Indigenous Knowledge and Resource Management in Northern Australia
making collective memory with computers

Boundaries and accountabilities in computer-assisted ethnobotany

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Abstract:
Designing software alongside ethnobotanists, and Indigenous owners and
practitioners of traditional knowledge brings to light a range of issues which expose
some of the assumptions underlying both western ethnobotany, and software design.
Collaborating over the development of software to facilitate the use of digital objects
in knowledge work, issues of knowledge politics, accountability, ontologies and
epistemologies arise. This paper discusses the ways these issues, in a particular
context, led to the development of a flexible, ontologically flat, epistemologically
open ethnobotanical software design.

Introduction: Aboriginal plant knowledge in contemporary Australia

Developing a database of ethnobotanical knowledge is not difficult. There are many
hundreds of examples. However designing software to support the traditional 'on-the-
ground' knowledge practices of Aboriginal people working to ensure the
intergenerational transmission of knowledge traditions, is much more difficult. For
many thousands of years, Australian Aborigines have observed, used, identified with,
and told stories about the plants they encounter in their environment. Their knowledge
has been passed down and renewed, from generation to generation. As traditional
Aboriginal culture faces increasing pressure from the colonising influences of western
education, governance, medicine, technology, religion and popular culture, many old
people are passing away, and taking with them their knowledge of the plant world in
the many different habitats which they and their ancestors have owned and cared for
over the millennia. Meanwhile, white Australian ethnobotanists, ethnographers,
anthropologists and linguists have been making notes, books and databases of
Aboriginal knowledge about plants, their names, their place in the world, and their
uses as medicines, food, and in the production of technologies.

There are two completely divergent knowledge traditions here interacting with the
same subject matter. The knowledge traditions are at work in two worlds, the world of
ethnobotanists who work to enlist traditional knowledge in conservation or
development projects, and the world of Indigenous people carrying on the ancestral
task of making knowledge alive in the new generation, within the ancestral contexts
of identity, ownership, custodianship, and accountability. Each has its own rules,
structures and boundaries.

Boundaries and accountabilities in software design and use.

This paper details aspects of the development and use of software for Indigenous ecological knowledge work with Yolngu Aboriginal people in northeast Arnhemland, on the north coast of Australia. This involves some working with boundaries and accountabilities. I am using the notion of boundaries and boundary crossing following Suchman (2002) in her paper on located accountabilities in technology production. She speaks of the boundaries between the software designers and software users, and makes a comparison with the work of Verran (1998) working at the boundary between Western academy-based sciences and Yolngu (Aboriginal) knowledges. 'Emerging technologies might be relevant but only if what (people) know assumes a central legitimated place' (Suchman 2002, p 93). Here we are dealing with both the boundaries between Yolngu and western knowledge traditions, and between the designers of information technologies and their users.

The story emerges from a variety of contexts in the Northern Territory of Australia, where Yolngu people are beginning to explore the use of digital technologies for their own knowledge purposes. The full story of the research project, called Indigenous Knowledge and Resource Management can be found on the website www.cdu.edu.au/ik. The project was set up to assist collaborations between the Charles Darwin University, and industry bodies who work in Aboriginal knowledge contexts, including the Northern Territory Department of Infrastructure, Planning and the Environment, and the Northern (Aboriginal) Land Council.

There was an accountability problem from the start. The three partner organisations were interested in research which would help them in their role of fostering the use of Indigenous knowledge in the work of natural and cultural resource management in the Top End of Australia. But the Aboriginal knowledge owners whom we worked with on the ground, were naturally interested in their own knowledge resources, and the ways in which ongoing traditional religious and political work could be supported by the digital technologies which they were beginning to meet. We soon found that processes of exclusion are as important as those of sharing in the work of keep land and culture strong, so we determined in the first instance to identify and support emerging solutions, regardless of how diverse and inaccessible they may be. We had been working since the days of cassette tapes, with people making, sharing and concealing audio recordings of ancestral songs and stories. We worked with people on repatriating audio-recordings from archives in Canberra and all the complex access protocols these repatriations involved. We helped people make digital collections of their family photos, which they want to keep safe and in some cases show only to their immediately family to strengthen family identity, and sometimes to present as evidence in highly contested Australian Native Title land claim cases. We worked with people videoing ceremonials and senior custodians telling creation and kinship stories on contested areas of land, to take home to show those who couldn't attend, and to allow very old people to comment upon further. One man organised to make a video of himself standing in various very remote places, telling the story of that land for other people (Yolngu and others) who haven't been there and may not know the full story of its history, its ownership and who is taking care of it. Another woman, the teacher in a tiny school in a homeland centre on her ancestral land was keen to find ways of using digital technology to link environment knowledge with ancestral connections 'for the children' (see http://www.cdu.edu.au/centres/ik/db_ftc.html). Plants were quite central to much of this work, but only insofar as they contributed to the ongoing social, political, and religious life of the people who used, sung, danced

and painted them. This proved to be a frustratingly complex state of affairs for our partners in the Darwin herbarium, who were primarily focussed upon plant knowledge.

In our search for a software design which enabled the ongoing accountabilities in Yolngu knowledge production to engage in digital knowledge work, and to cross boundaries between Yolngu knowledge work and the learning and negotiating agendas of outside bodies (researchers, resource managers, mining and government policy makers, lawyers etc) we collaboratively explored and critiqued a good range of existing software, and where possible preserved the accepted software conventions in our new designs.

The divergent practices of knowledge at work in the two worlds present a fundamental problem to our research. The ways in which Aboriginal people do their knowledge work 'out on country' with or without digital technologies, turns out to be quite different from the ways in which western scientists and bureaucrats do theirs. The prefix ethno- has long served to relativise local communities of practice as limited by the everyday life of ongoing ancient Indigenous worlds. The notion of ethnobotany seems to imply a superior western scientific knowledge regime which naturally supplies the standard against which all other plant knowledge and use systems can be, or should be measured. Western botany is assumed to bear within it a privileged relation to truth. It is pure, somehow, while local, traditional, indigenous practices are somehow compromised by the exigencies of everyday life, by the need, now, to do this or that, and by old and young having to collaborate to pull together the necessities of life today, and keep alive the possibilities of life tomorrow. They refuse a doctrine of objectivity that promises transcendence (Haraway, 1991) in favour of a knowledge system where ancestry kinship, language, land and identity are thoroughly integrated (Christie 2005b).

As we worked with databases and related software with Aboriginal knowledge owners and practitioners, we encountered resistance to the promise of a transcendent knowledge, and the embrace of digital technologies to support the ongoing embedded, accountable, negotiated knowledge work put in place by the ancestors.

Political boundaries

In his work on Indigenous knowledge and the politics of classification, Agrawal (2002) argues that official databases of Indigenous knowledge are emerging through a particular internationalist instrumental logic that begins with the assertion that Indigenous knowledge is a highly significant and under-utilised resource in the development process. He notes the irony that the databasing case studies he comes across are in fact 'all examples of collaboration between some international development agency and a local group to initiate a development programme' rather than simply to keep knowledge traditions alive within their communities. In her quite different work comparing the history of the imperial archive with contemporary databasing projects, Helen Verran (2005) makes a similar claim, identifying in both, a drive to somehow capture knowledge for colonial purposes. According to Agrawal, this instrumental drive leads to a complete transformation of what Indigenous knowledge is seen to signify. 'Ultimately, the description (of the plant and its uses) is aimed to give the reader a sense of the potential for generalisation' (2002, p290).

He goes on to identify some of the dangers which accompany the foregrounding of the knowledge itself, rather than its owners, the people in their social, political and ecological context. Only the bits of Indigenous knowledge which are potentially relevant to development are seen to need attention and protection. This particularisation is the first necessary step in the creation of a well-funded ethnobotany database. If the knowledge isn't useful, the databases won't be funded. There follows a process of validation, where the particularised claims (of the usefulness of this or that plant as a food or medicine for example) are tested and validated using criteria deemed appropriate by western science. 'Independently, such knowledge has no existence, only possibilities' (ibid. p290). The processes of validation are necessarily processes of abstraction. What is true here must be true everywhere. Once the knowledge is abstracted, it can be generalized, that is, taken up by others in other places. Abstraction does not guarantee generalization, it just makes it possible. There are many factors which contribute to the taking up, extension or abandonment of scientific and technological artefacts (Latour 1987), including pieces of Indigenous knowledge. Argawal's point is that the instrumentality demanded of development or conservation imperatives (which underpin the databasing he observes) means that, whatever its truth value, some knowledge no longer counts, because of its lack of utility.

In their work on classification and its consequences, Bowker and Star (1999) examine other processes through which, by virtue of embedded information architecture, some knowledge no longer counts, not this time because of its lack of utility, but because some things are harder to characterise than others, they don't easily fit into the structure, and they fall through the cracks. Some phenomena are hard to name or have fuzzy boundaries and are hard to classify. Some are contested, some radically singular. They may get left out, or lost inside the database. Other things are more 'charismatic' than others – in our case, crocodiles and kangaroos, for example as compared with maggots, or dead logs, both of which are highly significant totemically in the Yolngu world. What gets left out then, is as much a political issues as an ontological one, but it is both. And there will of course always be things missing. Odours (algal blooms, paperbark flowerings), and sensations (breezes from particular directions at particular times) for example are not included, even though they are highly significant totemically. This silent selectivity has the effect of 'grooving' where we produce from the digital data a particular view of the world which has its shape, not because the world is so, but because this is the nature of our data structures (Bowker, G. & Star 1999; Christie 2004).

The intractable problems of funding and architecture will never be completely resolved. However the question of how (or whether) software will be useful to Yolngu knowledge work around plants, will only be adequately addressed as Yolngu take up the technologies and configure and deploy them in their everyday lives.

Herein lies the first boundary to be crossed. Insofar as the imperative for databasing arises from outside of the community of knowledge holders, the accountability of the knowers to their own community may sometimes be compromised through the privileging of particular logics of conservation or development. Software development will become truly accountable to the knowledge owners only if it takes

place as a part of the ongoing traditional work of passing on knowledge practices to the new generation.

Ontological boundary work

In the western world, botany is understood to be an objective science and a profession, on the basis that plants themselves constitute a particular sort of observable objective set of entities. There is first of all, assumed to be *such a thing* as a plant. The ontological status of plants as a category is never doubted. But Australian Aboriginal languages tend not to have a word or concept which identifies *plants* as being a separate sort of thing from, say *animals* or *rocks* (Yolngu languages have no word for *animal*, either). In the many hundreds of Australian Aboriginal languages, we do not find a word for *plant* per se, but of course there are thousands of species names for different things we English speakers call plants, and detailed knowledge of where they can be found, how their life cycles tell us about the world, and how they can be used for food, medicine, and making things. Yet we cannot say, of course, that *plants* as a *category*, or as a *sort of thing*, actually exist for Aborigines as they do for example, for Europeans. This fundamentally taxonomic question turns out to be a significant issue in the work of designing technologies for environmental knowledge work in non-Western cultures. A taxonomy, according to a dictionary definition, is 'an orderly classification of plants and animals according to their presumed natural relationships', and computers are programmed to replicate this structure by (re)producing natural relationships among digital objects.

The western science of botany is ultimately framed by a Linnaean, taxonomic understanding of the plant world. An evolutionary perspective sees all plants, in fact all living things, as being related to each other in a complex kinship system determined by evolutionary history. Species within a single genus are considered to be closely related because they share a more recent common ancestor. Using the evolutionary paradigm, we find some surprises, the whale as a mammal rather than a fish, for example, but we can still lay everything out on an evolutionary tree, a taxonomic system of organisation towards which computer technology itself has naturally evolved. The Linnaean hierarchy inscribed in plant database metadata structures involves a constant act of forgetting the very real but private ongoing arguments among taxonomists which reveal the 'discovery' of relatedness as a thoroughly culturally and politically invested process.

But plants, in Australian Aboriginal cultures, are not so much related to each other as species, but to particular animals, or particular ancestors or clan groups or songs, or ceremonial designs. How particular species of plant are related to *each other* is much less relevant in Aboriginal knowledge work, than how they are related to the rest of the sociomaterial world. Sometimes different stages in the lifecycle of a plant or animal, or different genders, have their own names and complex networks of relatedness. The flowers of a particular plant for example, may be related (as a 'calendar') to the abundance of a particular food source (fish species, wild honey, or flying foxes) or ceremonial time. It may also be related to a particular ancestral journey bestowing particular rights over particular practices and resources to certain people. It has its value through its extensive connections to people, places, events and entities *outside of* what we know as the plant world.

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An ethnobotanical database then, which organises its contents according to a western taxonomy and limits itself to the phenomena English speakers call 'plants', radically limits its usefulness in the local everyday work of Indigenous knowledge-production. Software designers developing systems which are truly accountable to an Australian Indigenous knowledge practice can not assume the objective world of plants, can not assume the ontological status of the species, can not limit itself to the plant world, and can not assume a Linnaean taxonomy.

Nor is it a wise move conversely to inscribe Aboriginal taxonomies or patterns of relatedness (person - clan – language - place – totem for example) into information architecture. Designers, in Australia have enjoyed very little success in their attempts to replace an embedded western classificatory system, with an imagined Indigenous alternative. One of many examples is the database developed for the Galiwin'ku Indigenous Knowledge Centre, in the Yolngu community of Galiwin'ku on Elcho Island, which claims to be a '42 level relational database to catch the way Yolngu people think about the natural world'. (*The Australian*, June 10, 2003, p29)

What in fact are called for, are fluid ontologies (Srinivasan & Huang 2004) which allow the emerging epistemologies of everyday knowledge work (Verran et al., 2006) to remain unfrustrated by any *a priori* assumptions of the nonIndigenous agendas. Verran's 'ontics' work with Yolngu, positions ontology as always 'emergent, partial and performative', and this important difficult everyday ontological work can not be pre-empted or prevented by hidden assumptions embedded in software. The software is not ontologically neutral, it is invested by the expectations of the programmers about both the nature of the world and the nature of work to be done upon it.

Epistemological boundaries

Lucy Suchman (2002, p92) makes clear in her paper on accountabilities in technology production, a tension between 'a view of objective knowledge as a single, asituated master perspective that bases its claims to objectivity in the closure of controversy, (and) multiple, located, partial perspectives that find their objective character through ongoing processes of debate'.

The real test of a software solution for Indigenous peoples is its usefulness in the context of intergenerational knowledge making. The software and its digital resources are put to use in particular knowledge practices. The database, in western science is understood to *contain* knowledge, structured according to the master perspective, 'a way of being nowhere while being able to claim to see comprehensively' (Haraway 1991, p193). It has its uses as a reference in a library and possibly even a 'Knowledge Centre', but in the everyday contexts of Indigenous knowledge reproduction, there is no master perspective. (Knowledge Centres in some remote Aboriginal communities in the Northern Territory of Australia are sponsored by the NT Library and Information Services, see
http://www.dcdsca.nt.gov.au/dcdsca/intranet.nsf/Pages/ntl_lkc)

Knowledge in the Yolngu world is constantly (re)negotiated in the ordinary intergenerational contexts of living out a life on the land, using all the resources at hand – old people, the land, particular ways of talking, of doing, protocols for agreement making etc for finding a way forward (Christie 1994).

An alternative Australian Indigenous epistemology may emphasise the performative nature of knowledge, its negotiation from multiple perspectives and multiple modes of presentation and prosecution, and its fundamentally narrative base.

 The role of a digital artefact (a picture of a plant, or a story about it from within a file management system) needs to be determined in a complex, ongoing, dynamic interaction between resources (digital and 'real', human and nonhuman), and knowledge makers who are configuring resources and (re)presenting them, and other people who are listening, agreeing, disagreeing, arguing, elaborating, engaging and disengaging. Narratives and databases, according to (Manovich 2001) are 'natural enemies'. Databases 'represent the world as a list of items and… refuse to order this list. In contrast a narrative creates a cause and effect trajectory of seemingly unordered items (events). Therefore… competing for the same territory of human culture, each claims an exclusive right to make meaning out of the world (p225)'. (See also Christie 2005b)

 Software in Indigenous 'ethobotanical' knowledge contexts, needs primarily to be accountable to the practices through which knowledge owners can rehearse and share their knowledge of plants in their world. A database with formal metadata fields will be fine for some knowledge work which reflects and reproduces a western knowledge tradition. But for ongoing work, the software needs to support the dynamic contested, complex configurations of objects, ideas, images, arguments, stories and claims which keep traditional knowledge communities alive, and prevent ossification.

Three accountabilities in plant knowledge software design

Working in everyday contexts with Indigenous knowledge makers, exploring software solutions and tinkering on the edges of software design, we have available two possible strategies.

The first is to stay on the user side of the designer/user boundary, and on the Yolngu side of the divergent knowledge traditions. This becomes the work of supporting the appropriation of computers, cameras, recorders etc by Aboriginal people interested in making knowledge together in intergenerational contexts. People everywhere pick up new technologies and play with them, trying to find out how they might be put to use. We work with Aboriginal knowledge owners, teachers and brokers, who are already exploring the uses of technology, ignoring or subverting the built-in assumptions about knowledge and doing their own things. They eschew databases, and focus upon objects as tools in the everyday work of politics, economics, sociality and religion. Collaborative research around these practices is ongoing (see www.cdu.edu.au/ik for details). This work is not without its dangers. Bowker (2000), in his work on biodiversity and datadiversity, has already demonstrated how embedded data structures unconsciously change the way in which we see the world (or to use Verran's expression, how we *do* the world).

The second more difficult but more justifiable solution is to design software solutions which dissolve the boundaries between programmer and user, and facilitates the practices of divergent knowledge traditions equally. Our research has gone some distance along this road, and come up with a proof of concept which we call TAMI.

(For an electronic proof of concept and description, see www.cdu.edu.au/ik and find TAMI in the 'emerging solutions' section).

TAMI stands for Texts, Audio, Movies and Images. The only ontological pre-suppositions we hope to admit are the inherent digital differences between texts, soundfiles, videos and images (ie the necessary technical differences between, say, .doc, .aif, .mov, and .jpg files). We support no other presumptions - taxonomies, hierarchies, fields, categories - and aim to be ontologically flat: as far as possible encoding no assumptions about the nature of the world and of knowledge. We leave open and enable the contestations and negotiations over what counts as knowledge, and what is knowable.

TAMI must afford some particular accountabilities for Yolngu digital knowledge work. The Yolngu digital knowledge resources we come across or which we helped develop, belong principally to one person and their immediate family, rather than to a wider group or community organisation. Other people are given access to the resources under particular conditions in particular contexts, and negotiations over access and withholding are crucial to traditional ownership and accountability practices. There are strong traditional principles of rights and responsibilities which govern their management. Individuals develop their own file management systems with their small collections at their personal or family level. Most are uncomfortable about the idea of having all the knowledge of a community put into the one database (access passwords notwithstanding), not so much because they don't want people to have access to their own resources, but rather because they feel responsible and accountable to undertake to manage their own resources properly. They are equally keen to avoid being held responsible in any way for the management of, and access to the resources of others. TAMIs are to be small, personal and privately owned and managed.

TAMI, secondly, is designed to be responsive to everyday work of Yolngu knowledge making. People already use their digital resources as props or artefacts, in a social context of knowledge-agreement production, in the same way that they have always used nondigital resources like paintings, photos, diagrams, ceremonial objects, and of course the land itself, in talking about and representing themselves and their histories, and making agreements.

In some contexts, this work is just people chatting together, reminiscing, enjoying being able to look at, represent and listen to traces of history and build the collective memory of the group. In other contexts it is serious business, making claims about ownership, about rights and responsibilities, about appropriate ways to go on together, and representations to, and agreements with, mining companies and government officials. In these cases the ways that the resources are identified, validated, accessed and displayed bear critical accountabilities.

Ease of access to resources and ease of configuration and display are therefore crucial aspects of a design which may allow negotiations to work across the boundaries of Yolngu and nonYolngu knowledge practices. The users must take an active role in information design as they bring together resources, group them and order them, and create products (like DVDs and printouts). The ways in which truth claims are

assembled and validated collectively can be supervised in context by authorities who may know nothing about digital technology.

One single screen enables search, upload and view. A workspace enables different objects to be viewed simultaneously, and arranged into folders. Users can upload resources into the database by a simple drag-and-drop, and metadata for objects and collections of objects constantly displayed in the workspace, can be altered at any time.

Dependence upon metadata brings another problem apart from the 'grooving' described above. It may bias the knowledge work in favour of those with better levels of text literacy. This is a problem when many Indigenous people have not had the chance to develop literacy skills in their own languages, and many young people are developing computer literacy having largely bypassed text literacy.

In TAMI, objects can be uploaded and searched without metadata. Metadata can be added at any time to help text-based search. A glossariser produces a list of all the words which are already in the metadata (including file names) and continues to update the list of words. The list contains English and vernacular words and is always visible on screen. A lemmatiser works to enable fuzzy search mechanisms and key-in and drop down menus work to reduce the glossary list to help search (key in b and only b- words remain, key in a and only ba- words remain etc). For a full description of the lemma work in terms of the complexities of phonology, see Christie (2005a).

But aside from these text helpers, the natural way to find objects in the database is always without a text-string search, that is, without a text driven FIND function. Texts, audio files, movies, and images can be searched by flicking through the full set of thumbnail resources (as images can be searched in iPhoto for example).

Bringing accountability and design back down to the user implies small manageable data sets. The system will not work for large repatriated data warehouses. We assume that each database will be small, and users will generally be looking for something which they know is inside there. A small number of one's own resources seems to be the most useful way of organising and utilising a toolbox of artefacts for ongoing conversation and agreement making. TAMI's focus is to make smaller amounts of valued resources easily enrichable for the purposes of collective memory making. This means that botanical images need to be available alongside maps, ceremonial photos, audio recordings etc.

In the TAMI design all resources enjoy free and equal status in the architectures. There is no necessary distinction between a plant and a part of a plant or an animal, person or a name, or an activity inscribed in its metadata structures. Resources can be related to a map interface (if their significance is a link to place) or to any other digital objects. Configurations can be saved and labelled without compromising the radical independence of any resource. TAMI is at this stage only a concept, with a simple logic, simple design and a single interface.

Using an 'innocent' system like TAMI, those who own the knowledge and the knowledge resources could retain three accountabilities:

- political accountability for what goes in to the digital system, what is retained, and what is removed and who has access to it. It does not 'lose track of its mediations just where someone may be held responsible for something' (Haraway 1991, p187),
- ontological accountability for how its contents can be produced, organised, retrieved, configured, and (re)presented,
- epistemological accountability for the way it takes its place in the ongoing work of knowledge production, and the ways in which truth claims can be prosecuted, assessed, vindicated or dismissed.

As a solution to an ethnobotanical problem, it has left the objectivist and utilitarian assumptions of ethnobotany behind, and by paying attention to cultural boundaries and accountability has proposed a software system which can keep complex local knowledge of plants alive in the world, while retaining the possibilities of equitable benefit-sharing.

Conclusion

The journey in search of a software solution to enable Australian Aboriginal people to continue their traditional knowledge work in a digital environment, ended in the exposure of some hidden assumptions, hidden boundaries and evaded accountabilities embedded within the design of conventional database software. We failed to find a suitable software solution, one which kept the ontological and epistemological options open, and retained the highly social and often contested practices of knowledge. It is, however possible to imagine suitable solutions, if we start with a closer look at traditional knowledge practices, particularly those at the work which is done intergenerationally in an Aboriginal social context. It is in this direction that our work proceeds.

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