CHAPTER 33

INTERDISCIPLINARY LANGUAGE DOCUMENTATION

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1. Introduction

Language documentation is in some ways an inherently interdisciplinary enterprise. In seeking a "comprehensive record of the linguistic practices of a given speech community" (Himmelmann 1998, 166), language documentation necessarily crosses the boundaries of fields other than linguistics. Linguistic practices may be underpinned by phonological and syntactic structures, but they are also inextricably embedded in cultural realities, expressing knowledge of the physical, social, and spiritual worlds in which they are spoken. In pursuing a language documentation project one quickly encounters questions of kinship, plant usage, biological taxonomy, place names—questions which are sometimes argued to lie outside the narrow domain of linguistics.

The paradox of language documentation is that it is too narrow (Burenhult 2013). While the comprehensive record created through language documentation may cover a wide range of topics, this record is often inaccessible and unusable to non-linguists. A biologist may be very interested to know that a particular language has fifteen different names for snakes, but without knowing to which species these names refer that information will be only marginally useful to the biologist. A physician may be interested to know that a certain language has several terms for malaria, each with differing symptoms, but without knowing which strains of malaria are denoted by each term, this information will do little to help the physician to understand the disease situation. Standard language documentation may even be too narrow for the field of linguistics itself, creating a record which is useful only to certain subfields. For example, the pretense of monolingualism assumed by most documentation projects obscures the multilingual context which may be of interest to sociolinguists. Even if linguists had the knowledge to cover a number of different domains, this would not guarantee a maximally useful record of language. Rather, each domain needs to be considered from a

variety of disciplinary perspectives, ensuring that the resulting documentation will be useful to the widest range of distinct disciplines. It is precisely this attention to multiple perspectives and multiple discourses which lies at the heart of interdisciplinary research (Aboelela et al. 2007).

Disciplinary specialization is relatively new within language documentation, and the history of interdisciplinary collaboration between linguistics and other fields goes back several centuries (Evans 2012, 186). In fact there is little justification for assigning many topics to particular disciplines (Salter and Hearn 1997, 21). For example, the domain of plants can be studied within several distinct disciplines, including botany, anthropology, linguistics, economics, and agriculture. While the disciplines may be distinct, the methodologies are often shared across the disciplines. For example, ethnographic methods may be employed by a soil scientist studying planting techniques. Rather than being distinct methodologies, disciplines are better thought of as registers of discourse which embody particular academic traditions. From this point of view disciplines are separated less by methodological approach and more by styles of communication which signal membership in the discipline. An important corollary is that effective interdisciplinary research requires bridging these differences in communicative styles.

This chapter provides an introduction to interdisciplinary language documentation. Given the variety of language situations and potential interdisciplinary collaborations, this chapter cannot hope to be a how-to guide. Rather, I take a more personal approach, drawing heavily on my own experiences with interdisciplinary research. I begin by describing why I think interdisciplinary research is necessary for adequate language documentation (section 2) and how interdisciplinary collaboration can enhance the documentation process (section 3). I provide three case studies from interdisciplinary projects with which I have been involved recently (section 4). I then discuss some of the challenges to doing interdisciplinary research, while also offering suggestions for overcoming these challenges (section 5). Finally, I conclude the chapter with a call for greater collaboration between linguists and other disciplinary experts working as equal partners in the language documentation effort (section 6).

2. Why interdisciplinary research is necessary

If we envision a more holistic science of language documentation, then linguists cannot do documentation on their own. The extraordinary range of technical domains touched on by language documentation means that linguists cannot hope to be specialists in all domains. Language documentation overlaps with the fields of biology, anthropology, geography, sociology, geology, and climate science, to name just a few. A nineteenth-century linguist might have been able to gain some skill in some of these fields, but as these sciences have advanced it has become increasingly difficult for linguists to master

the skill set required of other disciplines. Unfortunately, this has not always stopped them from trying.

When linguists venture outside their domain of expertise they generally adopt one of two strategies: either they become increasingly vague or they assume a false expertise. In the first strategy language documenters simply choose to ignore the subtleties of disciplines which intersect the margins of linguistics. For example, rather than unraveling the complexities of kinship and marriage practices, a language documenter may choose to simply gloss vernacular terms with sequences of terms in a language of wider communication. While glossing a certain term as "mother, mother's sister" may be more or less correct, it fails to capture the intricacies of linguistic practices associated with kinship. And vaguer glosses such as "mother, aunt" may further obscure the system. Confronted with complex domains such as biology or astronomy, language documenters may simply choose to ignore semantic details. Even languages with otherwise comprehensive lexical documentation may lack semantic detail in these areas. For example, the massive *Yup'ik Eskimo Dictionary*, recently revised with over 11,000 entries, lists five separate constellations with the definition "a certain constellation" (Jacobson 2012). The extremely detailed *Dena'ina Topical Dictionary* lists thirteen constellation names (excluding dialect variants), only two of which are identified (Kari 2007). This comment should not be interpreted as a criticism of these particular dictionaries or their compilers; vague definitions such as these are typical of most language documentation and could be said to be the accepted lexicographic practice in our field. Exceptions do exist, such as Pawley et al.'s (2011) *Dictionary of Kalam*, but these exceptions are notable for their involvement of disciplinary specialists outside linguistics.

In defense of the vague approach to lexicography one could argue that such fine semantic detail is not relevant to linguistics. But this argument leads us down a slippery slope. How does one decide when semantic detail is not needed? Does a *chair* need to be specifically identified, or is the gloss "a certain kind of furniture" sufficient? It is much more likely that language documenters choose to exclude semantic detail not because they feel it is irrelevant but because they lack the disciplinary expertise to provide that level of detail.

The second common approach to disciplinary boundaries in language documentation is to attempt to go it alone rather than seeking advice from disciplinary experts. This approach is in some ways more insidious than the vague approach, since it can give the false impression of authoritativeness. For example, much of what passes for ethnobiologically oriented language documentation is actually conducted by well-meaning linguists with little or no formal training in biology. But a linguist with a biological field guide is a dangerous thing. Without formal training in species identification a linguist must either rely on a gloss in a language of wider communication or else make use of pictures and descriptions in field guides. Glosses are notoriously unreliable for identification purposes. A gloss such as "ginger" for a plant fails to uniquely identify the plant, which may in fact turn out to be a kind of turmeric or other rhizome. So simply seeking a Linnaean binomial equivalent for "ginger" is not only unhelpful but potentially misleading. Yet attempts to do ad hoc identification using field guides can be even

more problematic. Photographs in field guides may not be representative of varieties present in all areas and may incorrectly represent relative and absolute sizes, leading speakers to prematurely "match" a name to a species in a picture. This practice can result in seemingly scientific Linnaean binomial identifications which are simply wrong.

Unfortunately, when dictionaries do provide ~~Linnaean~~ names for biological terms they generally do not provide information as to how the identification was performed. That is, we have no way of knowing whether the scientific name was determined by: (i) referencing existing identification of the translated term in the gloss language; (ii) using a field guide with the linguist only; (iii) using the field guide with native speakers; or (iv) consulting a disciplinary expert.

I have seen the first of these approaches used on several occasions, and it is probably extremely common among dictionary compilers. In this approach the identification is not based on observation of the biological specimen but rather on a pre-existing identification of the translated term. For example, if I ask a speaker to identify the plant known in Western Pantar as *kallang bu*, she might respond with the Malay gloss "jambu." Without even taking a sample of the plant, I can enter "jambu" into my lexical database, leaving the scientific name field to be filled out later. I might even enter the English translation "guava." Upon returning from fieldwork it is relatively easy to then look up the binomial name *Psidium guajava*, a member of Mytaceae family. Entering this name I then give the appearance of scientific authority, without ever having to engage a botanist or do any botanical identification. Notably, the methodology by which this binomial name was assigned is not recorded in the published dictionary (Holton and Lamma Koly 2008). Unless we can know how species determination was made, the use of ~~Linnaean~~ terminology by language documenters merely gives the appearance of a "scientific" approach without making any actual scientific contribution.

But there are even more potential problems with this approach. In the case above, the term "jambu" is actually ambiguous in Malay; there are several different kinds of "jambu," referring to plants as different as guava (*Psidium guajava*), cashew (*Anacardium occidentale*), and rose apple (*Syzgium aqueum*). If I search for "jambu" in the Indonesian Wikipedia I am redirected to "jambu air," which is identified as *Syzgium aqueum*. So I could ~~have~~ just as easily have (mis)identified Western Pantar *kallang bu* as *S. aqueum*.

The second and third approaches, using a field guide, can be helpful as an elicitation device. Looking at photographs or drawings of plants with speakers may generate many new terms for biological species. But as an identification technique field guides can be terribly misleading in the hands of untrained users. I once attempted to use a popular illustrated guide to fish identification in Indonesia (Allen 1997). Working with an extremely knowledgeable group of speakers we attempted to identify the illustrations corresponding to the 100 or so vernacular fish names known to the speakers. While this would seem to be a relatively straightforward task, it turned out to problematic on several levels. The first and most obvious problem was that there was no one-to-one correspondence between vernacular names and the species in the book. This of course is entirely expected, and is true of all languages. For example, the English fish name "red snapper" can refer several different species of fish across several genera. Moreover, a

single species may have several vernacular names, denoting different stages in the lifecycle, for example. When presented with a picture book full of different fish there is a natural tendency among native speakers to want to assign exactly one vernacular name to each photograph. The second problem with field guides is that they tend to emphasize some aspects of the species over others, and the emphasized aspects may not be those which are most salient to the linguist and the speakers.

The last approach, consulting a disciplinary expert, is unfortunately rarely followed. The expert must necessarily accompany the linguist to the field, or else biological or other samples must be collected and transported (necessitating a permitting process) for later identification. Without access to firsthand information the disciplinary expert will be of little help. Interdisciplinary collaboration addresses this shortcoming by actively involving disciplinary specialists as equal partners in the documentation effort, forging a research model which integrates the needs of both linguistics and the other discipline.

While this section has focused on ~~botanical~~ identification, similar challenges arise when linguists attempt to play the role of disciplinary experts in other fields as well. The task of language documentation is enormously complex, and linguists simply cannot go it alone—a point to which we shall return in section 6 below.

3. Benefits of interdisciplinary collaboration

As the situations described in the preceding section suggest, involving researchers from disciplines outside linguistics can improve the quality of documentation by providing more accurate and nuanced understanding of domains for which linguists may lack adequate knowledge. In its simplest form this kind of interdisciplinary research might consist of relying on biologists to correctly identify flora and fauna. This kind of interdisciplinary work is clearly beneficial, in that it increases the quality of the resulting documentation. But if the two (or more) disciplines merely work in parallel then there is less chance that they will reap the benefit of the insights that a different disciplinary perspective can bring. In order to realize the full potential of interdisciplinary language documentation the various contributing disciplines must work as a team. In such a collaborative approach the results achieved can be much greater than the sum of the parts.

In the best cases interdisciplinary research results in cross-fertilization whereby questions raised by one discipline lead to interesting avenues of research in another discipline. For example, in Tobelo (ISO 639-3 tlb), a language of Eastern Indonesia, a covert taxonomic category of "sexual biotic forms" can be delineated ~~as~~ those biotic forms which can be classed as *nauru* "male" or *beka* "female" (Taylor 1990). This distinction cross-cuts Western binomial classifications, in that some species of coral and alga are considered to be sexual, while others are not. For example, black corals (Anthipatharia)

have both male (*o kalibaharu ma nauru*) and female (*o kalibahru ma beka*) forms, while other corals and Porifera (except barrel sponges) are classified asexual, referred to simply as *o pahi*, not **o pahi ma nauru* or **o pahi ma beka*. For the biologist this raises the question of what distinguishing biological feature of black coral might underlie the Tobelo folk classification.

On the other hand, biology can also lead to interesting linguistic questions. For example, the botanical distinction between the similar-looking plants true taro (*Colocasia*) and elephant ear taro (*Alocasia*) motivates the search for a linguistic distinction between these families. Both plants have been used as food crops and widely transported across the tropics, though they require preparation to remove toxic calcium oxalate crystals prior to consumption. However, true taro is both less toxic and more calorific. This might inspire a search for corresponding lexical distinctions, as found for example in Hawaiian *kalo* "taro" (< PMP *talEt) and *ape* "elephant ear" (< PAN *biRaq).

An additional benefit of interdisciplinary research is that it better aligns with many indigenous views of the world. While the Western scientific tradition has attempted to understand the world from the perspective of disciplinary silos, traditional knowledge is more likely to be tightly woven together in web of language, culture, and environment (Maffi 2005, 601). Field linguists engaged in language documentation quickly discover that speakers do not view language as disembodied from the larger ecological system in which their language is used. Nor has this fact gone unnoticed by other disciplines beyond linguistics. In his handbook on cultural astronomy Fabian notes that "because astronomy is often so integrated into indigenous culture, by pursuing an understanding of it, we will surely proceed to a deeper understanding of the people who hold it dear" (2001, 6). Similarly, by pursuing a better understanding of the various knowledge systems encoded in language we will ultimately improve the quality of language documentation.

Finally, in today's disciplinary world, working across disciplinary boundaries requires collaboration, and this collaboration itself has a beneficial effect on the research process. The benefits of collaboration between linguists and language communities are well-established (Dobrin and Berson 2011); collaboration across disciplines can bring similar non-linear benefits. Different disciplines bring not only different expertise but also different underlying assumptions and different research traditions, allowing the documentary linguist to see language from a fresh, unbiased point of view. These benefits are evident in the case studies described in the following section.

4. Case studies

The design of interdisciplinary research projects will vary depending on a number of factors, including especially the nature of the disciplines involved. Before attempting to generalize about project structures, I review below three interdisciplinary projects with which I have been involved recently, documenting botany, astronomy, and

mathematics, respectively. I don't make any claims that these three projects are representative of interdisciplinary research involving linguistics; nor would I claim that the variation among the project structures is due solely to the nature of the disciplines involved. However, these examples do illustrate some of the ways in which projects can vary. Some of the projects are more linguistically driven, while in others linguistics takes more of a secondary role. Some projects are more community driven, while others are driven primarily by researcher agendas. My purpose here is not to ~~describe~~ guidance on how to do research in each of these areas but rather to illustrate the range of ways in which interdisciplinarity is embodied and the ways in which interdisciplinary research projects can arise.

4.1. Abui ethnobotany

Ethnobotany is an inherently interdisciplinary enterprise, drawing not only on botany and linguistics but also on anthropology, ecology, economics, and pharmacology (Martin 1995). Both linguists and ethnobotanists document linguistic knowledge of plants, but the two fields differ significantly in terms of their approach. Most notably, ethnobotany focuses first and foremost on identification and usage of plants. This often means collection of voucher specimens, but however it is achieved, unambiguous identification is crucial. Local names for plants may also collected, but for the ethnobotanist this information is secondary in that it is of little use without proper identification of the plant. In contrast, linguists focus on the name of the plant and show less interest in identification. It is easy to locate examples of this practice, even for better documented languages. Abui (ISO 639-3 abz) is the best documented of twenty or so Alor-Pantar languages of Eastern Indonesia, yet the recently revised and expanded dictionary lists hundreds of examples of botanical terms identified with an English generic followed by "species," as shown in Table 33.1.

In some cases linguists provide usage information, which is potentially valuable for ethnobotanical study. Thus, it is helpful to know that Abui *tuli* has a medicinal use, and that *tifol* is used to make arrows. However, the lack of identification renders this information of limited use to botanists. This practice may help to explain why ethnobotanists have tended to work on their own, without input from linguists.

My own interest in ethnobotanical research grew out of ongoing lexicographic work with Western Pantar (ISO 639-3 lev), a language of the Alor-Pantar family related to Abui. This work has led me to explore increasingly diverse domains of knowledge, such as landscape (Holton 2011) and kinship (Holton 2014). The domain of botanical knowledge remains one of the most difficult challenges in this work. To overcome this challenge I recruited expert collaborators with a thorough knowledge of local botany, and I equipped myself with numerous field guides and botanical reference works ("flora"). In spite of these efforts, the dictionary of Western Pantar still contains numerous examples of vaguely defined botanical terms, as shown in Table 33.2.

Table 33.1. Abui botanical terms and definitions (Kratochvil and Delpada 2014)

afui	"tree species with edible leaves"
akal	"tree species"
kawaaka	"tree species used for building houses in its branches"
kiya	"tree species"
malika	"fig tree"
mayak	"tree species"
nabu	"tree species"
tuli	"tree species, the leaves are used for rubbing wounds, also used to make a scoop"
muok	"cassava species"
bale	"a type of thick bamboo"
tifol	"bamboo species, thin bamboo used for making arrows"
tuol	"bamboo species"

Table 33.2. Vaguely defined plant terms in Western Pantar (Holton and Lamma Koly 2008)

asar	"kind of large purple tuber"
batte kai	"kind of strong-tasting variety of basil"
bayam	"kind of wild amaranth"
dede	"kind of vine"
diddi	"kind of cultivated plant used to make bows"

Vague definitions are not unique to the Western Pantar dictionary but are found also in many dictionaries of endangered languages, including the Abui dictionary mentioned above. But while the lack of precise identification may be frustrating for ethnobotanical research, as discussed in section 2 above, it is in many ways less problematic than the over-specification which results from supplying a binomial ~~Latin~~ name based on identification from a field guide.

In order to improve upon this amateur approach, in 2016 I invited a botanist, Michael Thomas, to accompany me on fieldwork to document botanical knowledge in Abui.[1] Thomas has many years of experience documenting the flora of the Pacific region, though he had no previous fieldwork experience in Indonesia and in particular did not speak Indonesian. This latter fact would turn out to be both a hindrance and an advantage. It is not at all unusual in disciplines outside linguistics for fieldwork to be mediated

[1] NSF-BCS 1545944: Alor-Pantar Languages: Origins and Theoretical Impact, PI Gary Holton.

through a translator, and this was one of the major accommodations that I would have to make in this interdisciplinary project. Though I was able to engage an Abui-speaking research assistant who also spoke English, I was nevertheless forced to spend much time translating between Indonesian and English for the benefit of Thomas. But this was only a minor inconvenience compared to the effect that Thomas's lack of Indonesian knowledge had on social position of the research team within the community.

Because Thomas did not speak Indonesian, most of the conversations among the research team were conducted in English, a language which was understood by only one Abui community member. As a result, our research team was often socially removed from the community and less integrated into daily life. Those "off-duty" times when the recorder is shut off and the notebook is put away can be extremely valuable experiences for the linguist or ethnographer, but our access to those ~~times~~ was limited.

On the other hand, Thomas's lack of Indonesian experience brought some important and unanticipated benefits in the form of his ability to see Alor and the Abui community from a fresh and unbiased perspective. I have been working in the Alor region for more than a decade, and as a researcher I have formed certain expectations about what can be asked and what people know. These are not conscious biases but rather acquired habits which subtly dictate whom I talk to about what. Working with a new colleague I found these biases repeatedly challenged, to the ultimate benefit of our research. For example, my sense of protocol would have prevented me from inquiring of a pregnant woman about her eating habits and use of plants during pregnancy, but prodded by Thomas this turned out to be an extremely fruitful line of inquiry. Pregnant women were eager to share this information, and it opened up an entire domain of traditional knowledge which had previously been overlooked as being too common or ordinary to be worth discussing with foreign researchers. Drawing on his experience from other areas of the Pacific Thomas had reason to suspect that this would be an interesting area of inquiry, and—equally important—he had no inhibitions against pursuing it.

Of course, the initial motivation to collaborate with a botanist was for their botanical expertise. However, in Alor the most valuable consequence of this expertise turned out not to be in the actual identification of plants—though this was of course critically important—but rather in the effect that this expertise had on Abui speakers. Though I can recite scientific names and distinguish a few plants, I am far from an expert, and it immediately became clear that the Abui speakers knew this. They easily distinguished my book knowledge of botanical guides from Thomas's comfort and ease within the botanical environment. Even when he could not identify a plant, it was clear to Abui speakers that he was asking the right questions, looking for the right cues. Where I might have gotten a one-word answer, speakers were eager to communicate knowledge to ~~him.~~ My role quickly devolved to that of middleman, being told to show or tell something to my botanist colleague. Abui plant experts shared plant knowledge with Thomas because they saw in him a kindred spirit. This is similar to the experience that Ralph Bulmer had when his Kalam teachers told him, "Why should we waste our time telling you something you couldn't possibly understand?" (quoted in Evans 2012, 184).

4.2. Gwich'in cultural astronomy

In contrast to the Abui ethnobotany project, the Gwich'in cultural astronomy project was initiated not by a linguist but rather by an astronomer. In 2011 I was approached by Chris Cannon, who had been working for several years as an astronomy educator, traveling to rural Alaskan schools with a portable planetarium to teach students about the night sky. During the course of his community visits Cannon had begun to suspect that Alaskans might have Indigenous knowledge of the sky which differed from the Western-based knowledge he was teaching. The suspicions grew out of offhand comments by students and elders about usage of particular stars, but cultural astronomy is particularly difficult to document, owing to both past and recent culture change. First, over the past several thousand years the ancient Babylonian scheme for carving up the sky into groups of stars, or asterisms, has ~~been~~ at least partially ~~borrowed by~~ most of the world's cultures, obscuring indigenous astronomies. Second, with the rise of modern systems of time-keeping and navigation over the past century, the night sky has become less relevant to most people's lives, rendering cultural knowledge of the sky more susceptible to loss.

Cannon began searching published and archival sources for information about Alaskan knowledge of the sky. While some information was available for Inuit languages, almost nothing was available for any of the Dene languages of Alaska. The Gwich'in cultural astronomy project thus began as an archival research project to seek out terminology relating to the sky in Gwich'in (ISO 639-3 gwi), a Dene language spoken in Alaska and neighboring Canada.[2] Modern references and documentation contain almost no information on Gwich'in astronomy. Dictionaries typically list just one asterism (i.e., recognized and named group of stars), *yahdii*, glossed as "Big Dipper." Cannon carefully combed through archival documents seeking additional terminology and additional identification of the stars involved in *yahdii*. Since much of the archival information had been collected by non-linguists, this required some careful philological work to identify the Gwich'in terms. Thus began a collaboration, with linguistics in this case initially taking a back seat to the astronomy work. The archival research strongly supported a hypothesis that the Gwich'in asterism *yahdii* was not equivalent to the Big Dipper, but confirming this would require fieldwork with Gwich'in speakers having knowledge of the sky.

Gwich'in is a highly endangered language, with few speakers under the age of 50. Moreover, few speakers still have specialized knowledge of the sky. Such knowledge is found only among those who were raised in a more traditional lifestyle, moving about in camps and living off the land. Hence, the challenge of documenting Gwich'in astronomy is much greater than that of documenting Gwich'in language more generally. While most speakers are familiar with the word *yahdii*, few are aware of the cultural significance of *yahdii* and other asterisms, and even fewer could identify the

[2] NSF-OPP 1317245: EAGER: Documenting Gwich'in indigenous astronomy, PI Gary Holton.

precise stars which comprise the asterism. We were fortunate to be able to recruit collaborators who had not only grown up the land but actually still made use of stars for practical tasks such as timekeeping and navigation. Without the collaboration of these few individuals the Gwich'in astronomy project would not have been possible. In this sense the Gwich'in projects differs significantly from the Abui ethnobotany project. While only a few Abui speakers in each community ~~had~~ deep knowledge of plants, almost all members of the community ~~could~~ identify and describe usage of a few hundred basic plants. By comparison ~~the~~ Gwich'in astronomy knowledge ~~was~~ ~~comparatively~~ fragile, embedded in the memories of just a few speakers (Cannon and Holton 2014).

As with many interdisciplinary collaborations, the challenge for linguists working with astronomers is to find common ground, a shared research interest. Linguists typically put more emphasis on form, considering meaning to be secondary to their investigation. As noted in section 2 above, where dictionaries include entries denoting stars and constellations, they usually fail to identify those stars and constellations. For example, the ethnographically rich *Dena'ina Topical Dictionary* (Kari 2007) lists eleven terms denoting constellations—more than are found in any other dictionary of any Alaskan language. Nine of these are glossed simply "(a) constellation," without further explanation. One is cryptically identified as "Jesus' ghost." And one is glossed "bear constellation," presumably referring to the Great Bear or Ursa Major. Curiously, the Dena'ina dictionary takes great pains to give literal translations for each term, as shown in the Table 33.3 below.

Some dictionaries do make an attempt to identify objects in the sky through reference to shape or location with respect to Western constellations. For example, the Yup'ik dictionary (Jacobson 2012) defines *ilulirat* as "part of the constellation Bootes [sic]; the constellation is *taluyaq* (fish trap) in Yup'ik, and this part is the funnel-like inside component." This definition gives the astronomer a little more information from which to infer the location of Yup'ik *ilulirat*. As shown in Figure 33.1, the constellation Boötes

Table 33.3. Dena'ina stellar terminology (Kari 2007)

a constellation	*bejech'a*	"its kidney"
bear constellation	*yuq'eltani*	"the one over the sky"
constellation, "Jesus' ghost"	*udunuyultaɬi*	"the one he is carrying back in"
a constellation	*kala q'edi*	"the one on the tail"
	belaq'a q'edi	"the one on the palm"
	k'tsikiq'edi	"the one on the top of the head"
constellations (unidentified)	*K'uzhaghaɬen ten*	"trail of the giant"
	yuq' niyunen beq'	"tracks of one that walked in sky"
	yubugh tayqan	"one who paddled around world"
	chulyin veq'	"raven's tracks"
	chulyin tusghiyu	"raven went through pass"

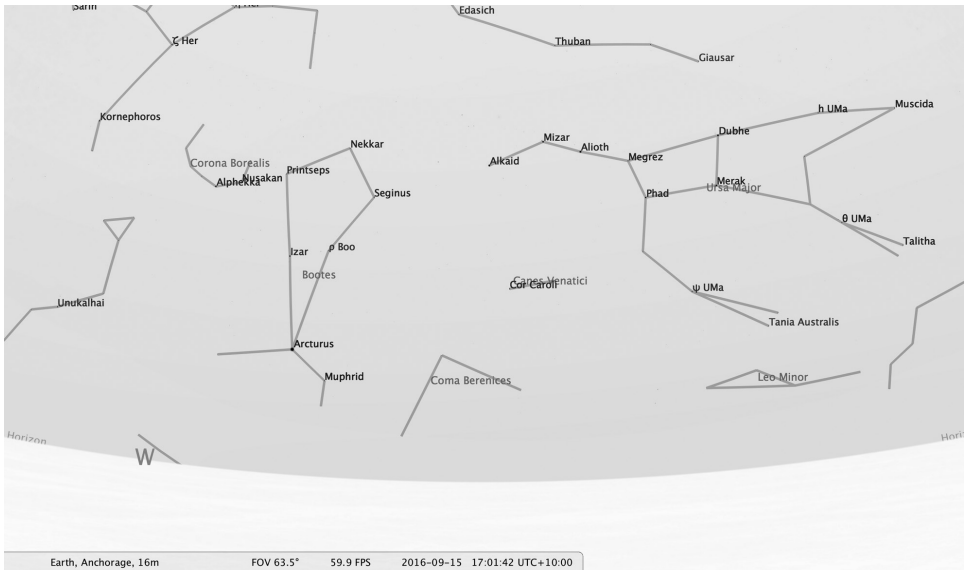

FIGURE 33.1. View of the sky from Anchorage, Alaska looking west-northwest, showing the location of Boötes to the west of Ursa Major. Image generated using Stellarium 0.13.3.

(Yup'ik *taluyaq*) does indeed have what appears to be a funnel-shaped component, tapering to a point at the star Arcturus. While it is still difficult to know just which stars comprise *ilulirat*, it is likely that the Yup'ik constellation include Arcturus, as well as Izar (ε Boo) and ρ Boo.

What these examples demonstrate is that for the linguist the notion of meaning is often structural, focused on the identification of the meanings of the various component morphemes in order to determine a literal translation. The actual location in the sky of the object denoted by the name is of relatively low importance. In contrast, for the astronomer these priorities are reversed. The crucial question for the astronomer is to which star or asterism does the term refer? In theory this is not a difficult problem, since each star in the sky can be unambiguously identified by its stellar designation using a standardized system such as Bayer designation. In practice few if any documentary linguists make use of stellar designation systems, preferring to focus instead on the form of the name itself rather than its identification in the sky. A prerequisite to pursuing interdisciplinary collaboration between linguistics and astronomy is recognizing the need to precisely identify stars and asterisms (Holton forthcoming).

4.3. Yup'ik ethnomathematics

Like the Gwich'in astronomy project, the Yup'ik ethnomathematics project also originated from outside the discipline of linguistics. This was a case where a

long-running research project sought greater interdisciplinary collaboration by adding a linguistics component and recruiting a linguist. Math educator Jerry Lipka has been researching Yup'ik (ISO 639-3 esu) traditional mathematical concepts for several decades. Most of Lipka's work has had an applied focus, working toward the creation of a culturally responsive curriculum for elementary education which incorporates Indigenous concepts (Lipka 1994; Lipka, Andrew-Ihkre, and Yanez 2011; Lipka et al. 2015). More recently this applied work has expanded to include a comparative component in order to assess the degree to which Yup'ik mathematical concepts might also be shared by other cultures. A cross-cultural perspective necessitates a cross-linguistic perspective; hence, Lipka reached across disciplines to seek collaboration with linguists, which is how I became involved in the project.[3]

Most linguists are likely to equate ethnomathematics with the study of numerals and counting. However, from the point of view of mathematics, the study of number words and their use turns out to be relatively uninteresting. As is well known, languages do vary in the ways that they employ reference bases to create higher numerals, but such variation has more relevance to the linguist than to the mathematician. For example, etymological traces of old numeral bases may provide insight ~~to~~ past language contact. While numeral bases may embody mathematical concepts, the speakers using those numerals are simply making use of a formal system rather than doing mathematics. Just as we wouldn't claim that English speakers are doing mathematics when they balance their checkbook, we wouldn't want to claim that a speaker with a base-six numeral system is doing mathematics simply by counting in her language. Doing mathematics requires abstract reasoning which is not required of rote calculations. Languages also vary in the extent to which they have developed higher-order systems of enumeration. Some languages have elaborate systems of specifying very large numerals, whereas other languages are content with counting systems which lump together all values greater than two. Again, such differences are of less interest to the mathematician than to the linguist (or cultural anthropologist), as they are more likely to reflect external exigencies than embedded mathematical principles. For example, where economic transactions take place in a second language there will be little pressure to develop complex enumeration systems in the first language.

Instead, the main focus of ethnomathematics research is on understanding the consistent abstractions which underlie everyday activities. Ascher and Ascher define ethnomathematics as "the study of the mathematical ideas of nonliterate peoples" (1986, 125). Actually, it is not lack of literacy which matters but rather the fact that the principles in question are embedded in prosaic human enterprises. These tasks might include activities such as games, art, music, house construction, or weaving, to name just a few. That is, the real interest of ethnomathematics lies not in the superficially mathematical topics such as enumeration but rather on the way people employ

[3] NSF-OPP 1203194: The Potential Contribution of Indigenous Knowledge to Teaching and Learning Mathematics, PI Jerry Lipka.

consistent abstractions in their everyday activities, such as in the creation of geometric patterns on a woven garment or the building of a house. Chemillier (2012, 318) proposes three features which characterize the object of ethnomathematics documentation. Namely, the objects of study should be: (i) based on explicit principles; (ii) removed from ordinary use; and (iii) proceed in a systematic fashion. Describing the abstract concepts underlying everyday activities requires surprisingly sophisticated mathematical theory, drawing on number theory, geometry, topology, and algebra, among other subfields of mathematics.

One of the preliminary findings to emerge from the Yup'ik ethnomathematics project is the role of symmetry, verification, and the center point. Finding the *qukaq* "center" through repeated *tapluku* "folding" serves as the basis for many everyday Yup'ik activities. In the subarctic climate which the Yup'ik call home, clothing construction is critical to survival. Clothing is constructed not according to sizes small, medium, large but rather proportional to body size. Yup'ik seamstresses use their own body measurements as reference points in the construction of clothing. In order to create clothing for other people of differing body sizes they make use of fractions generated through folding. Crucially, through folding and verification it is possible in theory to generate a prime fraction. For example, thirds can be generated by folding to the center of the remainder, creating two divisions of the whole, one of which is twice as long as the other (Figure 33.2).

Similar concepts of symmetry can be identified in other cultures as well. For example, halving and the identification of the center point are critical to Woleaian house and canoe construction, where scaling proceeds through repeated folding and identification of *lug* "center," in a manner similar to Yup'ik garment construction (Alkire 1970). For the linguist documenting ethnomathematical knowledge the critical factor is the complete and systematic recording of processes. Rather than simply collecting mathematical terminology, activities must be recorded in their entirety, capturing each segment of the process.

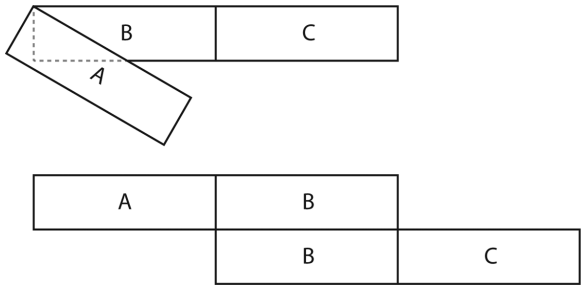

FIGURE 33.2. Yup'ik halving to create three equal parts (after Lipka et al. 2015)

5. Challenges of interdisciplinary language documentation

As these case studies make clear, there are numerous potential benefits ~~of~~ doing interdisciplinary research. However, it should also be acknowledged that there remain many practical challenges which impede the implementation of interdisciplinary projects. Most of these challenges arise from differing academic traditions and standards of practice across disciplines. While such barriers cannot always be surmounted, interdisciplinary projects can run much more smoothly if all parties are aware of the inherent disciplinary barriers in advance. I will describe a few of the challenges below, along with suggestions for overcoming them.

5.1. Data ownership and sharing challenges

Different disciplines have different traditions regarding data ownership and sharing. While the general trend across all disciplines is toward increasingly open access to research data, some disciplines are further advanced along this cline (Corti et al. 2014). Within documentary linguistics it is customary to view the speech community as at least co-owners of the data, while at the same time advocating broader sharing of data. Indeed, the field of documentary linguistics is founded on the concept of the creation of an enduring record of language use, accessible to future generations. However, in practice the collections created by documentary projects are more often than not closed. For example, only a small proportion of the corpora produced by the Dokumentation bedrohte sprachen project are open. Since other disciplines may have different expectations or obligations with respect to open data, it is critical to negotiate data ownership and sharing policies in advance of embarking on an interdisciplinary project.

5.2. Publication challenges

Interdisciplinary projects may face~~s~~ challenges when it comes to academic publishing, for at least two reasons. First, many traditional journals are based within single disciplines, so it can be difficult to find an appropriate venue. A paper about linguistics and mathematics may be unsuitable for either a linguistics or a mathematics journal. One possible solution to this problem is to seek publication in a dedicated language documentation journal, such as *Language Documentation & Conservation*, which may be more open to interdisciplinary work, or, if the work reflects significant discoveries, a broad-based science journal such as *Nature* or *Science*.

A second publishing challenge derives from differences in discursive style. Interdisciplinary projects inevitably result in multi-authored papers, with different authors bringing different writing traditions. Some disciplines rely heavily on prose to provide context, while others emphasize concise writing and a formulaic presentation. One solution to this challenge to generate multiple papers, allowing different disciplines to take a leading voice in each paper. For example, a linguist might take the lead on a paper submitted to a linguistics journal and written for a linguistic audience, while a botanist might take the lead on a paper submitted to a botany journal and written for a botanist audience. Producing multiple publications provides more opportunities for the voices of each discipline to be heard, while still endorsing the interdisciplinary spirit of the project. This approach has the additional advantage of helping to overcome the venue problem mentioned above.

5.3. Funding challenges

Different disciplines have different funding requirements, as well as different funding traditions. Hence, attempting to fund an interdisciplinary project through a funding mechanism accustomed to funding only one discipline can be a challenge. For example, a linguistic documentation project may be content to employ just a handful of locally based research assistants, whereas a botany project might need to employ dozens of local assistants to provide guide services and to collect and process samples. Salary models for researchers may differ too. Most academic linguists rely on institutional support for their salaries, whereas in the hard sciences it is common for researchers to be required to bring in half or more of their salaries through extramural funds. Adding these salary expenses to a language documentation proposal can significantly inflate the budget beyond what might be supportable through ordinary linguistics funding mechanisms. Research equipment and procedures related to other disciplines may also bring added costs. For example, the preparation and processing of biological specimens requires specialized supplies as well as allowance for transport costs.

One solution to the funding challenge posed by interdisciplinary projects is to seek joint funding through more than one funding stream or more than one division within a single funder. This approach allows each funder or funding stream to support those aspects of a project which are most familiar to them.

5.4. Logistics challenges

Balancing the differing logistical requirements of different disciplinary traditions can be challenging for an interdisciplinary language documentation project. Logistical issues may range from equipment to transportation to permitting. In recent years documentary linguistics has become increasingly dependent on equipment, including

digital recorders, cameras, GPS, and laptops, but other disciplines may add considerably to this equipment burden. Biologists may need to bring specimen collecting vessels, plant dryers, and photo stands, and this added equipment can have the effect of making a language documentation project seem like an expedition. This added equipment obviously complicates transportation, especially for difficult-to-reach field locations. But transportation may be complicated also by the research needs of other disciplines. For example, botanists may need to travel deep into remote valleys or other difficult-to-access areas in order to collect plants. Such travel can be physically demanding and even dangerous and requires that the linguistic team be appropriately prepared and equipped.

Permitting requirements present an additional hurdle. Documentary linguists are likely to be familiar with the permitting process for language documentation, necessitating approval for working with human subjects and for making and archiving recordings. Other disciplines may face much more stringent permitting requirements. For example, botanists will usually need to seek permits from national herbaria and to provide assurance of compliance with the Convention on International Trade in Endangered Species of Wild Fauna and Flora. These additional permitting processes can add significant time and expense to a language documentation project. None of these logistical challenges is likely to prevent a language documentation from progressing, but projects will be more successful if they anticipate these challenges in advance and make allowances for them.

5.5. Academic challenges

In spite of the recognized advantages of interdisciplinary collaboration, much of the academic reward system remains organized around disciplinary silos. While universities celebrate the media attention and photo opportunities generated by interdisciplinary projects, there has been little progress toward providing real incentives for collaboration across disciplines (Rhoten and Parker 2004). As a result much interdisciplinary research is initiated by senior researchers, while students and younger scholars remain steeped in disciplinary traditions. Reaching across these disciplinary boundaries requires a certain amount of faith on the part of junior scholars that their efforts will be rewarded in terms of dissertations, fellowships, tenure, publishing, and grant opportunities. It also requires a broader effort on the part of universities, funding agencies, and professional organization to encourage interdisciplinary research.

Until the incentives for interdisciplinary research are changed, a linguist may have an extra burden to explain the value of a publication in, say, a biology journal to their graduate committee or tenure review committee. Evaluation metrics are grounded in disciplinary traditions and do not easily translate across disciplines. But this extra effort necessary to cross academic hurdles may be worthwhile if it better captures the linguistic practices of a community and hence facilitates a more robust and compelling language documentation.

6. Conclusion

Interdisciplinary research relies fundamentally on collaboration with experts in other disciplines, and as such may run counter to the traditional lone wolf image of the field linguist. As Thieberger notes, "a linguist may be the only outsider to learn and prepare materials in a given language and culture" (2012, i). But this need not be the case. As the modern field of documentary linguistics continues to evolve, approaches which emphasize collaboration are increasingly employed (cf. Czaykowska-Higgins 2009). If linguists can reach out to speaker communities to engage in collaborative research, then surely we can also reach out to practitioners in other disciplines, so that we don't end up being the "only outsider" working with a language community.

The most important point to bear in mind about interdisciplinary research is that it must necessarily weigh the constraints and requirements of each participating discipline. While the balance between the disciplines may be negotiable, it is likely that each participating discipline will have certain fundamental principles to which the project must adhere. Within linguistics, for example, the accurate recording of linguistic form is arguably non-negotiable. This is perhaps the most common criticism of amateur attempts to do linguistics; namely, that they do not adequately document the speech stream, through either recording or transcription. Casual methods which "spell it like it sounds" might be useful to a philologist with no other access to documentary records, but they do not constitute acceptable practice for a modern language documentation project. Similar non-negotiables exist in other fields as well. Cultural astronomy mandates precise identification of stars using Bayer designations (Holbrook 2012, 360). Simply defining a term as "a certain star"—as is done in most linguistic reference works—is no more useful to an astronomer than a linguistic record without an accurate transcription or recording is to a linguist (though it may serve as a starting point for future research).

Within the field of ethnobotany the non-negotiable is specimen collection. "Carefully prepared botanical collections are always required to identify plants with certainty" (Conn 2012, 250). This fact is easily overlooked by linguists, who may lack the skills, resources, and motivation to collect specimens and may mistakenly believe that the basic requirement of ethnobotany is identification by standard binomial name. However, without a voucher specimen to support the binomial name there is no way to be certain that the binomial identification is correct. A skilled botanist may be able to key some species in the field, but without a specimen these field identifications cannot be confirmed. Moreover, even the most skilled botanist cannot key all species. Photographs can provide a useful record, but they cannot substitute for actual specimens. Botanical identification may be quite difficult, requiring careful examination and comparison with previously identified species, and botanical classifications may change over time as new techniques emerge.

The defining feature of a successful interdisciplinary language documentation project is that it engage with relevant disciplinary specialists in a meaningful way. Not all disciplines will necessarily be equally involved in every project, but each discipline will bring some non-negotiable points to the table, and these should be respected and incorporated into the project. This means ethnobotany projects need to include botanists; cultural astronomy projects need to include astronomers; and ethnomathematics projects need to include mathematicians.

The necessity to engage disciplinary specialists cannot be overstated. The various chapters in the "Collaborating with Other Disciplines" section of Thieberger's (2012) *Handbook of Linguistic Fieldwork* seem to suggest guidelines by which domain-specific documentation can be added to language documentation project. These articles have tiles like "X for linguists," where X is some non-linguistic domain or discipline. The implication is that with just a few pages of reading a linguist can do the work of a disciplinary specialist with many years of training. Specifically, the implication is that linguists can work across disciplines if they just learn a few tricks of the trade from those other disciplines. One might call this an "additive" approach, in that it adds additional disciplinary topics to an existing research project. The additive approach thus contrasts with the collaborative approach, which engages other disciplines as equal partners through collaboration with practitioners of those disciplines.

One argument in favor of this additive approach is that something must be better than nothing. Surely better to have some documentation of star terminology than none? Unfortunately, as the examples discussed in this chapter make clear, a little knowledge can be dangerous, leading to the superficial appearance of authority without true expertise. Attempting to equate indigenous asterisms with common constellations can create errors in the record which are very difficult to uncover. Similarly, the inclusion in dictionaries of binomial names for flora and fauna without also collecting adequate voucher specimens can create errors which go unchecked in the corpus. In cases like these it may actually be better for the linguist to forgo attempts at scientific identification if she lacks access to collaborators from relevant disciplines.

Moreover, the additive approach often fails to provide adequate expertise. It takes more than handbook and field guide knowledge to probe the depths of scientific knowledge in an endangered language. Speakers recognize disciplinary expertise, as Ralph Bulmer found when he collaborated with a geologist and suddenly discovered a wealth of Kalam rock terminology (see section 4.1 above). While linguists may be aware of stories like Bulmer's, there is still a strong tendency to go it alone. Too often linguists have attempted to inject interdisciplinarity into documentation projects by simply attempting to learn something about another discipline, supplemented heavily with amateur field guides. While this approach may give the impression of interdisciplinarity, by failing to engage fully with other disciplines it can actually generate spurious results while giving the appearance of scientific rigor.

Linguistics is not alone in presuming an additive approach to interdisciplinarity. In a four-page article King (2015) describes how anthropologists can add language documentation to their work in just six steps. Martin (1995) devotes a chapter of his *Ethnobotany*

handbook to linguistics, providing advice for how botanists can record better language information. This twenty-one-page chapter covers a range of topics, including phonology; transcription; linguistic analysis; historical linguistics; and categorization. As in the case of the "X for linguists" articles, the ostensible motivation for these guides is that some exposure to other disciplines is better than none. But this is not necessarily true. How can we reduce the entire practice of language documentation to six steps laid out in a mere four pages, or even twenty-one pages? Surely there are many more subtleties to our field than that. Likewise, how can we assume that linguists can suddenly become domain experts in ethnobotany or cultural astronomy or ethnomathematics simply by reading a chapter in a handbook? Surely interdisciplinary work requires a deeper level of commitment.

Interdisciplinary research involves much more than simply learning a few key techniques from another field. In particular, interdisciplinary work requires linguists to step outside their comfort zone, forging compromises in research methodologies and research goals. An authentic interdisciplinary approach must engage researchers from other fields as equal partners in a collaborative effort. In particular, we must ensure that other disciplines are aware of what documentary linguistics can offer to a collaborative enterprise. Scholars from other disciplines may still view linguistics as a field which is dedicated to diagramming sentences and advancing theories about universal grammar. Consider Martin's warning to ethnobotanists seeking a linguist collaborator:

> As you begin your search for a linguist who can accompany you to the field, . . . do not be surprised to find many researchers dedicated to . . . topics which are on the cutting edge of linguistic theory. Few [linguists] have the opportunity to live many years with local people, a necessary condition for pursuing the descriptive and historical approaches which are of most interest to ethnobotanists. (Martin 1995, 203)

We can disagree with this characterization of our field, but there is little doubt that such views persist outside our discipline. Changing these perceptions will require continued cross-disciplinary outreach on the part of linguists (and may require linguists to spend more time engaged in fieldwork).

Fundamentally, collaboration will always require compromise and negotiation in order to balance the possibly competing goals and agendas of the various fields. Interdisciplinary research requires that we be aware of methods used by other disciplines and adopt these when possible in order to generate comparable data sets (McClatchey 2012, 290). The necessity of compromise is the fundamental challenge of interdisciplinary collaboration, but it is also the source of many of the rewards of interdisciplinary research, pushing us beyond the comfortable assumptions and disciplinary prejudices of our field, resulting in a more holistic documentation of endangered languages. My experience has been that other disciplines are eager to collaborate with linguists, and endangered language documentation presents many opportunities for interdisciplinary collaboration. As Will McClatchey (2012, 297) puts it: "The ethnobiologists and other scientists are waiting for the linguists to call."

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