Bilingual Dictionaries for Australian Languages: User studies on the place of paper and electronic dictionaries

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Abstract

Dictionaries have long been seen as an essential contribution by linguists to work on endangered languages. We report on preliminary investigations of actual dictionary usage and usability by 76 speakers, semi-speakers and learners of Australian Aboriginal languages. The dictionaries include: electronic and printed bilingual Warlpiri-English dictionaries, a printed trilingual Alawa-Kriol-English dictionary, and a printed bilingual Warumungu-English dictionary. We examine competing demands for completeness of coverage and ease of access, and focus on the prospects of electronic dictionaries for solving many traditional problems, based in particular on observations on the usability of a prototype interface developed in our project. The flexibility of computer interfaces can help accommodate different needs including those of speakers with emerging literacy skills, but they are not useful in communities where computer access is generally unavailable.

1 Introduction

This paper[1] reports our preliminary investigations of dictionary use and usability by speakers, semi-speakers and learners of Australian Aboriginal languages. Dictionaries have long been seen as an essential contribution by linguists to work on endangered languages, something emphasized in recent decades within the Australian context, particularly in survey articles such as [Goddard/Thieberger 1997], but little emphasis has been placed on the actual use and usability of such dictionaries (though see [Lindstrom 1985, Hansford 1991]). Issues explored include ease of access, accommodating low levels of literacy in English and the vernacular, and range of users' knowledge of the vernacular.

In 1998, Manning and Simpson began a project on the possibilities for innovative computer interfaces for dictionaries of indigenous Australian languages, both for creating and browsing dictionaries. A major goal was the development of an innovative interface for browsing the contents of the Warlpiri dictionary [Laughren/Nash 1983, Laughren et al. in prep], the biggest machine-readable dictionary of an Australian language. *Kirrkirr,* the computer interface for Warlpiri [Jansz et al. 1999, Jansz et al. 2000], provides not only conventional lookup of dictionary entries, but coloured network representations of related words, and semantic domain views, pictures and pronunciations, facilities to help users with poor spelling, customisability of the level of detail in the display of dictionary entries, and the ability for the user to annotate the dictionary with notes.

As requirements analysis for that project, in 1999, Corris, Poetsch and Simpson investigated actual and potential uses of paper and electronic dictionaries by various user groups

[Corris et al. in press, Corris et al. in prep.]. In this paper we try to synthesize some of our current results, with a particular eye to drawing lessons on the usefulness and usability of electronic dictionaries from these studies. We wanted to establish: who would use the electronic interface, how they would use it, for what purpose, and indeed whether they would be able to use it. Corris's survey of dictionary usability studies [Corris 1999] found that existing studies e.g. [Béjoint 1981, Atkins/Knowles 1990, Hulstijn 1993, Atkins/Varantola 1997] concentrated almost entirely on the use of paper dictionaries by children and learners of world languages, or on surveys of committed dictionary users, and thus there was little information of the kind we needed. To address this, in our studies in Central Australia in 1999:

(i) Corris took the prototype Warlpiri electronic dictionary and demonstrated it to a range of potential users in Alice Springs, and in two remote Warlpiri-speaking communities, Yuendumu and Willowra. She observed their reactions to it, and also to a partial printout of the Warlpiri dictionary.

(ii) Poetsch accompanied Margaret Sharpe to Minyerri, an outback community in the vicinity of Katherine for a workshop introducing the Alawa community to a new 3-way Alawa-English-Kriol[2] paper dictionary that Sharpe had compiled. Poetsch designed 13 task-based activities to be used in workshops with potential users for seeing how efficiently people could find information in dictionaries.

(iii) Simpson tested use of the electronic dictionary (Warlpiri) and paper dictionaries (Warlpiri and Warumungu) with Warumungu and Wakirti Warlpiri students (both languages from the Tennant Creek region) in 3 adult education courses, and then in another Warlpiri-speaking community, Lajamanu. She used a mixture of observation and task-based activities.

2 Current endangered language dictionary structure

While some compilations of Australian languages contain thesauruses [Heath 1982, Evans 1992], alphabetically ordered dictionaries are by far the most common [Goddard/Thieberger 1997]. So far, all of these are bilingual or trilingual, with English, the language of wider communication (LWC), being one of the languages. Endangered language (EL) dictionaries are almost always bilingual, because the makers are usually not speakers. Most of the dictionaries are arranged as EL-LWC. Sometimes, such dictionaries have LWC-EL finderlists, sometimes separated into semantic domains. A very few dictionaries have definitions in the vernacular as well; these include the Warlpiri dictionary [Laughren et al. in prep] and the Arrernte dictionary [Henderson/Dobson 1994]. The EL-LWC direction is apparently adopted for two reasons:

(i) This arrangement is typically most useful for speakers of the LWC (which includes in almost all cases the lexicographer) who are trying to learn, understand or explicate the EL, in other words for decoding the EL. It also fits with the desire of many lexicographers to produce documentation dictionaries, which record every word they can of endangered languages

(ii) It has a symbolic value: putting the Australian indigenous language first is a claim that it is important. Speakers sometimes feel that EL-LWC is the only direction that could truly be described as a dictionary of the EL [Corris et al. in press].

The microstructures of EL dictionaries differ according to how big the dictionaries are. Most of the bigger ones include vernacular definitions and example sentences for some words; these are useful because they can contain cultural and grammatical information. This information is also useful for further study and documentation as well as for speakers maintaining the language. Actual definitional practice varies from one or two LWC glosses, to structured entries. Part of speech information is usually included.

Many of these properties of the macro- and microstructure have been taken for granted by lexicographers. The emerging literacy among EL speakers means that these properties now have to be reconsidered. Linguists and lexicographers hope that EL dictionaries can free learners (both of language and of literacy) from dependence on teachers, allowing them to learn independently. To some extent this view is shared by literate speakers of indigenous languages. It seems that EL speakers often agree that documentation and maintenance are important functions of a dictionary [Carroll to appear]. There is also anecdotal evidence to suggest that the dictionary is important in the minds of speakers as symbolic of the status of the language. But there is little record of negotiations between speakers of endangered languages and dictionary makers, in particular of speakers' views on dictionary structure – perhaps because in some cases the speakers were not previously aware of dictionaries – but see [Hansford 1991, McConvell et al. 1983, Carroll to appear, Stebbins 1999].

All the dictionaries we tested were primarily alphabetically ordered EL-LWC dictionaries. The Warlpiri dictionary [Laughren et al. in prep] data files comprise about 10,000 headwords, including subentries, organized as Warlpiri-English, with lengthy definitions in English and often in Warlpiri, and extensive exemplification. Printed on A4 pages in a 10pt font, it would comprise over 2,000 pages. A shorter beginner's Warlpiri dictionary is about 100 pages. A short (60 pages) Wakirti Warlpiri dictionary also exists [Nash 1990], although information on this dialect is also incorporated into the big Warlpiri dictionary. The Alawa-Kriol-English dictionary [Sharpe 1999] comprises front matter, including some cultural and grammatical information, and then Alawa-Kriol-English, semantic domains, and shorter Kriol-Alawa-English, and English-Alawa-Kriol finderlists, for a total of about 250 pages of A4 text. Simpson has compiled a draft Warumungu-English dictionary [Simpson in prep], but it currently lacks any English-Warumungu finderlist. A picture of the Kirrkirr interface is shown in Figure 1. Space requirements prevent us from showing samples of all the dictionaries. See [Corris et al. in prep.].

3 Users and uses

Groups of potential users for EL dictionaries include linguists, teachers, and indigenous people. We concentrate on this last category. Indigenous people fall into different categories with different needs, depending on factors including their level of literacy in English and the indigenous language. All in all, we worked with 76 people affiliated with indigenous languages.[3] The most important distinguishing feature is perhaps the level of knowledge of the indigenous language

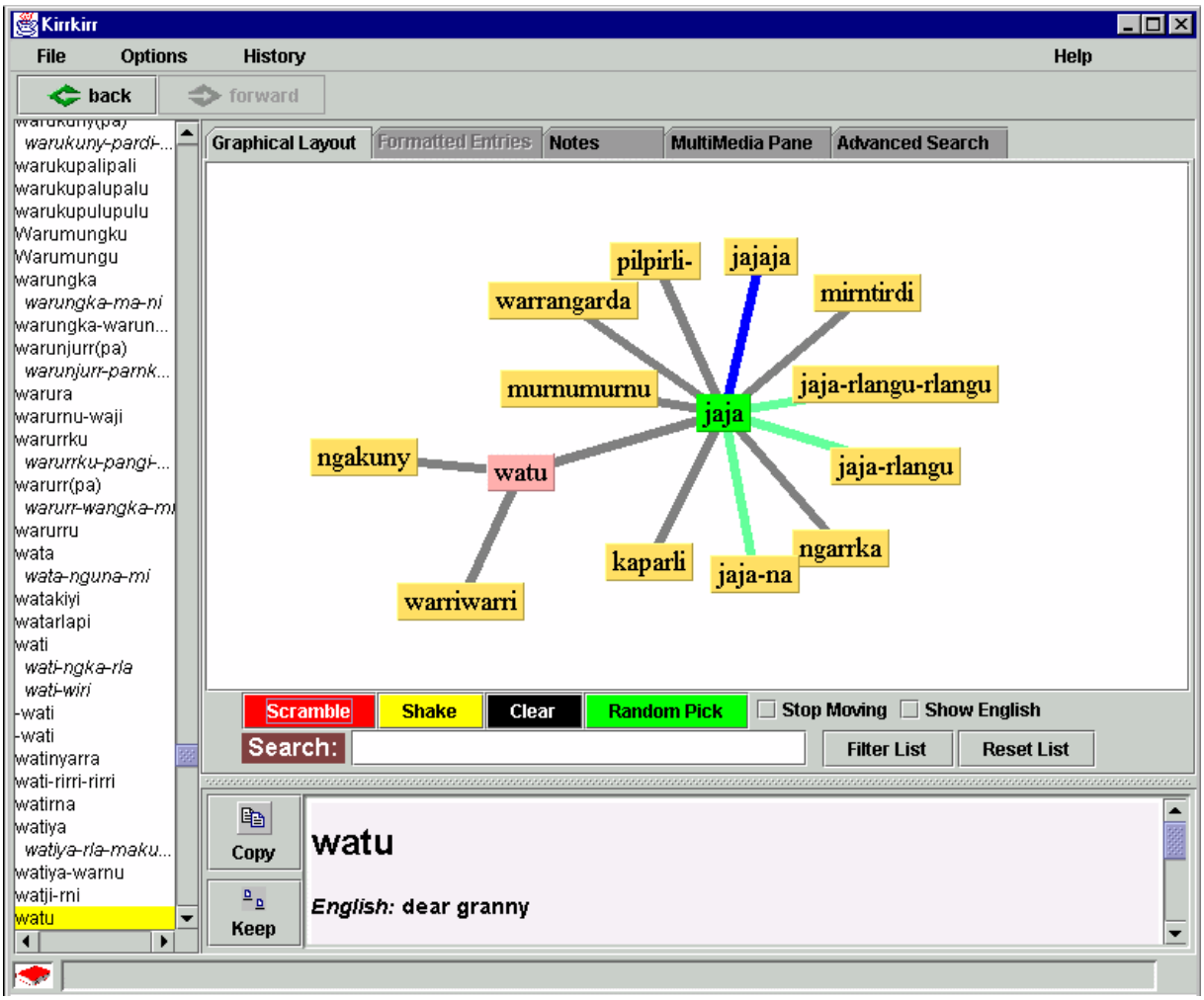

Figure 1: One view of the Kirrkirr user interface.

in the community, both of the spoken language and of the written language. Alawa, Eastern (Wakirti) Warlpiri and Warumungu are all languages in need of revitalization: older people are competent speakers, but in general children no longer learn the language natively. For Alawa, while people under 50 are most likely to be literate in English, with respect to speaking skills, they are likely to be most proficient in Kriol, less proficient in English, and least proficient in Alawa. In contrast, Warlpiri is the first language of all three Warlpiri communities that we investigated, and there are active bilingual programmes. Many people can write Warlpiri as well as English, though most old people are illiterate. These disparities we encountered had repercussions for our methodology and we discuss this in the next section.

At the moment, the lack of availability of dictionaries of indigenous languages and the low levels of vernacular literacy restrict the uses of dictionaries by speakers and their descendants. We saw no use of paper dictionaries in classrooms. The few natural uses we have observed include: (i) finding out meanings for words now used only by older speakers for translation and picture documentation work, (ii) checking spelling, (iii) making materials for school language

programmes, and (iv) browsing to find unfamiliar words or to find how familiar words are represented in the dictionary. In addition to these we might mention the 'symbolic' function of dictionaries in showing the status of the EL as a 'real' language.

Potentially, dictionaries of indigenous languages are a very useful tool to assist in the maintenance and revitalisation of the languages. They could play a role in classroom and non-classroom language acquisition. However, like any approach to language engineering, there are concerns to address. A lot of effort has been put into vernacular literacy, on the assumption that it assists language maintenance, as well as language preservation. In some respects this is a dubious assumption, because writing a language does not necessarily lead to speaking it or maintaining the language. Moreover, in some cases putting effort into writing the language can detract from efforts to encourage learners to speak the language. It is certain that much more effort should be put into oral language development. At any rate, the problem with all potential uses is that, currently, people are typically not aware of their potential and do not necessarily have all of the literacy and reference skills required to use the dictionary. They do not pick up dictionaries and browse through them for interest, except on first being presented with one. For this reason alone having an engaging electronic interface may be a useful tool.

4 Method

The methodological approaches we took were determined by a number of considerations. Firstly, the nature of language use in the communities we worked in: historical forces meant that the experience and competency of each speaker of his/her traditional language, and English, varied greatly. Secondly, the literacy skills and educational experience of each individual and generation (in each language) differed significantly. In general this amounted to very limited successful literacy, education or dictionary skills, particularly for older people. Consequently subjects required a great deal of time to complete reading/writing tasks and needed assistance/guidance to do so. For example, a crossword requiring 12 lookups took many users some 45-60 minutes. One thing that the users we worked with had in common was that they were unlikely to have had the number of years of educational experience necessary to find words in a comprehensive dictionary, read an entry and understand all of the information it contained. Thirdly, there were no established tests of dictionary use for indigenous languages. In fact there is very little previous work in the area of dictionary use by speakers/semi-speakers of indigenous languages, (e.g., work like [Hansford 1991] does not involve concrete tests of dictionary use).

Due to these factors, we used two approaches to investigating dictionary usability: observation and getting people to carry out tasks involving dictionaries. These approaches were ethnographic in nature and produced qualitative and anecdotal, rather than quantitative data. We have used this data to analyse the patterns that emerged in people's use of dictionaries and to make preliminary recommendations for future research in this area. We hope that our investigations may be useful inspiration for lexicographers to develop effective strategies for further testing dictionary use in similarly diverse contexts. We suggest that for many indigenous users of dictionaries of Australian Aboriginal languages, it will not be possible to design standardised tests of dictionary skills.

We observed use of dictionaries, both when they were shown to users for the first time, and in literacy courses, where dictionaries were available for use. Corris demonstrated the electronic dictionary to a range of people at different communities, focusing especially on school children. She observed: how they used the interface, what they looked up, what seemed to interest them, and what difficulties they had in using it.

We also got some participants to carry out tasks using dictionaries. However these tasks were not carried out under strict test conditions. Completion of them also involved a great deal of observation and assistance. More details on the tasks are presented in [Corris et al. in prep]. Poetsch designed 13 task-based activities, ordered in terms of difficulty, to be used in workshops with potential users for seeing how efficiently people could find information in dictionaries. In preparing these tasks, she assumed low levels of spoken and written competency. Most tasks required basic searches for simple word for word translations. Searches to solve tasks were deliberately designed to involve reading the shortest and least dense entries. Task 1 required the participant to order, alphabetically, a set of cards with 10-15 English, Kriol, or Alawa words on them. Tasks 5a - 5g (Alawa crossword puzzles) each contained 12-18 clues of the form: How do you write "accident" in Alawa? How do you write "jamin.jamin" in English? What is a Kriol word for "nyalal"?

Simpson tried to observe dictionary use in action by incorporating dictionary tasks as part of literacy and linguistics training courses that she was running. For example, task 8 involved giving Warumungu students a list of about 10 misspelled Warumungu words to spell correctly. Task 13, designed for an advanced/fluent Warumungu speaker with a medium level of written language required the speaker to look up words in the electronic dictionary from song texts that she was writing to check spelling of words as a way of proof-reading the texts.

5 Results

The results of our observations and tests can be classified in terms of four aspects of dictionaries: (i) attitudes of users and makers to dictionaries, (ii) exhaustiveness, (iii) functionality, and (iv) practical considerations. We have briefly discussed the first point in Section 3. Here we concentrate on the functionality and practical considerations for paper and electronic dictionaries.

Learning to use a dictionary. The first step in any kind of dictionary skills training that needs to happen is to explain that a dictionary is a language learning tool – even though it is not a substitute for talking with older speakers. This is not widely recognised. It needs to be accepted that people will not acquire the necessary literacy and dictionary skills within a timeframe of one or two training workshops. Users require a lot of ongoing opportunities for training or practice. We suggest using people's skills in using English dictionaries as a springboard. That is, serious consideration should be given before creating either a macro-structure or micro-structure which is radically different from what they have learned from English dictionaries. The dictionaries we trialed ranged from having little to adequate front matter, invariably in English. Following the usual truism, we saw no evidence of people using it. Electronic dictionaries can provide learner supports (like Balloon Help) to give training to at least fairly literate users.

Familiarity with alphabetical order. Many users from all languages did not grasp alphabetical order in English, let alone in the indigenous language. It needs to be recognised that alphabetical order is a separate skill from general literacy. For many users, alphabetical order proved an obstacle at all stages of lookup. Users either flicked randomly through until they came across the right letter, or, alternatively, the users systematically began at the beginning of the alphabet for each look up and went through each letter until they reached the one needed. Similar difficulties recurred for alphabetical order within words.

Familiarity with English alphabetical order creates a serious problem when the alphabetical order of the indigenous language is different. A linguist might consider it logical to treat digraphs such as *ng* and *ny* as single letters, and to separate say, words beginning with *na* and *nu* from words beginning with *ng*. However, this retards skills transfer for people who are familiar with alphabetical order in English, but not trained in orthographic conventions of the EL.

While the decision about how to list words is best made by appropriate literate people within the community, such concerns suggest using the same alphabetical order as in the LWC (see also [Goddard/Thieberger 1997]), and that there is unlikely to be value in making multiple alphabetical orderings available in an electronic dictionary (it only increases confusion). Effective typography (outdenting headwords in a large bold font) helped with paper dictionaries. We hypothesize that cutting an index into the sections of the dictionary, and showing alphabetical order at the top of each page as a prompt would be worthwhile. An electronic dictionary can avoid alphabetical lookup problems by allowing users different ways of accessing words, through typing in a word, through fuzzy spelling options, and through links (which allow them to make use of sight-words, words they recognize the shape of). Corris and Simpson found that the ability to type a word in the electronic interface was quickly adopted. Corris also found that for some users the word list down the side was helpful because if they typed in the first three or so letters of a word, the word list automatically scrolled down to that point. This displayed a list of words that start with those three letters and the users could choose from there the sought word.

Learner's vs. Comprehensive Dictionaries. Linguists and lexicographers working on endangered languages tend to want to include as much information as is known, in terms both of numbers of words and of information about words. To some extent this view is also shared by many older illiterate speakers of indigenous languages, who want information "put in the book". But for many users a learner's dictionary with short simple entries and illustrations is essential. For many of them even the shorter version of the dictionary will be a challenge to learn to use. Comprehensive dictionaries are there for the long term record, and for people with very high levels of literacy, most commonly non-Aboriginal teacher-linguists and linguists. However, for economic and personnel reasons, there are rarely multiple versions of dictionaries for small indigenous languages. A paper dictionary cannot provide different interfaces for different users by virtue of its rigid structure. An electronic dictionary allows different levels of interface for different users, and we have experimented with this in Kirrkirr.

Satisfaction with macro-structure. For proficient speakers of Australian indigenous languages

the order EL-LWC is useful for decoding the Australian indigenous language, such as for finding out what hard words used on old tapes are. One Warlpiri speaker whose Warlpiri literacy is much better than her English literacy used the Warlpiri vernacular definition, or the Warlpiri example sentence in the electronic interface, to check whether the word was right. She seemed to use the Warlpiri in preference to the English. But she was exceptional in having stronger Warlpiri literacy than English literacy.

For people who don't know the language well or who don't have high levels of vernacular literacy, but do have reasonable English literacy, LWC-EL order is more useful, and furthermore helps those who want to improve their English literacy (see also [Zorc 1983]). Alawa and Warlpiri people without much proficiency in speaking or writing the indigenous language but with better English literacy skills were observed using the English finder-list section of the dictionary in preference to the indigenous language section when they wanted to look up a specific word (for spelling, composition of sentences or translation, as opposed to browsing). Simpson's impression of Warumungu and Warlpiri students in the same class was that the Warumungu students used the Warumungu dictionary (with no finderlist) less often than the introductory Warlpiri students who were tossing the Warlpiri dictionary (with finderlist) across the table to each other,[4] and using the finderlist. The electronic finderlist had some similar results. Corris noted a Warlpiri boy at Willowra, who had problems spelling Warlpiri, using searching on the English 'dingo' to find the Warlpiri *warnapari*. This usage pattern did not match the design of any of the paper dictionaries: for such a usage pattern, a true LWC-EL dictionary would have been superior. An electronic dictionary is a partial solution to this problem in that it immediately keys people into full dictionary entries, rather than letting them use the finder list as if it were a dictionary, or forcing two or more dictionary lookups for those who want more information, but a usage pattern involving widespread use of the English finderlist suggests some extensions to the design of Kirrkirr, in particular allowing display of a scrolling English wordlist.

Citation forms. Some participants found the idea of a citation form for verbs hard to grasp. They were disappointed when they couldn't find inflected forms of verbs in the dictionary. Here, again, electronic dictionaries offer a possible solution, as there is no problem with including all inflected forms as headwords in the dictionary. Space isn't an issue.

Pronouncing the vernacular. Alawa participants were not confident when it came to reading or pronouncing words. They would go through the long process of finally locating the sought Alawa word only to not be able to read it, not know what it sounds like, nor where the stress falls. Electronic dictionaries offer the extremely useful ability of allowing sound recordings to be accessed through the dictionary entry.

Extracting relevant information. Lengthy, detailed entries were very hard for users not familiar with dictionaries. Margaret Carew reports (p.c. to Jane Simpson, 1999) on a dictionary workshop with Warumungu adult education students, who came up with the following minimal wishlist for the contents of a dictionary entry: word, part of speech, meaning, one example sentence, who said it and when so you can check it. While this wishlist is lexicographically rather naive, it reflects the problems with long entries for low-literacy learners.

The point is that either several versions of a dictionary need to be *designed* to cater for different levels of learners, or there needs to be sufficient *training* that different groups can find the information that they need in one larger dictionary. Paper dictionary suggestions included leaving a space between each entry. When shown a modified (reduced) version of a few pages of the dictionary, which included entries with larger, clearer font, less information and more spaces between each entry, three Alawa participants reported that this would be a more suitable version for their needs. Ideas like this (or simply the display of a single entry in a window) are again more practical for electronic dictionaries.

Distinguishing headwords and subentries. Alawa users became distracted where there were a lot of sub-entries. In contrast, we designed Kirrkirr so as to eliminate the headword/subentry structure in the formatting of entries, while preserving it by treating headword/subentry relationships as akin to other links like synonym, antonym, or possible preverb. This seemed to be highly successful, as users enjoyed observing and explaining these relationships without there being sources of confusion.

Reading definitions/wordlists. Participants also had various problems with reading definitions. These resulted from the use of obscure and overly technical words in definitions, the use of reversed forms in finderlists (*kangaroo, stone* for *stone kangaroo*) and not understanding that a *to* before a word was indicating that it was a verb. All these items point to more care in realizing a user-centred dictionary design, for both printed and electronic dictionaries. E-dictionary search methods typically lessen the need for some of these conventions, such as using reversed forms in finderlists.

Grammatical information in entries. Part of speech abbreviations were puzzling to users, most of whom had very limited familiarity with such grammatical terms. These abbreviations were read as being part of the definition. There is no general awareness of grammatical terminology in the communities. It again emphasized that users needed training in appropriate grammatical terminology, and in ignoring information that was unimportant to their needs. Electronic dictionaries again allow several different levels of interface, some with grammatical information, some without it, and facilities like balloon help for describing what abbreviations mean

Semantic links. Users had difficulty following links at the end of entries with cryptic abbreviations or symbols, SYN, ANT, etc. Users have been much more interested in and successful with the network displays of links with clear colour coding that we have provided in our electronic dictionary interface – although this works best for people with a reasonable knowledge of the language. Probably the colour coding is much more easily grasped and remembered than abbreviations for obscure words

Font size. Small font size was a difficulty for users with low levels of literacy, as well as for those users with eye-sight problems. Practical considerations prevent using large fonts in paper dictionaries with large numbers of entries. Large print is not a problem for electronic dictionaries, though care must be taken in design to allow for variable font sizes, and computer displays are in general less readable than printed text.

Observations on electronic dictionary use. Electronic interfaces still possess the charm of novelty. For the most part the children Corris showed the Warlpiri e-dictionary to were very computer literate and willing to spend time looking at it even if they didn't understand all its features.

The version of the Warlpiri e-dictionary demonstrated to the children plunges them straight into the dictionary, with three kinds of information (apart from the labels linking other information) on the screen at once: an alphabetically ordered word-list, a semantic network, and the definition of one headword from the semantic network. This did not cause great difficulties for the children Corris observed. However, in discussion with potential users, Corris found that some wanted more control over what information is immediately on display, to avoid confusion for inexperienced dictionary users. It may be that a simple front page is needed, allowing the user to choose different levels of interface.

Corris found that at Yuendumu young children (years 1-6) were quite computer literate and were enthusiastic about clicking and seeing different things happen, and general negotiated the various windows and options easily. However, the actual content was sometimes of less interest than the moving things, different colours, and sounds. Nevertheless, the facilities that Kirrkirr provides for dealing with poor spelling (word lists, spelling correction, browsing links) were found to be helpful. Post-primary girls were quite thoughtful in browsing it, and discussing the purposes of the links in the semantic network – a number of the (female) students found the interface sufficiently interesting that they turned up to play with it during lunchtime of their own accord.

Teachers were quite enthusiastic, and saw a role for it in encouraging kids to learn Warlpiri, and in teaching dictionary skills and concepts. They liked the spatial layout, and said they would browse in it and learn things. They suggested further development to make it a basis for classroom activities (such as adding in games and puzzles). Adult literacy workers were less interested in the graphical interface, and mainly interested in looking at definitions. Even for them, the improved access to the dictionary that the electronic version provided seemed to stimulate discussions of word meaning, and they were eager to make use of the notes feature for annotations. We conclude this section with a positive anecdote (and we've since fixed the mentioned bug!):

"One of the introductory Warlpiri literacy students, who had not been very interested in the literacy class, spent nearly 3/4 hour looking at Kirrkirr apparently in absorbed concentration. She wasn't especially interested in the sound and picture possibilities. She moved between words, scrolling along the list, typing in the search, clicking on the words in the network pane. She wasn't even put off when the dictionary definitions stopped appearing – looking at the networks of words instead. ... After the Kirrkirr demo she asked if she could have a printed dictionary to take away with her to use in camp to learn the words. I interpret this as a desire to learn words in her own time and place."

6 Conclusions

Solutions to the problems experienced by users trying to access information in a dictionary are in two categories: redesigning the dictionary and redesigning the user. On the first point,

electronic dictionaries potentially solve a number of the problems of paper dictionaries. Paper dictionaries can be used anywhere, and are easy to annotate, but suffer from space restrictions, and the need for everything to be written/visual and constant. Strengths of electronic dictionaries are complementary: there are no space restrictions, and the presented information can be customized to the user, but at the moment they suffer from inaccessibility: they are expensive and can only be used in certain places and are not easily transportable. Practical restrictions on what can be done include a lack of skilled lexicographers, especially native speaker lexicographers, a lack of knowledge of computers among dictionary makers, and a lack of time and money to produce multiple dictionary versions. On the second point, the user should be trained to use the dictionary. As we have discussed, the short-term prospects for this are not good, because of the lack of resources and the general low level of literacy of any kind in the communities we visited. While a combination of these two approaches is ideal, we see reasonable prospects for addressing the latter through providing such features as learner supports, adaptable interfaces, and opportunities for active reading and chance learning within a captivating electronic dictionary environment, and we are keen to pursue the development of this system in future work. Nevertheless, in many contexts, the development of better paper dictionaries still remains the most viable option for widespread use.

Notes

[1] We thank many people for their help: Mary Laughren for access to the Warlpiri Dictionary, Robert Hoogenraad and Jenny Green for arranging Miriam Corris's work; Denise Angelo and Margaret Sharpe for arranging Susan Poetsch's work; Carmel O'Shannessy and Margaret Carew for help with Simpson's work, Kevin Jansz and Nitin Indurkhya for work on the electronic version of the Warlpiri dictionary, David Nash, and audiences at a Central Australian Linguistics Circle, the Applied Linguistics Association of Australia's 1999 Annual Congress, and a University of Sydney Linguistics Postgraduate Seminar.

[2] The creole of the Katherine area is known as 'Kriol'.

[3] For more information on the participants, see [Corris et al. in prep.].

[4] An alternative explanation is that the main use for dictionaries in that class was for checking spelling. Some of the Warumungu students are fairly confident writers, and it is easier to ask someone how to spell a word than to look it up.

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