Chicago Maya and *MacNorsk II*: A Tale of Two Software Development Projects (Original Construction vs. Prefab)

Karen L. Landahl, Barbara Need and Mike Ziolkowski
University of Chicago

"Commercial enterprises have undertaken development of materials for widely taught languages, while it has fallen primarily to academia to fill the void for those less commonly taught."

During the past decade the computer has been touted as the premier technology for the delivery of foreign language instruction. The computer's multimedia capabilities are especially appealing (e.g. the ability to combine text, graphics, sound and moving image in one package) – as are its interactive aspects (e.g. providing a variety of feedback on the quality of a student's performance). In the drive to create software for language instruction, a division of labor emerged. Commercial enterprises have undertaken development of materials for widely taught languages, while it has fallen primarily to academia to fill the void for those less commonly taught. Developers in academia have faced funding difficulties as well as skeptical colleagues who often view such efforts as electronic flashcards, perhaps useful but not of much scholarly value. The skepticism is fueled by the long development period that often characterizes many homegrown efforts. And if the conceptualizer of the project is an academic, then s/he is probably a content expert, but not nearly so expert in programming and interface design. The developer faces some choices: 1) use template software that requires basically filling-in-the-blanks (easy but not flexible, may require agreement on pedagogical approach), 2) use a second-order scripting environment where the developer manipulates objects which in turn create code (less easy but more flexible), or 3) program from scratch (least easy but most flexible), an approach that often requires hiring a programmer at considerable expense.

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Several years ago we became involved in two software projects intended to assist the learning of less commonly taught languages: Yucatec & Quiché Maya, and Norwegian. In light of the skepticism described above, as well as the commonly held view that language courses are more akin to occupational training than to the intellectual endeavors that characterize other humanities courses, our first goal was to make our projects as full of intellectual content as possible. Our second goal was to make the products as flexible as possible in order to take maximum advantage of the time and money put into development. That is, we wanted to ensure that, given the considerable effort expended, we did not tie the specific language content to a single programming format (such as *HyperCard*) nor limit the use of a programming format to a single target language (i.e. when creating an original program). In the following discussion, we focus on content and programming issues that address the above-mentioned goals in relation to our specific projects, but which provide ideas extensible to all projects where there is concern for repurposing, linguistic breadth, and phonological acquisition.

First we will look at the *MacNorsk II* project. This developed from *MacNorsk*, which was originally created by Louis Janus and David Rose from what was basically a set of electronic flashcards which Rose made using *HyperCard* as a study aide to help him learn Norwegian. The product Janus and Rose developed emphasized vocabulary, grammar, geography, and vowel pronunciation and discrimination. They made their product available to the world outside St. Olaf College, where the initial development took place, and invited users to add to it. Barbara Need, a student of Norwegian and computer enthusiast, was eager to make additions to the program, and soon a group of us were thinking about ways to enhance it.

Some of the changes we made were straightforward additions to content. We created vocabulary stacks for the useful areas of clothing and the home and updated the geography stacks to reflect the changed political situation in Northwestern Europe. (*MacNorsk* was developed before the dissolution of the Soviet Union.) We also updated the information on the counties of Norway and rewrote city descriptions, which locales we illustrated with photographs taken by a colleague. We also nativized the program so that the user may choose to work with an entirely Norwegian interface. We obtained permission for all copyrighted

materials used and made substitutions for items we deemed difficult to get permission for; e.g. professionally performed music, photographs of widely recognizable living people. We provided new recordings for the speech used in the program, some from native speakers and some from pre-recorded materials. (All of our subjects signed release forms.) The best sound quality possible for the best possible learning was our goal. Much linguistic information is usually carried where the signal is rapidly changing, therefore the fine structure of the speech sound wave must be faithfully represented in the digitized signal. All speech was sampled at 20 kHz with 12-bit quantization – which was then converted to 8-bit for playing on the older Macs. We aimed for a variety of male and female voices, which the learner hears randomly making each use of the program different. We also restructured the program so that each unit (a stack or set of stacks) comes with its sounds in a separate folder, rather than attached either to the Home or to the vocabulary stack, which are the typical locations and which was where we found them. This reconfiguration generally speeds up the program and adds some flexibility: the sounds can be more easily substituted or repurposed.

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Since one of the challenges of learning a new language is being able to understand a variety of speakers, we wanted not only to provide users with examples of male and female speech, but also to demonstrate that a set of dialects comprise Norwegian (or any other language). There are, in fact, two standard Norwegian languages: Bokmål and Nynorsk. Most courses in the United States teach Bokmål, a spoken and written language which is the variety of Norwegian developed from the Danish spoken at Court when Norway was part of the Danish kingdom (1397-1814). Contemporaneously, local dialects continued to develop naturally from the varieties of Old Norse that had been spoken in the country prior to Danish rule. In the middle of the nineteenth century, Ivar Aasen, a language scholar, decided to create a written language, Nynorsk, which more closely resembled what the people actually spoke. Students at Norwegian schools take their classes either in Bokmål or in Nynorsk with the local dialect as the spoken alternate to Nynorsk. We decided that illustration of the dialectal situation in Norway would add considerably to the intellectual content of the product. The same colleague who took the photographs of Norwegian cities also conducted video interviews with inhabitants. In *MacNorsk II* we included video stills of speakers from several cities

along with the corresponding audio in which they introduce themselves and say a few words about their lives. For size considerations we have decided to include only this limited amount of information. We are considering a separate project that will focus solely on the dialectal issue.

"In previous work with Japanese, we have had considerable success using visual feedback to assist learners with the acquisition of pitch accent and durational distinctions for consonants & vowels."

We also wanted to expand the pronunciation exercises in *MacNorsk II*. In previous work with Japanese, we have had considerable success using visual feedback to assist learners with the acquisition of pitch accent and durational distinctions for consonants & vowels. The feedback was provided by Kay Elemetrics' *Visi-Pitch* (exclusively for Intel) which produces a real time display of fundamental frequency. This information is presented as a single line. When it rises, pitch goes up, and when it falls, pitch goes down. We used the length of lines to indicate vowel duration and the length of spaces between lines to indicate consonant duration. This simple display worked well. *Visi-Pitch* provided a non-judgmental tutor that students enjoyed working with. The students could use the visual display to determine whether what they heard in their own Japanese was "objective" or influenced by their native phonology. Since Norwegian also has a pitch accent and durational distinctions, we wanted to provide a similar facility in *MacNorsk II* for the Macintosh platform. We did not think this would be difficult because there exist considerable literature on and analyses of Norse prosody. And, since Norwegian has a large and difficult (for English speakers) vowel system, we wanted to enhance the vowel unit's discrimination exercises and lip aperture pictures for production. We wanted to provide visual feedback as for pitch. To do this we first needed complete acoustic analyses for the Norwegian vowel system, but we discovered that none existed. We undertook that task and further discovered that Norwegian vowels are not amenable to traditional formant analysis. This in turn led to our creation of the concept "supraformant". (To read more about our research on visual feedback and on the supraformant, see Works Cited III. B. & C.). Given the amount of phonetic research required for Norwegian, we decided not to hold up development of *MacNorsk II*, but to work on a separate visual feedback program for the Macintosh that will be useful for any language. We have named this future product *Dr. Vox*.

Certainly one of the advantages of using *HyperCard* is the availability of extant programming. *HyperCard* itself comes with sample buttons and fields which perform a

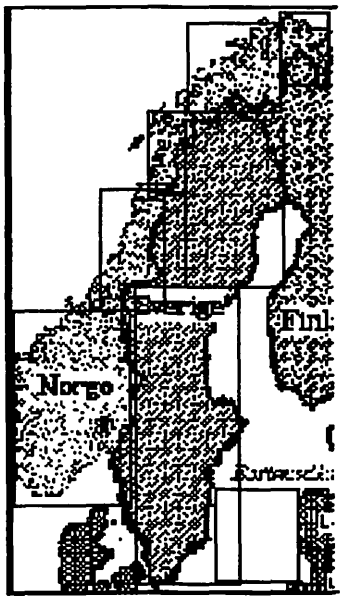
wide variety of functions (e.g. sort cards, dial the phone, open a stack) and *MacNorsk* came to us with programming already in place to play sounds, go Home, go to the Notes stack, etc. In addition, the scripting language for *HyperCard* (HyperScript) is fairly easy to understand, so that a developer can look at a script and copy or edit it so that it does what s/he wants. (This assumes, of course, that the script contains only native HyperScript commands. See below for a discussion of some the problems introduced by developers' additions to HyperScript.) We altered such scripts to play new sounds, to display pictures rather than sounds, etc. Another advantage is that *HyperCard* is designed to incorporate a wide variety of media: sounds, pictures, and movies, which combine to enhance the learning experience.

There were also some disadvantages to using *HyperCard*. One problem we faced quite often was a restriction in the shape of the button. A button is a rectangular space on a card which can be programmed to perform a number of functions. Unfortunately, many objects in the real world are not rectangular in shape: political boundaries, for instance. We had to play with button size, multiple buttons and overlapping buttons to make sure that when someone clicked on a particular picture the right sound would play. As you can see in the illustration, we had to use five buttons to cover Norway and three to cover Sweden. In addition, some of Norway is not covered by a button, and some of Sweden is covered by a Norway button. In the Bottenvika (Baltic Sea), the button which is entirely within the boundaries of the sea is on top of the button that extends into the sea from Sweden. Buttons (and other objects) may be layered, but the object which is on top is the only one which is actually activated when clicked on. Another problem was related to rescripting. Many of the stacks had lots of card buttons all doing the same thing. There was no easy way to reprogram these as a group. The developer had to edit each script individually. We were eventually able to write a script to change scripts, but it would be nice to be able to group buttons and have them all do the same thing.

"One of the problems we faced in implementation was that some scripts become highly individualized."

Such scripts, if not properly annotated, become hard to generalize to wider use. In particular, a *HyperCard* script may consist of native *HyperCard* commands and/or commands which call scripts written by developers. If a user clicks on a button, and the command in the script is "playMe", then the script for the command "playMe" can

be in any number of places. Unless the button script is annotated with information about where to find the command script, it is not easy to figure out where to look for it in case one wants to edit or amend it. In addition to annotating the scripts as thoroughly as possible, we disintegrated sound files from the stacks so that the program calls sounds externally. This means stacks are smaller and sound files are exchangeable (different dialects or languages) and, as with Maya (see below), the sounds are easily accessible for other uses. Image files (photographs and video) are also external to the stacks, saving stack space, and making them exchangeable if a developer wishes to repurpose the stacks for use with a language spoken in another country. Line drawing illustrations (clothing, appliances, etc.) are part of the stacks and most of these are appropriate for use with other languages. These properties of *MacNorsk II* make it possible to reuse its scripts for other languages with a minimum of rescripting.



Next we turn our attention to *Chicago Maya*. This project needed to satisfy two requirements: 1) To provide an archival/official University of Chicago version of the text and audio for the courses Spoken Yucatec and Spoken Quiché developed at the University in the 1960s and still the only basic courses available in these languages. 2) To provide a pedagogical course that permits students to access both text and sound in a unified format.

The situation that *Chicago Maya* replaces is the following: those who currently order the course receive the text (presented in narrow phonetic transcription with English glosses) in microform and the audio on cassettes high-speed duplicated from analog cassette, real-time dubs from the master recordings. We decided on the CD-ROM format for the project because of the large sound files

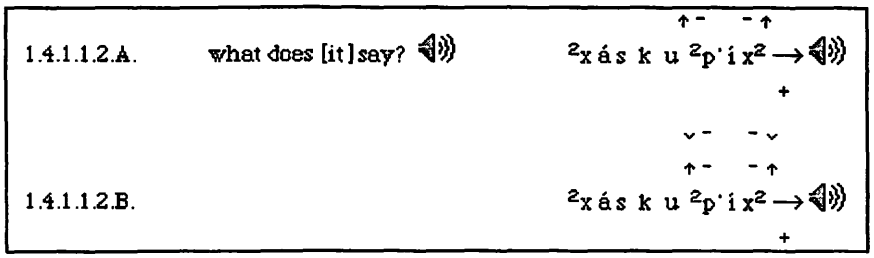
necessitated by archival-quality sound, and we wanted to include the first eighteen lessons from each course, both text and audio, in an interactive format. The Macintosh platform was selected because it is preferred by the general editor of the project.

"Given the enormity of our task and the need to make the longevity of the product a priority, we decided that we wanted to be in more control of the programming than we would be with commercial authoring software."

The first step in the project was to digitally remaster the open reel, acetate tape originals, which were fast approaching the end of their usable life span. The second step was to hire a programmer. Given the enormity of our task and the need to make the longevity of the product a priority, we decided that we wanted to be in more control of the programming than we would be with commercial authoring software. We did not want to worry about the upgrade schedule for the program nor whether it was still on the market. We are still vulnerable to operating system and hardware changes; but, since we own the source code, we would not have to start completely from scratch in order to accommodate our product to a new situation. Our programmer created three programs: *Chicago Maya Editor*, *Chicago Maya Viewer*, and *Chicago Maya Converter*. *Chicago Maya Editor* allows one to enter text (which we do using the Chicago Maya font) and link it to sound files. To create the sound files we used DigiDesign's Audiomedia II board and *Sound Designer II* software. This produces sound files sampled at 48 kHz, with 16-bit quantization and puts them into the Audio Interchange File Format. Sound quality was further preserved because the board allows direct digital input to the hard drive. The *Chicago Maya Viewer* is the end-user program which functions as a digital Level 3 tape recorder with text so the user can see the text, listen to the audio corresponding to the text, and repeat and compare. The *Chicago Maya Converter* serves to transfer Editor format to Viewer and vice versa. This flexible structure makes it possible for users to change sound files, alter transcriptions and glosses, or use the programs for a totally different language as long as they have an appropriate font and the means to digitize and edit sounds. The user can also print out the text and transfer the audio to tape. The content can be repurposed easily. Users may make any or all of these changes as long as the new configuration acknowledges that the content and/or software originated from the official copyrighted University of Chicago CD-ROM (and cites the shareware code we used to help build the text editor).

There are two components we wish to add to the *Chicago Maya* software: 1) saving students' utterances to disk for future analysis, and 2) allowing the user to suppress

some lines of the transcription to simplify presentation for beginners. The transcription used is finely detailed, providing information about sound segments, suprasegmentals, and paralinguistic features, as can be seen in the illustration below from Chapter 4 of the *Spoken Quiché Maya* CD.



The future for both projects could include conversion for use on the Web. Much of the functionality of *MacNorsk II* could now be implemented using HTML tools, but we have decided that *MacNorsk II* is complete as it stands because of copyright issues, among others. The major problem with putting any such language course on the Web is the enormity of the sound files.

When undertaking any CAI development project, it is obviously crucial to begin with a statement of goals. In academia, especially, those goals should then be re-evaluated in light of budgetary constraints, time available, and expertise obtainable, as well as the political climate with respect to the enthusiasm for CAI development at the institution. Then the developer should proceed to choose the development environment most appropriate to achieving the updated goals.

A general lesson from our projects seems a fitting, final desideratum: Individual instructors and developers have, no doubt, pet 'optimal' techniques for computer-aided instruction; however, it is unavoidably true that no clear CAI standards exist. In their absence, it seems best to emulate old standards that are flexible with respect to repurposing. In *Chicago Maya*, for example, we computerized the Level 3 tape recorder for the Macintosh platform. Creating newer techniques such as visual feedback for pronunciation acquisition, as was originally envisioned for the *MacNorsk II* project, requires extensive development effort and specialized linguistic knowledge: *Dr. Vox* remains "work in progress".◆

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Works Cited

I. Software:

Blair, Robert W. and Refugio Vermont-Salas. *Spoken Yucatec Maya*. CD-ROM. Component of *Chicago Maya*© Project. Karen L. Landahl, project director. Norman A. McQuown, general editor. Chicago: Language Laboratories and Archives, University of Chicago, 1997.

Sandberg, Mark, Karen L. Landahl, Barbara Need and Mike Ziolkowski. *MacNorsk II*©. CD-ROM. Rev. ed. based on *MacNorsk* by Louis Janus and David Rose. Chicago: *MacNorsk* Development Team, 1997.

Wick, Stanley A. and Remigio Cochojil-González. *Spoken Quiché Maya*. CD-ROM. Component of *Chicago Maya*© Project. Karen L. Landahl, project director. Norman A. McQuown, general editor. Chicago: Language Laboratories and Archives, University of Chicago, 1997.

II. *Chicago Maya*© references:

Blair, Robert W. and Refugio Vermont-Salas. Spoken (Yucatec) Maya. Books 1 & 2. Chicago: Department of Anthropology, University of Chicago, 1965-67.

Wick, Stanley A. and Remigio Cochojil-González. Spoken Quiché (Maya). Books 1-3. Chicago: Department of Anthropology, University of Chicago, 1966-69.

III. *MacNorsk II*© references:

A. Project references

Need, Barbara. "The interactive Norwegian project at the University of Chicago: *MacNorsk II*." Occasional

Papers in Linguistics: Runes and Representations: *Proceedings of ScandiLingFest I*. Chicago: Department of Linguistics, University of Chicago, 1993. 88-96.

Need, Barbara, Karen L. Landahl, Mike Ziolkowski and Mark Sandberg. "What we have learned: '*MacNorsk II*' and beyond." Biennial Conference of the International Association for Learning Laboratories (IALL). University of Notre Dame, South Bend, IN. May 25-27, 1995.

Need, Barbara, Mark Sandberg, Louis Janus, Karen L. Landahl and Mike Ziolkowski. (1993). "*MacNorsk*." Biennial Conference of the International Association for Learning Laboratories (IALL). University of Kansas, Lawrence, KS. June 3-5, 1993.

B. Supraformant references:

Lowenstein, J.H., K.L. Landahl, M.S. Ziolkowski and P.D. Viechnicki. "The supraformant hypothesis for vowels: Evidence from Norwegian." The 3rd Joint Meeting of the Acoustical Society of America and the Acoustical Society of Japan, Honolulu, HI. December 4, 1996.

"The Norwegian Vowel Group." Web pages. <http://gsbdrl.uchicago.edu./norsk>.

Ziolkowski, M.S., J. Lowenstein, K.L. Landahl, P.D. Viechnicki and R.E. McDorman. "An analysis of Norwegian vowels: What determines the topography of a vowel space?" The 130th Meeting of the Acoustical Society of America, St. Louis, MS. November 27-December 1, 1995.

Ziolkowski, Mike, Peter Viechnicki, Karen L. Landahl and Joanna Lowenstein. "The supraformant hypothesis and the acoustic structure of Norwegian vowels." *CLS 32: The Main Session*. Ed. L.M. Dobrin, K. Singer, and L. McNair. Chicago: Chicago Linguistic Society, 1996. 461-475.

C. Visual feedback references:

Landahl, Karen L. and Michael S. Ziolkowski. "Discovering phonetics units: Is a picture worth a thousand words?" *CLS 31: Papers from the 31st Regional Meeting of the Chicago Linguistic Society*, 1995, Volume 1: The Main Session. Ed. A. Dainora, R. Hemphill, B. Luka, B. Need and S. Pargman. Chicago: Chicago Linguistic Society, 1995. 294-316.

Landahl, K.L., M.S. Ziolkowski, M. Usami and B.K. Tunnock. "Interactive articulation: Improving accent through visual feedback." *The Proceedings of the Second International Conference on Foreign Language Education and Technology*. Ed. I. Shinjo, Karen L. Landahl, M. MacDonald, K. Noda, S. Ozeki, T. Shiozawa and M. Sugiura. Kasugai, Aichi: The Language Laboratory Association of Japan, 1992. 283-292.

Lory, H. and Y. Hirata. "Individual-based Pronunciation Training Program in Japanese: Theory into Practice." Proposal to the Consortium for Language Teaching and Learning, 1997.

Tunnock, Brenda. "Computer-driven, Pedagogical Tools Toward the Acquisition of Japanese Accent." M.A. Thesis. The University of Chicago, 1991.

Ziolkowski, Mike and Karen L. Landahl. "How successfully does visual feedback train listeners to produce and perceive non-native phonological contrasts?" *Proceedings of the XIIIth International Congress of Phonetic Sciences* (ICPhS 95). Vol. 1. Ed. K. Elenius and P. Branderud. Stockholm: Department of Speech Communication and Music Acoustics, Royal Institute of Technology, KTH and Department of Linguistics, Stockholm University, 1995. 330-333.

Ziolkowski, M., M. Usami, Karen L. Landahl and B. Tunnock. "How many phonologies are there in one speaker? Some experimental evidence." *ICSLP 92 Proceedings: 1992 International Conference on Spoken Language Processing*. Ed. J. Ohala, T. Nearey, B. Derwing, M. Hodge and G. Wiebe. Alberta: The University of Alberta, 1992. 1315-1318.

***Karen Landahl** is Academic Director of the Language Laboratories and Archives and an Associate Professor in the Department of Linguistics at the University of Chicago. She specializes in phonetics and language acquisition. **Barbara Need** is a Manager of the Language Laboratories and Archives of the University of Chicago. She is also a gradudate student in the Deparment of Linguistics working on a dissertation in Historical Syntax. **Mike Ziolkowski** is a senior graduate student in Department of Linguistics at the University of Chicago and Director of Research & Development for Cypress Consulting, Ltd.*

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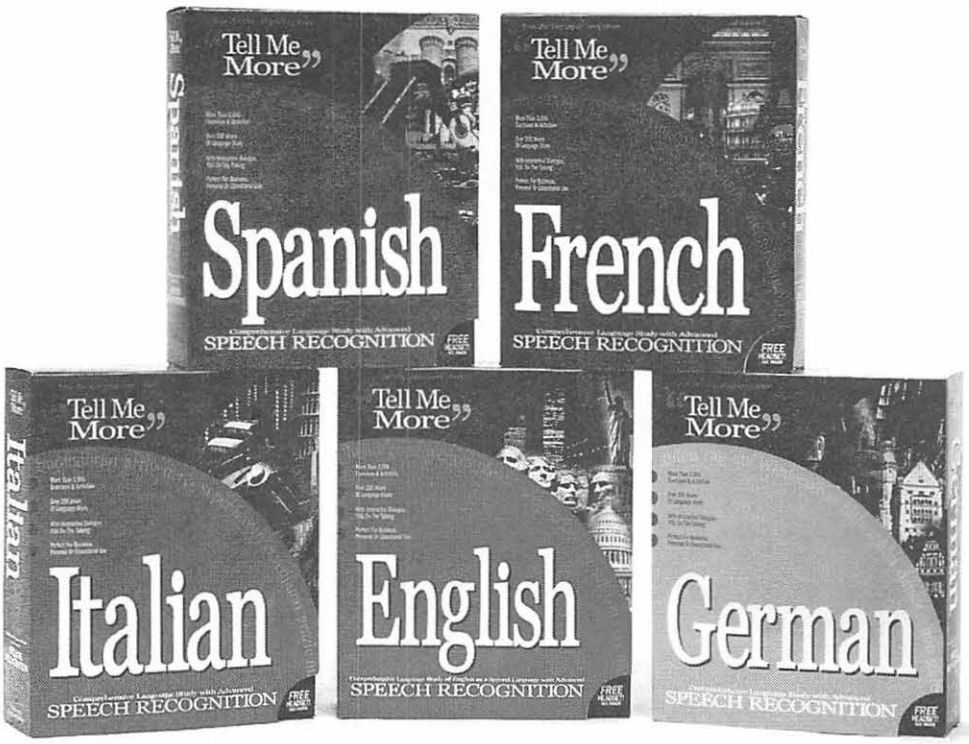

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