Morphological Representation in an Endangered, Polysynthetic Language

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This article presents the results from an initial psycholinguistic study of patterns of morphological representation in Dene Suñine (Chipewyan), an indigenous and highly endangered language spoken in Northwestern Canada. Our investigation focused on how morphological knowledge in this polysynthetic language is affected across various levels of language attrition by employing a morphological segmentation task and an off-line lexical decision task. We discuss the manner in which these tasks target different aspects of morphological ability and then turn to methodological issues associated with conducting psycholinguistic studies with language users that differ in levels of age, education, literacy, and bilingualism (Dene–English). Finally, we report on the challenges of doing psycholinguistic research outside the confines of a university setting and make some recommendations to other researchers who might wish to undertake similar studies.

Key words: morphological awareness; polysynthesis; Athapaskan; endangered language; comparative psycholinguistics

Dene Suñine (literally, “the true people,” formerly known as Chipewyan1) is an Athapaskan language spoken in the Canadian subarctic and is closely related to Slave and Dogrib as well as to its better known southern cousins, Navajo and Apache, which are spoken in the southwestern United States. It is one of only two Athapaskan languages in Canada not to be on the verge of extinction.2 However, the long-term prognosis for this language is grim. There are estimated to be about 3000 speakers, most of whom are in their middle-to-late adulthood. A handful of isolated communities in northern Saskatchewan still report some monolingual speakers as well as children learning Dene Suñine (henceforth, Dene) as a first language.

The authors thank Valerie Wood, Shirley Cardinal, and Ernest Ennow for their assistance in developing the stimulus list. We also thank an anonymous reviewer for many helpful comments. We are grateful to Valerie Wood for conducting the two experiments at Cold Lake First Nation as well as to the 10 speakers who served as experimental participants. This research has been supported by a Community-University Research Alliance grant (833-99-1023) from the Social Science and Humanities Research Council of Canada (2000–2003); a Support for the Advancement of Scholarship grant from the Faculty of Arts, University of Alberta (1999–2000) to Sally Rice; as well as by a Major Collaborative Research Initiative Grant from the Social Sciences and Humanities Research Council of Canada to Gonia Jarema (Director), Eva Kehayia, and Gary Libben.

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1 Chipewyan is a term of Cree origin meaning approximately “pointed skins.” It referred to the traditional hides worn by members of this Dene group and, although a widely used ethnonym, it was also an epithet and is highly disfavored by Dene Suñine speakers today.

2 Carrier, encompassing many dialects spoken in British Columbia, is the other (cf. Standing Committee on Aboriginal Affairs Report, 1990).
Why do we begin with this dire account of a language on the brink of survival? Precisely because it is moribund we feel a scientific imperative to learn as much as possible about this and other indigenous languages of the Americas while fluent and semiﬂuent speakers are still alive. An equally important reason is because these languages typically exhibit morphological systems far more complex than most European systems (viz. English, German, and Finnish) on which many of our claims about morphological representation and processing are based. Therefore, they present ideal testing grounds for the evaluation of hypotheses concerning the extent to which morphological factors shape the representation of words in the mind and the extent to which morphological computation is involved in lexical processing of speakers whose language does not have a written tradition. The two experiments that we report on below take a ﬁrst step toward the realization of these goals by addressing two fundamental questions: (1) Do Dene speakers show awareness of morphological constituency in their language? (2) Do Dene speakers show sensitivity to morphological constituency in their language?

These two questions form the foundation for subsequent investigations of morphological processing in this language. They allow us to investigate whether morphological effects can be obtained in the absence of a written tradition and the extent to which such effects vary across members of an endangered language population in which the older speakers are typically much more ﬂuent in the language than younger speakers. Finally, the questions provide for the opportunity to develop psycholinguistic techniques that yield valid and reliable results when employed with participants who vary dramatically in age and education.

**TYPOLOGICAL BACKGROUND**

Morphologically, the typical Dene verb shows extraordinary polysynthetic and fusional characteristics. These are due partly to the sheer number of morphemes potentially integrated into the verbal unit, but are also due to the extensive tonal and morphologically conditioned phonological alternations that occur as well as the frequent contractions, elisions, and metatheses that take place in normal speech. The language supports a fair amount of suppletion and allomorphy in addition to a high degree of stem polysemy. Table 1 illustrates some of the above points with a partial conjugation paradigm for simple forms of the Dene verb corresponding roughly to the English lie down. Note that the shape of the word-ﬁnal stem (roughly, the last syllable) varies with number and tense/aspect.

According to traditional accounts, the Dene verb word consists of a verb theme (the basic lexical entry made up of a stem and one or more thematic preﬁxes) and some number of additional, often discontinuous, preﬁxes. The examples in (3)–(6)

<table>
<thead>
<tr>
<th>TABLE 1</th>
<th>A Dene Conjugation Paradigm for lie down*</th>
</tr>
</thead>
<tbody>
<tr>
<td>IMPERFECTIVE</td>
<td>PERFECTIVE</td>
</tr>
<tr>
<td>1SG</td>
<td>nestéih</td>
</tr>
<tr>
<td>2SG</td>
<td>níteih &lt; ne-n-teih</td>
</tr>
<tr>
<td>3SG</td>
<td>nestéih</td>
</tr>
<tr>
<td>1DU/PL</td>
<td>nité &lt; ne-i-d-tés</td>
</tr>
<tr>
<td>2DU/PL</td>
<td>nuhté &lt; ne-û-uh-ți</td>
</tr>
<tr>
<td>3DU/PL</td>
<td>henté &lt; ne-û-uh-ți</td>
</tr>
</tbody>
</table>

*From Li (1946, p. 413).
feature exploded and glossed representations of some commonplace Dene verb words and give a sense of both the potentially elaborate prefixal system, as in (3) and (4), and the extensive reduction, as in (5) and (6):

(3) \( \text{beghāyenį́į́} \) (from Li, 1946, p. 417)
< be- –ghá- –ye- –n- –i- –l- –qį- 3SG for 3SG MOMENTANEOUS 1SG CLSF handle animate object
``I have given him/her to him/her''

(4) \( \text{bečsidiąnuńį́į́} \) (from Li, 1946, p. 417)
RECIPI from DIST 2SG CLSF split
``You split several objects''

(5) \( \text{nįłoston} \) (from SR fieldnotes)
< ńį- –la- –hu- –s- –tőn
2SG hand OPTATIVE 1SG clasp
``Let me shake your hand''

(6) \( \text{hulcę́} \) (from Li, 1946, p. 414)
< he- –ghwa- –n- –l- –zé
INCEPT OPT 2SG CLSF hunt
``You will start to hunt''

It could be said that the Dene verb stem lexicon is just a large inventory of light predicates (on par with English make, get, take, or put), which only achieve lexical status and meaning once they have been fleshed out, usually idiomatically, through the elaborate prefixal system within the verbal unit. This is not unlike what happens in the English periphrastic constructions make up (``invent''), get away (``escape'') or get by (``subsist''), take on (``assume a responsibility for''), or put up with (``tolerate''). The verb theme is composed of the stem, a valency classifier, and any other obligatory thematic prefixes. Any remaining prefixes are called nonthematic and these encode derivational and inflectional categories as diverse as subject and object pronouns, aspect, mood, a variety of adverbial notions, and any incorporated noun stems that may be required. The minimum utterable Dene verb word thus consists of two syllables since the verb stem cannot stand alone. For McDonough (2000), notably, this is akin to a verb plus auxiliary, where the auxiliary contains tense-aspect-modality information along with subject agreement and possibly a valency classifier, if overt.

The Athapaskan prefixes have received a number of analytical treatments. According to Li (1946, p. 410), Dene reportedly has 10 prefix slots which, descriptively, are characterized in the list in (7) and ideally aligned in the diagram in Table 2:

(7) i. incorporated postpositions which may be preceded by their pronominal objects or not
ii. local and adverbial prefixes
iii. iterative prefix (also called distributive)
iv. incorporated noun stems
v. third-person pronominal subjects
vi. pronominal objects
vii. modal prefixes

### TABLE 2

A Templatic Rendering of the Dene Verb Prefixes + Stem*

<table>
<thead>
<tr>
<th>PP</th>
<th>Adv</th>
<th>Iter</th>
<th>Incorp</th>
<th>Pron Subj 3rd</th>
<th>Pron Obj</th>
<th>Mode</th>
<th>Asp</th>
<th>Pron Subj 1st/2nd</th>
<th>Class</th>
<th>Verb stem</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>8</td>
<td>9</td>
<td>10</td>
<td></td>
</tr>
</tbody>
</table>

* After Li (1946).
### Table 3
A Zonal Rendering of the Dene Verb-Prefix Template

<table>
<thead>
<tr>
<th>Disjunct prefixes (lexical)</th>
<th>Conjunct prefixes (grammatical)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PP</td>
<td>Adv</td>
</tr>
<tr>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>

*After Li (1946), Kari (1989), and Rice (2000).*

- viii. aspectual prefixes
- ix. first- and second-person pronominal subjects
- x. (valency) classifiers

Table 2 illustrates the so-called templatic model of the Athapaskan verb. There are alternative accounts, notably the zonal approach introduced by Kari (1989) and elaborated on in K. Rice (2000). Under this analysis, the prefixes in positions 1–4 in Table 2 form part of a disjunct or lexical zone (having primarily a derivational function), while the prefixes in positions 7–10 comprise the conjunct or grammatical zone (since they mark more universal inflectional categories such as tense, aspect, modality, subject agreement, and valency). These zones are indicated in Table 3.

The theoretical implications underlying such a “slot/filler” or “zonal” approach to the verb aside, the expectation that certain prefix positions exist and should be filled, coupled with some robust phonological processes alluded to above, complicates the task of parsing and glossing elements within the verbal unit. Because this language, like most Amerindian languages, has received scant attention in the psycholinguistic literature, the way in which verbs are represented and processed by speakers (for example, as decomposable entities or as fixed expressions) is largely unknown. The two experiments below initiate a research program whose aim is the investigation of the extent to which current psycholinguistic models of multimorphemic parsing and activation are generalizable to a language showing this level of morphological complexity and the extent to which morphological processes are susceptible to language attrition across generations. As we have stated at the outset of this article, such a research program needs to begin with the fundamental questions: Do speakers show morphological awareness and morphological sensitivity?

**EXPERIMENT 1: MORPHOLOGICAL AWARENESS**

Morphological awareness can be conceived of most straightforwardly as the knowledge that multimorphemic forms are indeed multimorphemic. A child, for example, can be said to possess morphological awareness when she or he can indicate that a word such as *toothbrush* is composed of *tooth* and *brush*. Typically, however, this awareness is not evenly distributed across words in the language. The child who may be aware that *toothbrush* is composed of *tooth* and *brush* may not be aware that *playground* is composed of *play* and *ground*. Similarly, most adults would be unaware that a word such as *helicopter* entered the language as *helicopter* rather than *heli* + *copter*, but would typically have very well-developed morphological awareness for forms such as *cupboard*, *undo*, and *unfillable*. A simple segmentation task can

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We ignore here the theoretical implications of this scenario which places inflection inside of derivation in the Athapaskan verb word.
thus be profitably employed to investigate whether speakers are aware of the morphological constituency of bimorphemic forms and to inform subsequent on-line studies of morphological processing (e.g., Libben, 1994; Libben & Derwing, 1996). In the case of multimorphemic forms, asking participants to divide a string into two morphological parts can also reveal where they perceive the major constituent boundaries to be (see Libben, in press, for an example of this technique with English trimorphemic words).

In this experiment we adopted this segmentation technique in order to address the two major questions in this study. If Dene speakers consistently segment multimorphemic Dene strings at morpheme boundaries, this would constitute evidence of their morphological awareness. Because participants were instructed to break the stimulus string at only one point, we further expected that preference patterns in the location of those segmentations would indicate whether particular break points were more vulnerable than others. Specifically, our goal was to ascertain whether speakers’ divisions of Dene verbs would correspond at all with linguists’ zone-based analyses. To illustrate, we sought to determine whether words in column 1 of Table 4 would be segmented in the manner shown in column 2.

**Methods**

**Participants.** Ten native speakers of Dene from Cold Lake First Nation (Alberta) served as experimental participants. They were all bilingual in Dene and English although English is now the preferred language for each of them. As is typically the case for endangered indigenous languages, the older speakers were considerably more proficient in the language than younger speakers. Accordingly, data from older speakers and data from younger speakers were analyzed separately. Six were considered “younger” speakers and ranged in age from 45 to 60; four were considered “older” and were all over the age of 60. This division was based mainly on life experience as nearly all the older speakers attended fewer than 8 years of formal schooling or were partially raised in the bush (traditionally) by parents and grandparents in a monolingual Dene environment.

Participants were tested at the Cold Lake First Nation reserve as part of a collaborative university/community research initiative and were given a $20 honorarium for their participation.

**Stimuli.** Forty test items were produced. Each of these items was a three- or four-syllable Dene verb having propositional content (that is, each item could stand alone as a complete utterance). Each item was comprised of a stem and at least one syllable corresponding to one or more disjunct (lexical) prefixes and at least one syllable corresponding to one or more conjunct (grammatical) prefixes.

**Procedure.** Our goal in this initial study was to develop a technique that could be used with elderly participants and that would be appropriate for speakers of a language lacking a written tradition.

All participants were tested individually by a native speaker of Dene. At the outset of the session, they were told that they would be asked to segment some words in Dene. They received instructions in English and some example words in English to segment. For example, they were asked whether it would be more natural to segment a word like “unhappy” as un + happy or unhap + py. They were also given some multimorphemic examples in Dene to segment. After participants indicated that they understood the task, the test session began. The 10 participants heard the 40 test items repeated three times.

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**TABLE 4.** Sample Stimuli and Expected Zone-Based Segmentations

<table>
<thead>
<tr>
<th>Stimulus</th>
<th>Zone-based segmentation points</th>
</tr>
</thead>
<tbody>
<tr>
<td>yeÎ±a’ayáti</td>
<td>yeÎ±a’ yaÎ± ti</td>
</tr>
<tr>
<td>3SG:for IMPF:3SG:CLF speak</td>
<td></td>
</tr>
<tr>
<td>“S/he is reading”</td>
<td></td>
</tr>
<tr>
<td>tÎ±odestáth</td>
<td>tÎ±o des tâáth</td>
</tr>
<tr>
<td>grass DIST:IMPF:1SG: S cut</td>
<td></td>
</tr>
<tr>
<td>“I’m cutting grass”</td>
<td></td>
</tr>
</tbody>
</table>
times on a tape recording. They were asked to indicate where each word could be split into two parts. The Dene investigator recorded each of their responses on a score sheet.

**Results**

Responses provided by participants were categorized into six types as shown in Table 5. This classification scheme exhausted the response possibilities and provided us with a convenient means of determining whether segmentations corresponded to morpheme, if not zonal, boundaries and the extent to which they clustered in particular locations. The classification scheme also formed the foundation of our investigation of whether response patterns were differentiated by participant group.

In Figure 1, the breakdown of responses is provided for both the younger six participants and the older four participants. As can be seen in this figure, the overall pattern of responses is similar across the two groups. In both cases, participants showed a tendency to parse the text items at a zonal boundary. For the younger group, 73% of the responses were at zonal boundaries. For the older group, zonal boundary parses comprised 81% of the responses. This difference was significant in the analysis by items [$F(1, 39) = 7.49, p = .009$] but not in the analysis by participants [$F(1, 8) = 2.57, p = .15$].

We conclude, therefore, that both groups demonstrate awareness of the morphological boundaries in multimorphemic strings. We note that the older participants show a greater proportion of zone-based parses than the younger group. This is consistent

**FIG. 1.** Segmentations of multimorphemic verb strings by younger ($n = 6$) and older ($n = 4$) participants.

### TABLE 5

Classification of Participant Segmentation Responses by Location within the String

<table>
<thead>
<tr>
<th>Category</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Break</td>
<td>Participant was unable to segment the word</td>
</tr>
<tr>
<td>Within DISJ</td>
<td>Division was within the initial disjunct prefix zone</td>
</tr>
<tr>
<td>Within CONJ</td>
<td>Division was within the medial conjunct prefix zone</td>
</tr>
<tr>
<td>Within CONJ+</td>
<td>Division was between conjunct &amp; stem but included a subject marker or classifier</td>
</tr>
<tr>
<td>Between DISJ/CONJ</td>
<td>Division was between the initial disjunct and the medial conjunct zones</td>
</tr>
<tr>
<td>Between CONJ/STM</td>
<td>Division was between the medial conjunct zone and the final stem</td>
</tr>
</tbody>
</table>
with the fact that the older group is more proficient in the language and suggests that zonal boundary parsing may constitute a part of that proficiency.

We also note that both groups showed a slight tendency to prefer segmentations between the prefix and stem portions of the string, as would be expected if their segmentations were guided by the purported major morphological boundary within the strings (that is, between prefix set and stem). While it is possible that some of the participants may have responded to phonological cues (e.g., syllable structure and high tone) rather than morphology per se, there were quite a few instances in which both older and younger speakers parsed particular words intrazonally in a manner inconsistent with either syllabification preferences (open syllables, no complex onsets) in the language or with morphemic breaks. To illustrate, consider the two forms in Table 4. A zone-based parsing strategy would predict a possible break right before the stems -tʃi, “speak,” and -təth, “cut.” A number of participants parsed these words and others like them in a way which combined the stem with the final fricative of the conjunct zone, i.e., yielding fragments such as -hʃ “CLF.speak, ’” and -stəth, “1SG.cut.” While it could be argued that these parses have created open syllables in the conjunct, they also produce phonotactically disallowed complex onsets. The two renegade fricatives were, in all cases, either the first person subject agreement pronoun -s- or one of two valency classifiers -ʃ- or -l-. It could be argued that these are relatively salient semantically and therefore readily fuseable with the stem morpheme. Relatedly, in a handful of other cases, participants parsed within the disjunct zone, especially when a pronominal postpositional object was present [the verb word illustrated in (3) is such an example]. These parses, too, may have been triggered by semantically or lexically salient material, although they created fragments of unequal size and effectively stranded the postposition. We have not yet determined to what extent high tone (which is both lexical and grammatical in Dene) interacted with parsing preferences, but it appears that it played no appreciable role.

Discussion

As we have discussed above, one important goal in this initial study was to determine the extent to which a task such as this could be profitably employed by Dene speakers, who are unaccustomed to metalinguistic analysis in their language and to psycholinguistic tasks in general. The results reported above are therefore reassuring in that they suggest that the segmentation procedure could indeed be employed with additional groups of both younger and older participants. We took the results as also offering an affirmative answer to our first question: “Do Dene speakers show awareness of morphological constituency in their language?”

In Experiment 2, below, we continued our investigation by addressing the second question: “Do Dene speakers show sensitivity to morphological constituency in their language?” As was the case in Experiment 1, our investigation had the twofold goal of seeking to answer the targeted question, while at the same time exploring the feasibilities of methodological procedures.

**EXPERIMENT 2: MORPHOLOGICAL SENSITIVITY**

The pattern of segmentation in Experiment 1 suggested that zonal boundaries in general and the prefix–stem boundary in particular might be salient for Dene speakers. In this experiment, we sought to determine whether the zones themselves might show differentiated salience. In order to achieve this goal, we altered the stimuli in Experiment 1 by changing a single vowel in the disjunct, conjunct, or stem zones to
create nonmorphemes in a selected region of the word (such a manipulation is also discussed for Navajo by McDonough & Willie, 2000). By asking the four older and six younger Dene speakers to perform a lexical decision on the vowel-altered and nonaltered stimuli, we sought to address the issue of zone sensitivity within multimorphemic strings and the issue of whether the two participant groups could be differentiated by their lexical decision accuracy.

Method

Participants. This experiment was conducted with the same 10 Dene participants that took part in Experiment 1. Thus the group was comprised of six ‘‘younger’’ speakers, ranging in age from 45 to 60 years and ‘‘older’’ speakers over the age of 60.

Stimuli. The 40 test items in the morphological segmentation task were combined with 20 filler items, so that participants responded to an equal number of intact and altered stimuli. This resulted in the stimulus presentation categories shown in Table 6.

All altered nonsense words were phonotactically plausible in Dene. Each participant heard only one version of each of the 40 stimulus verb words: a correct form, a version with an altered disjunct vowel, a version with an altered conjunct vowel, or a version with an altered stem vowel. All participants also heard 20 filler words, bringing the total number of stimuli presented to 60, thus balancing for ‘‘yes’’ and ‘‘no’’ correct responses.

Procedure. The testing session began with general instructions regarding the nature of the task. Participants were told that they would hear 60 words being spoken on a tape. They were told that all of the words would sound like Dene, but only some of them would be actual words of Dene. As illustrative examples, they were given English word pairs in which one item was a real word and the other was a nonsense word (e.g., dog vs deg and unhappy vs unhappy). These were followed by a practice session in Dene whereby participants heard five phonotactically plausible practice items (three acceptable and two nonsense items) and were asked to respond ‘‘yes’’ or ‘‘no’’ as to whether the form heard was a good word in Dene. Here, ‘‘not good’’ meant that the word was phonotactically possible, but morphologically strange. All participants rated all practice items (which included both polysyllabic nouns and verbs) accurately. Performance in the practice session indicated that participants were indeed focusing on morphological acceptability. The 60 test items were repeated three times on audiotape. As in Experiment 1, the Dene investigator recorded responses on a score sheet.

Results

Both the younger and older participants showed sensitivity to the vowel alteration manipulation. The younger participants responded ‘‘yes’’ to unaltered items 92% of the time. This success rate was not significantly different from the 88% success rate for older participants [$F_{\text{part}}(1, 8) = 0.29, p = .66$; $F_{\text{items}}(1, 39) = 1.8, p = 1.8$]. For the altered stimuli as a group, younger participants responded ‘‘yes’’ 24% of the time. The rate of ‘‘yes’’ response for the older participants was 16%. This difference was not significant by participants [$F(1, 8) = 1.2, p = .30$], but was marginally significant in the items analysis [$F_{\text{items}}(1, 39) = 3.9, p = .053$].

We conclude, therefore, that both groups of participants were responding appropriately to the task, as demonstrated by their overall accuracy in distinguishing between

<table>
<thead>
<tr>
<th>Label</th>
<th>Example</th>
<th>Correct response</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unaltered</td>
<td>de yéne gha</td>
<td>Yes</td>
<td>10 core + 20 filler = 30</td>
</tr>
<tr>
<td>Altered DISJ:</td>
<td>da yéne gha</td>
<td>No</td>
<td>10 core = 10</td>
</tr>
<tr>
<td>Altered CONJ:</td>
<td>de yént gha</td>
<td>No</td>
<td>10 core = 10</td>
</tr>
<tr>
<td>Altered STEM:</td>
<td>de yént ghu</td>
<td>No</td>
<td>10 core = 10</td>
</tr>
</tbody>
</table>

Note: The altered vowel is presented in bold.

TABLE 6
Stimulus Conditions for the Lexical Decision Task
altered and unaltered stimuli. The distinguishing trend between older and younger participants supported the view that the task was also sensitive to the differences in proficiency between the groups. We proceeded then with the investigation of whether particular domains of vowel alteration resulted in greater rejection rates than others and the extent to which patterns of rejection interacted with participant group differences.

The correct answer for all vowel-altered stimuli was “no.” Therefore, all items that were not judged to be acceptable words in their intact form by either the younger or older groups were excluded from the analysis. This resulted in the elimination of seven of the 40 core stimuli and ensured that “no” responses by participants indicated the effect of vowel alteration rather than some other characteristic that might have contributed to their rejection of the unaltered form of the word. The pattern of responses is presented in Fig. 2.

The analysis of variance by participants and by items did not reveal significant effects of factors of age, zone, or their interaction (all $p$’s > .14). The trends, however, are consistent with those observed in Experiment 1. Overall, older participants responded more accurately (i.e., fewer “yes” responses) than younger ones. The older participants showed a relatively uniform level of sensitivity to alteration in the three zones of the stimuli. The younger ones, however, were less sensitive to prefix alterations than to stem alterations. Within the two stem zones, changes to vowels in the conjunct zone were least noticeable. The relation of these trends to characteristics of Dene verb morphology is discussed in the following section.

**GENERAL DISCUSSION**

In Experiment 1, we found that parsing is largely zone-based and that the stem has a privileged status; both older and younger participants parsed right before the stem 44% of the time. The low degree of intraconjunct parses suggests that the integrity of this zone is important. Phonology may also be a factor since the conjunct prefixes are generally subsyllabic if not suprasegmental and tense/aspect/mood prefixes, subject prefixes, and valency classifiers generally form a single syllable.
The biggest difference between speaker groups resided in the greater proportion of within-disjunct zone parses for the younger speakers. One possible explanation for this difference may be that younger speakers adopted a strategy whereby they parsed after a readily recognizable morpheme. In the majority of cases, this segmentation appeared to be after a word-initial possessive prefix or an incorporated nominal object (as illustrated in Table 4). Older speakers were relatively indifferent to nonstem material.

There may be several motivations for the younger speakers’ behavior. Both phonologically and semantically, there is more variety at the margins of Dene verbs. That is, there is a greater range of material that can occupy the disjunct zone (or the stem, for that matter) than the conjunct. The disjunct zone can contain from zero to four prefixes and it often ends up being several syllables in length, especially when it contains a postpositional phrase or an incorporated nominal or adverbial prefix. The conjunct zone, on the other hand, is rarely more than two syllables in length and is frequently only one. Moreover, the grammatical material compressed into the conjunct is often phonologically and semantically predictable.

To recapitulate, both disjunct prefixes and stems display much more phonological and semantic richness than the conjunct. Morphosyntactically, the typical polysyllabic Dene verb sandwiches grammatical material between relatively salient lexical morphemes. Participant sensitivity to the verbs’ margins was more or less intact for older speakers, while younger speakers displayed decreasing awareness and sensitivity to morphological content or boundaries across the word. As with the older speakers, they privileged the stem in both experiments. However, unlike the older speakers, they were differentially sensitive to the two remaining zones. Their performance was much worse on or around the conjunct than the disjunct.

Stepping back from the results, a few comments are warranted about the stimuli which have ramifications for the tasks we developed and the results we obtained. In our instructions to our Dene-speaking confederates who helped us develop the stimuli, we stressed morphological complexity and syllable length above all else. However, since we wanted to use the same examples in both tasks, we needed polysyllabic words which could undergo vowel alteration in all three positions (disjunct zone, conjunct zone, and stem) and still remain phonotactically viable nonwords. That requirement may have skewed the naturalness and transparency of the stimuli by constraining the set of available forms.

In addition, some of the items may have represented an overarticulation of a Dene verb rather than a more usual colloquial and contracted pronunciation such that even more fluent ‘‘older’’ speakers may have judged a form to be unacceptable even if it was not (a comparable situation might occur with nonliterate English speakers confronted with the form want to after a lifetime of only hearing wanna). This last point is especially important with respect to both tasks. There is a strong tendency toward open syllables in the language (save for the stem syllable), which may have biased some of the response patterns. Except in very rare circumstances, any closed syllables in Dene end in continuants (e.g., /l/). Some of our participants parsed certain verbs containing either the -s- 1sg subject agreement marker (in prefix position 9) or -l- or -¸-, one of the two valency classifiers (in prefix position 10), inside the conjunct, producing an open conjunct syllable and a stem with a complex onset (the stem-initial consonant with either the subject marker or valency classifier consonant preceding it). It seems in retrospect that two separate pressures might have contributed to this unexpected parse: syllabification preferences (for open syllables) and the semantic transparency of either the subject marker or one of the two valency classifiers, each of which could be thought of as creating a lexical variant of the stem (analogous to an English lie/lay distinction).
Finally, despite the first author’s long study of the language, the research design may have contained an Anglo-centric bias. We took for granted that vowel quality was robust, both phonologically and semantically. That is, we assumed that vocalic alterations could be used to produce nonwords. In truth, there is much vowel variation tolerated both between and within speakers, since vowels do not carry much of the signal in Dene; consonants do.4

Participants nevertheless showed a high overall rejection rate for vowel-altered verbs. Thus the manipulation was effective. However, enhanced effects may have been obtained through consonant alteration. This underscores the critical need to conduct psycholinguistic investigation on speakers of languages such as Dene and to do so on language-internal grounds.

TOWARD A COMPARATIVE PSYCHOLINGUISTICS
OF ENDANGERED LANGUAGES

This is the first in a series of studies on lexical representation in Dene. It is being conducted as part of a major collaborative research project between the University of Alberta and Cold Lake First Nation, a predominately Dene community situated in central Alberta along the Saskatchewan border. This program of psycholinguistic research seeks to address what should be a time-critical imperative for us all: (1) to broaden the experimental basis from which psycholinguistic conclusions can be drawn and (2) to collect as much experimental data as possible on endangered languages while fluent speakers are still available. That said, there are profound methodological challenges that those of us used to working with relatively young, compliant, and literate undergraduate participants in a university laboratory rarely have to take into account. In what follows, we outline some of these difficulties and suggest some possible methodological solutions, for the intellectual payoff from studying these speaker populations experimentally far outweighs the difficulty faced in obtaining the experimental data in the first place.

The most obvious procedural difficulties include (a) having to rely on a subject population of speakers who are not literate in their language, (b) being able to devise and conduct on-line tasks with both older and younger speakers, and (c) developing psycholinguistic techniques appropriate for polysynthetic languages. With respect to the first challenge, the lack of literacy in the language extends far beyond the need to develop auditory stimuli or to conduct visual picture-naming tasks. Given the oral nature of the language,5 it effectively means that the extent and degree of metalinguis-

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4 The Dene spoken in Cold Lake (CL), a community where all the speakers are aged 45 or older, is far more conservative than that spoken in Northern Saskatchewan, especially in the linguistically healthy, relatively speaking, communities of Wollaston Lake (WL) and Black Lake (BL), where children still learn the language as their mother tongue and Dene is spoken both inside and outside the home. Compare the following forms for *S/he ate because s/he was hungry* by community, paying special attention to vowel quality and syllable length:

<table>
<thead>
<tr>
<th>Community</th>
<th>Stem</th>
<th>Vowel</th>
<th>Syllable</th>
</tr>
</thead>
<tbody>
<tr>
<td>CL</td>
<td>berbahe'ber</td>
<td>hó'ta</td>
<td>sîyetj</td>
</tr>
<tr>
<td></td>
<td>meat-for-PERF 3SG-crave</td>
<td>CONJ</td>
<td>PERF 3SG-eat</td>
</tr>
<tr>
<td>WL</td>
<td>berbafer</td>
<td>t'á</td>
<td>sêti</td>
</tr>
<tr>
<td></td>
<td>meat-for-3SG-crave</td>
<td>CONJ</td>
<td>3SG-eat</td>
</tr>
<tr>
<td>BL</td>
<td>berbahaijájáj</td>
<td>7á</td>
<td>sêti</td>
</tr>
<tr>
<td></td>
<td>meat-for-PERF 3SG-crave</td>
<td>CONJ</td>
<td>3SG-eat</td>
</tr>
</tbody>
</table>

These dialects are mutually intelligible, nevertheless.

5 Although some speakers can read a modified Roman orthography more or less, there is no widely agreed upon orthography for this language and virtually no reading materials exist for older, fluent speakers. There are many low-level pedagogical materials as well as some 100-year-old hymnals and prayer books written in a modified syllabic orthography like that traditionally used by the Cree, but
tic awareness for most speakers may be limited. Speakers, especially older ones, may occasionally engage in some spontaneous discussion about the meaning of a word, but they do not necessarily attend to patterns in morphological structure the way that visually reliant academics do.6 Another consequence of orality is a resistance to providing or considering citation forms or expressions used outside of context. For example, in the lexical decision task, many subjects reported that the form given, X, was bad and the speaker really meant to say Y. When asked to consider only the form heard on the tape, the speaker might reply, “Yeah, it’s okay, I know what he’s trying to say.”

Simply sitting down for an hour to engage in talk about language is unnatural for most linguistically naïve speakers anywhere. It is especially so for most First Nations speakers. With age and effective illiteracy in the language comes a general mistrust of academics.7 Moreover, the school experience of many of Canada’s indigenous peoples, including our participants at Cold Lake, has not been pleasant. Older speakers are invariably the product of residential schools which, for many, was a traumatic and life-altering experience. Given the fact that, as young students removed from their homes, they were routinely punished for using their native language and were frequently treated as inferior for being “indian,” there is some residual skepticism for any renewed interest in their language by outsiders. For younger speakers educated on or off a reserve, their education has typically been marred by a chronic sense of failure, of feeling behind their nonaboriginal peers in reading and other subject matters, and in an extraordinary high attrition rate. On the typical reserve in Canada, there are very few high school graduates, let alone professionals with advanced degrees. For most aboriginals, language knowledge issues are far less important than poverty, inadequate housing, substance abuse, and violence. In the typical university psycholinguistics lab, socioeconomic and cultural issues rarely come into play. We spend more time worrying about our participants’ handedness than on whether they were ever traumatized in a classroom setting.

With regard to the second major challenge, fashioning experimental paradigms appropriate to cultural practice and to nonliterate and technologically naïve participants of varying ages is an important consideration in this psycholinguistic agenda. More indirect methods such as eye-tracking or ERP, while initially more invasive, may give better response information.

Working off-campus, especially in a native community in which life experience and level of native language ability is so varied, means that there will be greater heterogeneity of participants than in an undergraduate participant pool. Indeed, in some aboriginal communities, there may only be a handful of speakers left with whom any experimental data can be gathered.

A final challenge stems from developing psycholinguistic techniques appropriate for polysynthetic languages which involve a high degree of fusion and portmanteau

neither of these kinds of materials foster an ease or facility with the written word. Moreover, there are virtually no Dene writers working to produce a literature. This lack essentially means that the language exists only in a spoken form.

6 Linguistic humor and punning are fairly prevalent in Dene, but this is generally confined to extensions of the classificatory verb stem system (e.g., saying someone is lying there using the stem classifier for a heap of mush rather than for an animate being). The first author, who has been working on the language for 8 years, has never been able to get speakers to engage in word or rhyming games. Furthermore, it was extraordinarily difficult for our speaker-confederates to produce nonsense stimuli lists.

7 It should be noted again that both experiments reported on here were conducted by a Dene-speaking confederate. However, she was known to be working on the university-sponsored language revitalization project that sponsored the study and it is also widely known in the community that she has a university degree.
morphemes. With polysynthesis and fusion typically comes an opacity of morphological structure both for the speaker and the linguist. Furthermore, a lack of a written standard means that language innovation continues apace and is not mediated by the conservational influences of orthography. Speakers contract and elide constantly, and convention and context probably play a far greater role in comprehension than the signal itself. For the linguistic outsider, acquisition in the absence of immersion, is rare. Moreover, since the most readily available of our subjects are semispeakers with a fossilized knowledge of the language, it is nearly impossible to ascertain the extent to which forms are decomposable.

Morphological opacity is not merely a by-product of polysynthesis, however. It may lead to it in the first place. Thurston (1988) and Grace (1997) discuss how a high degree of allomorphy, stem polysemy, and figurative (and therefore opaque) lexicalizations are symptomatic of insider-oriented or esoterogenous linguistic communities. For speakers of so-called esoteric languages (as opposed to more exoteric and easily analyzable and acquired *lingua francas*), nonanalyzability and idiomaticity are the norm. Dene could be considered an esoteric language on both sociocultural grounds (the language was traditionally spoken by small, mobile groups of people generally related to one another by marriage or who banded together for subsistence purposes) as well as on linguistic grounds (the language is highly suppletive, idiomatic, polysemous, and figurative). Thus, there are pressures on speakers both within the language and within the speech community not to regard the language as particularly decipherable or decomposable, in the way that Western linguists, with their expectations of morphological decompositionality based on literacy, training, and familiarity with highly analyzable Indo-European languages generally assume (cf. S. Rice, 1999). Without the aid of either speaker intuitions or a rich historical record, linguists are seriously challenged in cracking the morphological code for the majority of items in such languages.

Therefore, for these morphologically exotic and esoteric languages, we are often unable to parse or gloss elements which may or may not be uttered in every instance. We suffer from a serious lack of awareness of the degree of idiomaticity of particular forms. In the absence of extensive databases built on narrative and conversational data as well as on elicited forms (both acceptable and unacceptable), we have no objective access to frequency information on forms, order of acquisition, order of attrition, or degree of semantic extension or bleaching of heavily recycled forms. We also have only the most tentative grasp of which items are considered fixed and conventionalized and which are novel and productive. Furthermore, we cannot build up sufficiently rich sources of knowledge about the language’s phonotactics or whether phonological diversity covaries with different regions of the word (e.g., stem versus prefix). In the off-line decision task, we varied vowels or full segments. Many morphological alternations are sub- or suprasegmental, involving nasality, tone, or vowel length. Many others affect consonants and involve voicing, spirantization, or the addition of an ejective release. Many dialectal differences in North American indigenous languages revolve around consonantal substitutions, not vocalic. It may well be the case that speakers do not attend to the vowel as much as the consonant because its signal load is much smaller, relatively speaking. As we discovered in our post hoc analyses and discussions with speakers, some test items contained semantically rich and phonologically uncommon morphemes either in the stem position or in incorporated elements within the disjunct zone. Their relative conceptual or perceptual salience may have caused speakers to unduly attend to these elements regardless of the meaning or transparency of the remainder of the word.

In summary, we have reported on a study that presents challenges due to heterogeneity at both the stimulus level and the participant level. Our goal has also been to
demonstrate the value of psycholinguistic research among speakers of indigenous (especially polysynthetic) languages and to identify salient trends and potential pitfalls in conducting experiments with these participants. This initial study underscores the need to work closely with confederates who are actively engaged in both the design of research protocols as well as in the development of stimuli. A collaborative approach to research is imperative for sociocultural reasons and is also perhaps the only way to insure the naturalness and efficiency of experimental tasks. This implies that there are no shortcuts to carrying out this sort of research—all assumptions regarding the task, the participant pool, and even the properties of the language, need to be scrutinized in every instance. We expect, then, that advances will be slow. Nevertheless, it is critical to the psycholinguistic enterprise that we look farther afield both linguistically and culturally while we have the opportunity to do so. Hard as it is, it has got to be done. In 10 or 20 years, the opportunity to test models of language representation and processing beyond a small set of well-studied majority languages may well be lost forever.

REFERENCES


