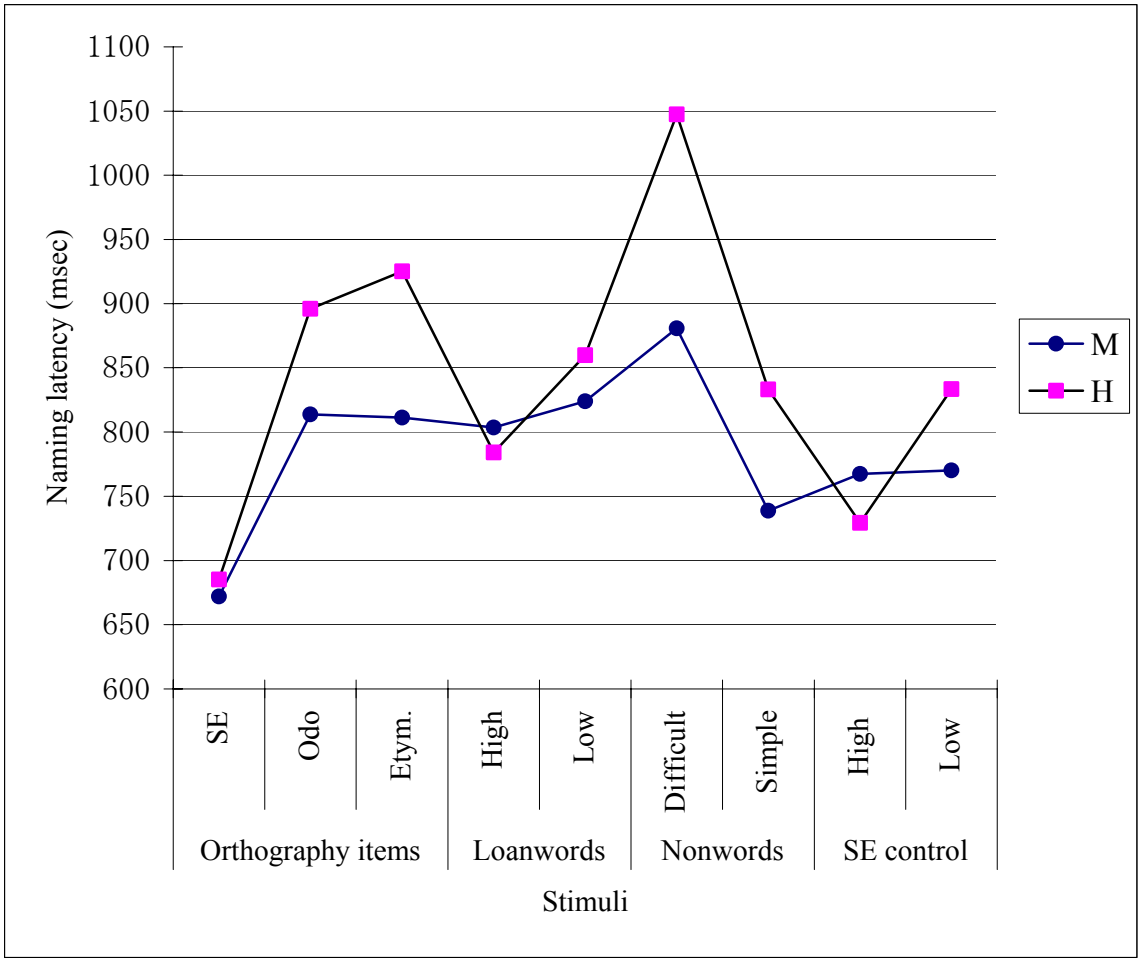

FIGURE 1. Mean naming latencies in Experiment 1a.

Mean naming latencies were analyzed by an analysis of variance (ANOVA) that resulted from the factorial combination of group (M vs. H) and category (orthography items, loanwords, nonwords, and SE control items). In the analysis, "group" was a between-subjects factor, whereas "category," "orthography," "frequency," and "regularity" were within-subjects factors.

For the orthography items, unsurprisingly the ANOVA exhibited significant effects of orthography, $F(2, 68) = 56.025$, $p = <.0001$. The orthography × group interaction was also significant: $F(2, 68) = 3.313$, $p = .0424$. The group effect was not significant: $F(1, 34) = 1.490$.

Also unsurprisingly, the frequency effect was significant for loanwords: $F(1, 34) = 6.130$, $p = .0184$. The frequency × group interaction was not significant: $F(1, 34) = 2.009$. The group effect was not significant either: $F(1, 34) = .016$.

For the nonwords, a significant effect of category (simple and difficult) was exhibited: $F(1, 34) = 107.420$, $p = <.0001$. Interestingly, the category × group interaction was also significant: $F(1, 34) = 4.408$, $p = .0433$. The group effect just missed significance: $F(1, 34) = 4.123$, $p = .0502$.

For the SE control items, both frequency and regularity were within-subject factors. Surprisingly, the frequency effects were not significant $F(1, 34) = 2.427$. The group × frequency interaction was not significant either: $F(1, 34) = 2.670$. Given the small number of items, the results on the regularity effect is not presented nor discussed. For the same reason, the results on the frequency effect should also be treated with caution.

The results of the lexical-decision task in Experiment 1a and the memory test in Experiment 1b showed a similar pattern in the effect of the two groups on the naming latencies in Experiment 1a. In these tasks, however, the group effect was only marginal. A close examination of overall results suggested that the two groups consistently showed different reaction times (H group significantly longer than M group) to the orthography items in HCE orthographies and to nonwords.

6. DISCUSSION. As we saw in §5, the results of Experiment 1a demonstrated significant group effects in naming times for nonwords and items in the two HCE orthographies. Bidialectal HCE speakers (the H group) had significantly longer reaction times than monolingual SE speakers (the M group). However, the two groups reacted very similarly for orthography items in SE orthography in Set 1, SE control words, and HCE loanwords. In this section, the interpretation of the results for each set of stimuli is followed by their implications for the two research questions, as well as for general issues in visual word-recognition theories in bilingual/bidialectal situations.

Regarding the orthography items (Set 1), a significant interaction between orthography and group was observed. As noted above, the orthography items are commonly used high-frequency words in three kinds of orthographies. The naming latencies of the two speaker groups for the items in SE were very similar. This suggested that the subjects in the two groups were very similar populations in terms of the recognition of high-frequency English words. The reaction times of the two groups for items in the two HCE orthographies were significantly different: there were significantly longer reaction times for the H group. The significant interaction of orthography and speaker group indicates that HCE speakers named items in the HCE orthographies significantly more slowly compared with the monolingual SE speakers. The implication of the significant group interaction effect seems ambiguous. It may suggest that although HCE speakers were not familiar with the two HCE orthographies,

the visual items nevertheless activated the corresponding HCE phonological forms, which delayed their reaction times. More specifically, the unfamiliar orthographic information and the familiar HCE phonology might have competed with each other in the process of recognition in such cases. At the same time, the result may suggest that HCE speakers perceived them simply as non-familiar visual forms (as in the case of nonwords). Since the mean reaction times of HCE speakers to HCE items (895.89 ms for the Odo and 925.06 ms for the etymological orthography) fall in between their mean reaction times to simple nonwords (833.29 ms) and difficult nonwords (1047.45 ms), it is difficult to decide what caused the difference. Performance on the orthography items is crucial for the first research question that was posed: Do bidialectal HCE speakers react differently to different HCE orthographies? When we compare the HCE speakers' reactions to the two different HCE orthographies, unexpectedly the items in the Odo orthography were named numerically (but not significantly) more quickly than the items in the etymological orthography. Given the fact that familiar SE spelling rules are used for the etymological orthography as opposed to the Odo orthography, it was predicted that HCE speakers would react to the etymological orthography more quickly. The orthography items tested in the present experiment do not represent a wide range of the HCE lexicon, and thus further study with comprehensive HCE stimuli is required before we reach a conclusion concerning the processing effect of phonology-based and etymological orthographies. Yet the results here suggest that processing effects might be similar for the two orthographies in Hawai‘i, as opposed to the commonly accepted view that the Odo orthography is very difficult to read, even for native speakers of HCE.

As for the loanwords, only the effect of the frequency was significant. The group effect was not significant. Considering the fact that the H group should receive more exposure to the loanwords (especially to the high-frequency items), the lack of difference between the performances of the two groups is surprising. However, if we compare the RTs for loanwords with RTs for HCE items, we see that those of the M group for the loanwords were similar to those for the HCE items, whereas those of the H group for loanwords were much shorter than those for the HCE items.

The most unexpected and thus most revealing results of this experiment were the significantly different performances of the two groups to nonwords. As stated above, the difficult and simple nonwords were included in the stimuli for three reasons. First, they were expected to serve as a control to see if the reaction to nonwords would be similar to that for HCE orthographies. Second, since they are not specific to the linguistic experience in Hawai‘i, the reaction to nonwords along with the SE control items was expected to verify that the participants were generally similar populations. Third, since the nonwords tested in the experiment were selected from among the 590 nonwords tested in Seidenberg et al. 1994, reaction to them was also expected to verify that the participants in the present study behaved more or less similarly to the participants in Seidenberg et al.'s 1994 experiments with respect to the pronunciation of a large corpus of nonwords. The participants in Seidenberg et al. 1994 were 24 McGill University undergraduates, native speakers of Canadian English. Surprisingly, the results from this study showed that the reaction times from the H and M groups were significantly different from each other. Since the nonwords were not specific to the linguistic experience in Hawai‘i, the findings imply that the participants in each group were not similar populations in terms of nonword pronunciation. In comparing the reaction times to the items in HCE orthographies, the mean RTs of both the M group and the H group

fall in between the mean RTs for simple nonwords and those for difficult nonwords. Compared to the reaction of the participants in Seidenberg et al. 1994, the participants in the present study are sensitive to the characteristics of items such as simple and difficult If we look at the mean RTs of the M group and the H group of the present study, we find that the performance of the M group is much closer to the RTs in Seidenberg et al.'s study, whereas the performance of the H group was much longer. Figure 2 below shows the mean naming latencies for nonwords by the two speaker groups in the present experiment and by the participants in Seidenberg et al. 1994.

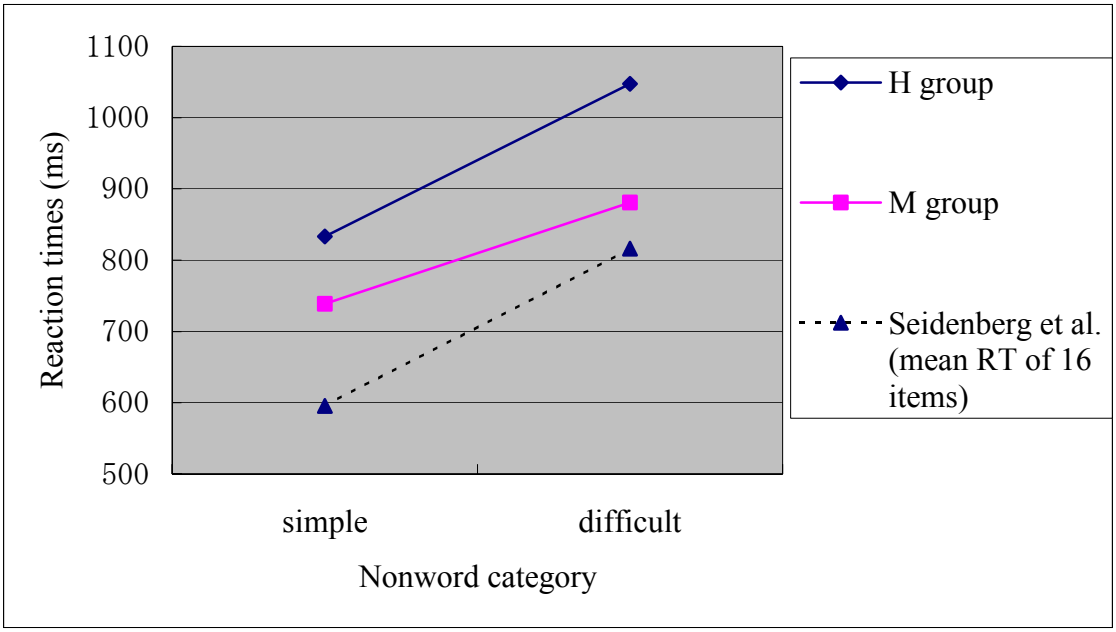

FIGURE 2. The mean naming latencies for nonwords by two groups in Experiment 1a and by the participants in Seidenberg et al. (1994).

Longer latencies of the H group than those of the M group and those of the participants in Seidenberg et al. for the nonwords suggest that the participants in the H group have a generally different reading pattern for items with certain characteristics compared with both the participants in the M group in the present study and the participants in Seidenberg et al. 1994.

SE control items, like the nonwords, were included so as to verify if the participants in each group were generally similar populations or not. As expected, the two groups reacted similarly to the SE control items.

In sum, the two groups behaved significantly differently for the items in HCE orthography and nonwords, although they behaved similarly for the SE items and loanwords. In other words, the results show a difference between speaker groups for items whose visual forms are unfamiliar to HCE speakers, but no difference between speaker groups for familiar visual forms. How can we interpret the results? The difference seems not to have been caused directly by the Hawai'i-specific features of the stimuli (for instance, phonological familiarity of the item, as in the case of HCE spelling items, or more exposure to the items, as in the case of loanwords), as I expected. Rather, the difference between the reactions of the two groups correlates with the visual familiarity of the stimuli. I argue that an inhibitory

effect of bidialectalism leads to longer naming times for the bidialectal speakers for visually unfamiliar forms.

The equivalence of the two speaker groups in naming the familiar visual forms suggests that orthography-to-meaning mappings (hereafter sometimes referred to as lexical mappings) and the resulting access of pronunciation for the two speaker groups are similar. For unfamiliar forms, when they have to activate orthography-to-phonology mappings (hereafter sometimes referred to as phonemic mappings), their naming times differ.

In bidialectal environments where one of the dialects has no conventional orthography, bidialectal speakers are assumed to be somehow integrating dual and/or complex phonological systems with one orthographic system in their mental lexicon.[19] Consequently, it is also assumed that in the acquisition of grapheme-to-phoneme mappings, bidialectal children develop more complex grapheme-to-phoneme mappings for cases where monolingual children develop relatively simpler grapheme-phoneme mappings. For example, children in Hawai‘i might have developed *th*—[θ]-[t]/[ð]-[d] correspondences for the syllable-internal *th* sequence, while monolingual children might have developed a *th*—[θ]/[ð] correspondence for the same *th* sequence. These dual grapheme-to-phoneme mappings may be activated whenever bidialectal speakers try to access the sublexical units in reading via the orthography-to-phonology pathway.

My argument here on the correlation between the more complex grapheme-to-phoneme correspondences and longer latencies in naming is consonant with the findings in some previous studies on orthographical depth[20] and its influence on visual word recognition. How phonemic mapping is used in word recognition varies in languages with different orthographic systems. For example, lexical access in English involves both lexical mapping and phonemic mapping, whereas native readers of Serbo-Croatian, where spelling-to-sound correspondences are very regular, are biased toward using phonemic mapping in word recognition (Feldman and Turvey 1983). By comparing the naming latencies to words (high-frequency and low-frequency) and nonwords in Serbo-Croatian, English, and Hebrew, Frost et al. (1987) found that the difference between the RTs for nonwords and high-frequency words is smaller in Serbo-Croatian and larger in Hebrew. For Serbo-Croatian speakers, the lexical status of the item (whether it is a word or nonword) did not seem to affect its naming latency. Frost et al.'s (1987) results were corresponded to the orthographical depth of the languages tested, where Hebrew was the deepest and English represented the middle along the continuum of orthographic depth. The effect of orthographic regularity was also investigated in the acquisition of phonological coding accuracy by children. By comparing the reading performance of English-speaking children (Grades 1-4 level) with German-, Dutch-, Swedish-, French-, Spanish-, and Finnish-speaking children for numerals, number words, and pseudowords, Aro and Wimmer (2003) reported that the translation of new letter

[19] As Siegel (2003:198) pointed out, due to the typological closeness of the dialects involved, the psycholinguistic question of whether they are unified, partially overlapping, or separate linguistic systems remains unanswered. In the same vein, the dual phonological systems in the mental lexicon of bidialectal speakers could be unified, partially overlapping, or separate systems.

[20] Orthographical depth is determined according to the complexity of an orthographic system's letter-to-sound correspondences. According to Frost et al. (1987), in a *shallow orthography*, the phonemic and the orthographic codes are isomorphic; the phonemes of the spoken word are represented by the graphemes in a direct and unequivocal manner. In contrast, in a *deep orthography*, the relation of spelling to sound is more opaque. The same letter may represent different phonemes in different contexts; moreover, different letters may represent the same phoneme (ibid.:104).

strings into acceptable pronunciations is easily acquired in all alphabetic orthographies tested in their study, with the exception of English. Their results are consistent with a suggestion in Seymour, Aro, and Erskine (2003) that English is the most inconsistent of 13 languages (English and 12 other European languages[21]) when placed on the continuum of orthographic depth at the level of grapheme-to-phoneme correspondences.

Returning to the situation in Hawai‘i, how might the bidialectal linguistic environment affect the native speakers' phonemic mapping? According to Share (1995), phonological recoding—the ability to translate a new letter string into a phonological code by which phonological word forms can be accessed—is considered to be the *sine qua non* of early reading development. As in the case of African American Vernacular English or Jamaican Creole, HCE is sometimes referred to as "bad English" or "slang" in Hawai‘i, and is not considered as an independent linguistic variety with its own grammatical and phonemic system. Unlike many of the bilingual situations where the speakers are well aware of operating in two different language modes, the speakers of dialects, especially at a young age, are typically unaware of their ability to command two different linguistic systems. As a result, when bidialectal children are developing literacy and grapheme-to-phoneme correspondences, they may often have to struggle to integrate the HCE phonemic system that they are familiar with and the SE phonemic system that the school teaches with one set of orthographic conventions, and must do so without knowing that they are dealing with two phonemic systems. In such circumstances, it should be natural for bidialectal children to mix HCE and SE phonology as "English" sounds. In that case, the already inconsistent and irregular (compared with other European languages) English grapheme-to-phoneme correspondences would gain even more complexity and opacity. Thus, assuming the orthographic-depth continuum, for bidialectal HCE speakers, and perhaps for other English-related dialect speakers, English orthography represents a slightly lower (deeper) point than for monolingual (monodialectal) SE speakers. I argue that monolingual SE speakers have relatively simple orthography-to-phonology mappings, resulting in relatively short naming times for HCE-orthography forms and nonwords. Bidialectal speakers presumably have more complex orthography-to-phonology mappings from the dual phonological systems (HCE-SE) they control. Therefore, forms requiring phonological mapping prior to recognition are more difficult for HCE speakers to name.

The reaction to more varied SE items in terms of both frequency and regularity by HCE speakers might have crucial implications for the argument discussed here. None of the SE control items I tested in the present experiment were of particularly low frequency. They were chosen so as to have similarly limited numbers of letters and syllables compared to the items in the other categories, such as the orthography items and loanwords. If we were to test a much larger number of SE items with a range of frequency and regularity—for instance, items with much lower frequency, or items that contain more irregular graphemes—we might see more of a difference across the speaker groups. Based on the argument that the inhibitory effect of bidialectalism leads to longer naming times for forms requiring phonological mapping prior to recognition, low-familiarity SE items with regular orthography-phonology mappings should lead to similarly long RTs for bidialectal speakers, as in the case with nonwords.

As regards the effects of bidialectalism on children's reading in Hawai‘i, there is one

[21] The 12 European languages tested in Seymour et al. (2003) other than English were: Finnish, Greek, Italian, Spanish, Portuguese, French, German, Norwegian, Icelandic, Swedish, Dutch, and Danish.

relevant study, conducted some 30 years ago. The Kamehameha Early Education Program (KEEP) investigated the causes of the difficulty experienced by local children in Hawai‘i in learning to read in the public schools in 1970s. In order to see if there was bidialectal confusion as a result of the inherent differences between HCE and SE, the KEEP Phone Discrimination Test (KPDT) was constructed. Smith et al. (1977) reported the development of a procedure for item inclusion, and the administration procedures of the KPDT. A subsequent large-scale administration of the KPDT would have contributed to the investigation of the effects of the two different phonological systems in bidialectal situations on reading, but it seems that no such study has been conducted thus far. However, the results of the test conducted for the item-inclusion process of the KPDT development, reported in Smith et al. 1977, has some relevance for the present discussion. In the test for selecting items to be included in KPDT, a large number of minimal contrast pairs such as *than/Dan* were tested in order to find the hypothesized sources of confusion. It was reported that five pairs of corresponding sounds seemed to be sources of phoneme confusion.[22] The reported phonological confusion about certain sounds is consistent with my argument here that bidialectal speakers have more complex orthography-to-phonology mappings due to their two phonological systems.

Since the subjects of this experiment were members of the University of Hawai‘i at Mānoa community, one might ask whether the effect obtained by the present experiment can be found with other populations in Hawai‘i as well. As Romaine (1994:530) pointed out, most people in Hawai‘i are being exposed to SE more than ever before, and the island of O‘ahu is where the most “decreolized” and therefore, the most acrolectal varieties are found. This suggests that the results obtained in the present experiments might be the most modest representation of what could be found for speakers from the other islands, and also for the overall population of Hawai‘i. Stronger effects might be observed if the same experiment were conducted on the islands of Kaua‘i or Hawai‘i, which are the least “decreolized.”

As for the issues specific to the domain of bilingual/bidialectal word-recognition studies, there are two hypotheses concerning the general pattern of activation of the stored knowledge of the other language(s)/dialect(s), as I discussed in §3. Do bilinguals activate words from both languages they store when a presented word is recognized (the language nonselective-access hypothesis), or do they activate only words of the language targeted in the specific setting (the language-selective hypothesis)? Although this fundamental question was considered specifically for the bilingual situation in Dijkstra et al. (1998) and the authors did not mention the bidialectal situation, we can see the parallel of the issue with bidialectal situations. As noted above, bidialectal speakers may not be as conscious of their bidialectal knowledge as bilingual speakers are. Moreover, the lack of a strongly conventional orthography for one of the dialects may result in a difference in the substance of the knowledge they store for the dialect.

In fact, the lack of a conventional orthography was a crucial factor in the choice of an experimental design for this study. In bilingual word-recognition studies, a monolingual lexical decision task seems to have been the most popular method to test the selective- and nonselective-access hypothesis. The typical experimental design used in such studies was a

[22] These were: /ð/-/d/ (e.g., *though/dough*), /u/-/ʊ/ (preceding /l/, e.g., *pool/pull*), /o/-/ʌ/[sic.] (e.g., *not/nut*), /s/-/z/ (finally, e.g., *bus/buzz*), and /θ/-/t/ (the last chiefly in the initial cluster /θr-/ or /tr-/, e.g., *three/tree*) (Smith et al. 1977:4). The third pair should be /ɑ ~ ɔ/-/ʌ/ (and not /o/-/ʌ/); other examples given in Smith et al. (1977) are *bomb/bum*, *cot/cut*, and *Ron/run*.

task in which the subjects responded positively if the stimulus was a word in a prespecified "target" language. This design is useful for testing the interference of the non-targeted language by manipulating the interlingual overlap (orthographic, semantic, and phonological) either in the stimuli themselves or in priming. In the present experiment, the target dialect (SE or HCE or both) was deliberately left ambiguous (more precisely, it was assumed to be a generalized lexical decision task). Before the experiment, participants were simply told that "words" and "possible words" would be presented on the computer screen. Regarding the lexical-decision task, participants were told to press the "yes" button for "words" and the "no" button for "nonwords." The primary task employed in this study was not lexical decision, however, but naming.

The generation of phonological information is indispensable in the naming of words and nonwords. The phonological information in visual word recognition is generated either via whole-word representations or a sublexical spelling-to-sound conversion. The involvement of the two different kinds of mappings is discussed in studies of the role of the phonology and orthography in visual word recognition (e.g., Grainger and Ferrand 1994). However, studies of bilingual word recognition have focused on lexical access via whole-word representations rather than the mediation of the sublexical units. A large number of the major bilingual word-recognition studies (Bijeljac-Babic, Biardeau and Grainger 1997, Dijkstra et al. 1999, Dijkstra et al. 2000, to mention just a few) employed lexical-decision tasks, not naming tasks. The reason that naming has not received much attention is an inherent constraint on the methodology of bilingual studies. Comparing the latencies to nonword naming by bilingual speakers with those by monolingual speakers differs crucially from comparing the performances of bidialectal vs. monolingual speakers. The difference relies on the fact that languages involved in bilingual situations often do not share a common orthography.[23] Nonwords are generally orthographically regular and pronounceable strings of letters in the target language. Therefore, the difference (longer RT for bilinguals than monolinguals) between bilingual speakers and the monolingual control group with respect to the nonwords may possibly be interpreted as being due to the higher skills or greater experience by monolinguals for reading the target language.[24] It is only in bidialectal situations where no conventional orthography is involved for one of the dialects that we can test non-orthographic effects reflected in the difference of nonword naming.

What is the implication of the results of the present experiment for the language-selective/nonselective-access hypothesis? As for the naming of the familiar visual forms

[23] Depending on the languages involved in the bilingual situation, the degree of the difference may vary: Imagine the case of the bilinguals who speak Chinese and English in contrast to those who speak Dutch and English.

[24] In fact, the different performance on nonwords in terms of RTs for lexical-decision tasks by bilinguals and monolinguals was reported in Dijkstra et al. 1999, but this phenomenon was simply not discussed. In Dijkstra et al. 1999, the same visual lexical-decision task involving the same stimulus material was conducted with Dutch-English bilinguals (Experiment 2) and English monolinguals (Experiment 3, as a control group). In Experiment 1, the mean RT to nonwords by bilingual speakers was 649 ms (Dijkstra et al. 1999:506), whereas in Experiment 2, the mean RT to nonwords by monolinguals was 575 ms (ibid.:509). The statistical analysis of the performance on nonwords was not presented. In general, the RTs of the Dijkstra et al.'s (1999) monolingual subjects were 106 ms faster than those of the bilingual subjects in Experiment 2 for real word stimuli. Dijkstra et al. stated that it is not unexpected, given the participants' higher proficiency in English (ibid.:509). Although they did not mention the faster (74 ms) mean RTs of monolinguals to nonwords, it is assumed that the differences in behavior to nonwords between the two groups is attributed to nothing but the different "proficiency" in English, including familiarity with English orthographic patterns used in nonwords.

such as SE items and loanwords, the reaction times of the two groups were similar. This leads us to think that there were no effects of knowledge of HCE for the items to be recognized via orthography-to-meaning (lexical) mapping. This observation is consistent with the fact that knowledge of HCE does not associate with any orthographic system. On the other hand, we have seen that the naming times for specific items was significantly different between the H group and the M group, and it suggests a different reading pattern for the two groups for the items requiring orthography-to-phonology (phonemic) mappings. The speakers in the H group arguably activate the knowledge of HCE as well as the knowledge of SE when they recognize unfamiliar visual forms, such as items in HCE orthographies and nonwords, and this explains the different performances of the two groups. As in the case of the familiar visual forms, where no interference of HCE was observed, the interference of HCE for the unfamiliar visual forms can be explained with the characteristics of the knowledge of HCE: HCE affects the reading pattern of the bidialectal HCE speakers only when the recognition process involves orthography-to-phonology (phonemic) mappings, because knowledge of HCE is phonology-based due to the lack of its own orthography.

Another factor that might have influenced the reading pattern of people brought up in Hawai‘i is the orthographic patterns in substrate languages such as Hawaiian or Japanese. As is observed with the names of the major islands (O‘ahu, Hawai‘i, Maui, Moloka‘i, Lāna‘i, and Kaua‘i), most of the place names in Hawai‘i are Hawaiian. In addition, many nouns from Hawaiian and Japanese are used in the everyday life of people in Hawai‘i, such as personal names, cooking-relating words, and cultural terms. The substrate languages of HCE, the heritage languages of Hawai‘i, have very different spelling patterns from English. For instance, Hawaiian does not have any consonant clusters, and Japanese allows consonant clusters only in very limited sequences. It is also possible that the exposure to the spelling patterns of these heritage languages may have influenced the reading patterns of people in Hawai‘i.

In summary, the results suggest that stored knowledge about a dialect that has no strongly conventional orthography affects recognition when it involves orthography-to-phonology mappings. In this experiment, the two groups behaved similarly in terms of SE items (both orthography items in SE orthography and a small number of high-frequency and low-frequency SE control items). Although the results of this experiment imply HCE effects for the recognition of SE items that require orthography-to-phonology mappings (such as low-frequency regular words), we would have to test considerable numbers of such items in order to know if the HCE effects are clearly observed in reading such target (SE) words. It is also desirable to test nonwords that conform to Hawaiian and Japanese types of orthography to test if the population in Hawai‘i would react similarly or differently from the population from the Mainland.

We must now turn to the implication of this study for general theories of visual word recognition. Models for word recognition have varied greatly in scope and detail (Seidenberg 1995:138). However, the majority of them allow us to distinguish direct orthography-to-semantic mapping and orthography-phonology-semantic mapping. The intervention of phonology is typically observed in naming nonwords. If we assume that the interpretation of the results of this study is valid, then the different performances between the bidialectal and monolingual population signify the critical intervention of phonology for the stimuli tested. By comparing the two populations, we can potentially test various items for which the role of phonology has not yet been clarified.

The four phonological alternations tested in the present experiments are shared, or partially shared, with other varieties of English, such as African American Vernacular English and Jamaican Creole. The effect of bidialectalism discussed here might be examined in some situations where African-American Vernacular English or Jamaican Creole is involved.

This study also provides information about the reaction times of HCE speakers for two different types of HCE orthographies. It is generally assumed that although the Odo orthography is phonologically consistent, it is difficult for the majority of HCE speakers to adopt either for writing or reading without a background in linguistics. However, the reaction times of the participants from Hawai‘i to the orthography items in Odo orthography were very similar to the reaction times to the items in the etymological orthography. The mean naming latencies of the Hawai‘i group for the items in the Odo orthography was 895.89 ms, whereas those for items in the etymological orthography was 925.06 ms, not a significant difference. At least for the items and population tested, and in word-recognition, neither of the two orthographies is more difficult than the other for speakers of HCE. Since it was not the main goal of this experiment to compare HCE speakers' perceptive reaction to the different HCE orthographies, the number of HCE items and the types of HCE items were not sufficient nor comprehensive enough to examine the overall visual word-recognition process of HCE orthographies. Moreover, the results of a word-recognition experiment may not suffice to assess a specific orthography with respect to the ease in perception, let alone the issue of language policy that the choice of the orthography would cause (see Romaine 1994 for a discussion of these effects). An experiment on sentence processing in HCE may shed further light on this issue, for example. A more comprehensive investigation of the processing effects of the two different HCE orthographies remains to be explored in future studies.

7. CONCLUSION. The present study explored the effects of different orthographic and phonological systems as factors in visual word recognition by bidialectal speakers. The results of the experiment showed significantly longer naming latencies for a bidialectal speaker group for items whose visual forms are unfamiliar (items in two HCE orthographies and nonwords). As a possible explanation to the results, I argued that bidialectal HCE speakers have more complex orthography-to-phonology mappings from the two similar but different phonological systems (HCE, SE) they store. My argument is consistent with recent findings in the bilingual-processing literature that have shown inhibitory effects in recognizing cognates and interlingual homographs from stored knowledge of the other language. Whether these effects are also observed in other items, such as lower frequency SE items, must be investigated further in order to determine the range of bidialectal effects.

Appendix A. Items used in Experiment 1a.

Set 1. Orthography items (24 items). Each subject sees 1/3 of the words in each orthography.

Sound change	Standard English orthography	Etymological HCE orthography	The Odo HCE orthography
1. realization of *th* as *t*	think	tink	tingk
	thing	ting	ting
	mouth	mout	maut
	nothing	nahting	nating
	thoughts	tauts	tawts
	south	sout	saut
2. deletion/vocalization of *r* after V	later	laytah	leita
	paper	paypah	peipa
	smart	smaht	smat
	honor	honah	awna
	scared	sked	sked
	yard	yahd	yad
3. word-final consonant cluster reduction	rest	ress	res
	priest	preece	pris
	dialect	dialeck	daialek
	correct	correck	korek
	waste	wace	weis
	nest	ness	nes
4. nasal cluster simplification	plenty	plenny	pleni
	behind	behine	bihain
	blind	bline	blain
	pound	pown	paun
	sound	sown	saun
	county	cowny	kauni

Set 2. SE control items (12 items). Each subject sees all items.

	High frequency		Low frequency	
	Regular	Irregular	Regular	Irregular
SE control items	slow	pint	cutlass	ravine
	shampoo	sign	terse	leaden
	shape	aisle	clench	covet

Set 3. Nonwords (32 items) Each subject sees all the items.

Nonwords	Simple nonwords		Difficult nonwords	
Pronounceable nonwords in terms of SE orthography	binch	blan	chence	cleash
	disp	drust	druile	freamt
	glay	hisk	gruite	hength
	hoothe	jope	jealm	nowth
	ronk	nadd	sidth	slote

	padge	plerk	smuice	snoam
	rike	rull	spetch	teign
	toal	wompt	thwee	zuct

Set 4. Loanwords (8 items). Each subject sees all items.

Loanwords	High frequency		Low frequency	
Loanwords from Japanese & Hawaiian	akamai	ume	mahea	hanawai
	hemo	manapua	pio	kotonk

Appendix B Items used in Experiment 1b.

Items that are also used in Experiment 1a. (48 items)

24 orthography items (presented in SE pronunciation)

yard	blind	smart	pound	think	correct
mouth	county	nest	honor	nothing	paper
south	dialect	plenty	rest	later	scared
priest	thing	behind	waste	sound	thoughts

8 loanwords

manapua	hemo	hanawai	kotonk	mahea	pio
akamai	ume				

8 high-frequency English items

shape	aisle	scary	toilet	sign	slow
shampoo	pint				

8 low-frequency English words

fabric	terse	clench	cutlass	leaden	trough
covet	ravine				

Fillers (47 items)

24 items in the "orthography" category (semantically similar to orthography items)

court	state	advance	teach	rock	front
foot	language	quart	everyone	afraid	employ
orient	dumb	virtue	early	lawyer	noise
hungry	cave	work	different	people	speech

8 items in the loan words category

pupu	kumu	halau	holoholo	kuleana	kakou
kokua	lomi				

7 items in the high-frequency English words category

ocean	spring	strange	chubby	reply	kitchen
detergent					

8 items in the low-frequency English words category

adage	languid	tepid	chorale	enzyme	usurp
lactate	galley				

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