Ethnopharmaceutical communication

Bridging the “two cultures” in ethnopharmacology: Barriers against interdisciplinarity in postgraduate education

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A B S T R A C T
As significant contributors to the generation, dissemination and publication of scientific knowledge, graduate students have considerable leverage on publication trends and the future direction of ethnopharmacology. The rigid discipline-oriented framework of academia is often cited as responsible for impeding interdisciplinarity, particularly for fields such as ethnopharmacology which span both the natural and social science domains. Funding opportunities, funding eligibility periods, time-to-degree patterns and departmental expectations and requirements for graduate students enrolled in the natural sciences are considerably different than for those in the social sciences. Consequently, adequate acquisition of ethnographic data is often compromised. Encouraging students to think across disciplines, cross-disciplinary collaboration, and flexibility in regards to the time and financial constraints imposed by departments and funding agencies would increase the likelihood of contextualizing bioscientific data with adequate traditional empirical knowledge, and ultimately embrace the core objectives on which the JEP was conceived.

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1. Introduction
Concern has been raised over the intellectual nature of ethnopharmacology in relation to how the domain is perceived as an interdisciplinary science (Heinrich and Gibbons, 2001). The Journal of Ethnopharmacology (JEP), widely considered to be a key gauge of current interests in the field, was conceived with the objectives of disseminating research findings that accurately reflect the interdisciplinary character of ethnopharmacology. Retrospective content analyses of the JEP prior to 2000, however, revealed that a clear majority of studies did not fulfill this objective such that data was rarely within an ethnographic context (Etkin and Ross, 1997; Etkin, 2001; Etkin and Elisabetsky, 2005). In 2006, the journal adopted the Rule of 5 to regulate the quality of submitted manuscripts towards true interdisciplinarity with a strong basis both in socio-cultural and natural sciences (Verpoorte et al., 2006). Although the Rule of 5 addressed the lack of interdisciplinarity in the journal, there continues to be concern over the lack of interdisciplinarity in the field itself, how it is practiced in academia, and how this affects its future direction.

At the Building Bridges with Traditional Knowledge II held in Honolulu, Hawai’i in 2001, student members met and discussed personal experiences and challenges related to combining ethnographic surveys and pharmacological data. The most often cited barriers were the difficulties in crossing institutional boundaries that demarcate the intellectual fields of research programs and academic departments. In such fields as ethnopharmacology which span both the socio-cultural and natural domains, the chasm may be particularly difficult to bridge.

More than 50 years ago, C.P. Snow’s influential Rede Lecture at the University of Cambridge, entitled “The Two Cultures”, addressed what he saw as the “total inability of highly educated people to cross a deep rift of mutual incomprehension” between the social and natural sciences (Kemp, 2009). Although Snow’s cultural diagnosis has been heavily debated, there is little doubt that disciplines differ far more than simply being specialized fields of knowledge. The two cultures show stereotypical differences in lecturing style, design of curriculum, role of graduate students, and even political, social and religious affiliations and beliefs (Bauer, 1990).

This paper addresses the disparities between the two cultures that impede students from successfully integrating the social and natural disciplines. Each culture has differences in the time required to complete a Ph.D., sources and duration of funding, and specific departmental requirements that encourage students to forego or reduce non-essential elements of their thesis and ultimately compromise the ability to practice true interdisciplinarity.
2. Interdisciplinarity within academic frameworks

Humans typically categorize knowledge of how nature is perceived into socially defined boundaries that conceptually describe a discipline. Any field of study that draws upon the corpus of more than one discipline is accordingly considered interdisciplinary. This concept, however, has been a long, continuing, and intense debate exemplified by the enormous bibliographies compiled by Chubin et al. (1986) and Klein (1990, 2008). Topics of discussion range from radical intellectual movements such as postmodernist/poststructuralist epistemological challenges to the institutionalization of knowledge in disciplinary form, to the simple cross-disciplinary borrowing of tools, data, results and methods intended for real-world problem solving, all while leaving disciplinary boundaries intact (Salter and Hearn, 1996).

Ethanopharmacology is considered an interdisciplinary science since it combines or integrates ethnology (or anthropology), the study of human characteristics, origins, cultures and social relations; and pharmacology, the study of drugs. As a specialized unit of knowledge, however, ethnompharmacology does not obtain the status of an academic discipline. A discipline, regardless of whether it forms an academic department, may be conceptualized as comprising a body of experts representing a more or less standard worldwide organizational form corresponding to common intellectual interests. Disciplines are further characterized by professional organizations, conferences, seminars, congresses and journals dedicated to its study and practice. Although the field of ethnompharmacology is sometimes considered a discipline, it is a discipline in name only, and usually not a degree-granting entity likened to a university department. Hence, JEP authors may identify themselves as ethnompharmacologists, but likely have affiliated themselves with different departments or institutes. Since there is no established standardized list of requirements to fulfill for a member to be certified as competent, this means that ethnompharmacologists have widely varying backgrounds. The study of ethnompharmacology must therefore be accomplished through specialization in pre-existing disciplines.

Naturally, not all research and knowledge is defined fully within disciplinary boundaries, and any interdisciplinary work by definition is understood in relation to these symbolic borders. University disciplinary walls are not so rigid as to preclude work outside them, and it is clear that interdisciplinary work does take place and is sustainable. Several interdisciplinary fields such as conservation biology, developmental studies, communicable and cultural studies have been successfully accommodated within university infrastructures. A growing number of universities house interdisciplinary research centers and institutes that are often problem or mission-oriented and are usually accountable to external sponsors (Alpert, 1985; Abrams, 2006). The National Academies (2004, p. 174) even suggests “a more dramatic or ‘revolutionary’ vision of interdisciplinarity ... in which institutions strive for a more complete integration of disciplines, institutions ‘without walls’, a high degree of flexibility and mobility for students and faculty, and research efforts that are organized around problems rather than disciplines”. Nevertheless, there are disincentives for universities to deviate from established disciplinary-departmental forms since, as Abbott (2001) argues, this may threaten the academic career prospects of Ph.D. graduates. Abbott contends that university departments are resistant to change since they are considered both producers and consumers of academic professionals in disciplinary labour markets. As departments participate in and draw faculty from the disciplinary labour markets, the current social structure of disciplines will endlessly re-create itself (p. 126).

Operating within departmental ‘silos’, a student wishing to explore the breadth of ethnompharmacology may take anthroplogy, ethnobotany, phytochemistry, toxicology and pharmacology as part of their university curricula, disciplines that according to Waller (1993) comprise a proper ethnompharmacological investigation. The greatest criticism of such processes, as with other interdisciplinary programs offered in academia, is that there are significant differences between including these courses from various disciplines into a program and integrating these disciplines within the framework of the program. This difference essentially describes the contrasting concepts of multidisciplinarity and interdisciplinarity described by Wilpert (1986).

Although the terms multi- and interdisciplinary imply the integration of more than one discipline, Wilpert (1986) describes these as belonging to a continuum of concepts with differing intervening levels of cooperation and coordination. Multidisciplinarity is considered to be comprised of more than one discipline, but with no cooperation or interaction between them while interdisciplinarity involves interactions between more than one discipline in which there is a shared sense of purpose. The term transdisciplinary has been increasingly used, particularly in Europe where it connotes a ‘structure of unity’ informed by the worldview of complexity in science and trans-sector problem solving through the collaboration of academics and stakeholders in society” (Klein, 2010, p. 24). In academia, transdisciplinarity is a theoretical form of interdisciplinarity that implies an overarching axiom that transcends disciplines. Sociobiology, structuralism, feminist theory and general systems theory have been considered leading examples.

Using such criteria, virtually every interdisciplinary field in academia operates from a multidisciplinary perspective since courses are offered individually with little overlap or integration. Arguably, this mode of training does not adequately prepare or encourage students to think across disciplines, requiring them to make this transition after graduation, possibly on the job, which may have potentially negative consequences (Erikkson, 1999; Klein, 2010). Therefore, in order for future professionals to think effectively across disciplines rather than along strict disciplinary lines, it is crucial that graduate programs incorporate interdisciplinary thinking into their academic curriculum.

3. Pedagogic and financial disparities between the social and natural sciences

Scientists pursuing interdisciplinary research may find it difficult to secure funding, publish and to have publications recognized by disciplinary peers. A famous example is the experience of Walter Nernst, awarded the Nobel Prize in 1920 for his Third Law of Thermodynamics which states that it is impossible to cool a body to absolute zero by any finite process. Nernst was obliged to wait fifteen years before receiving his Prize, simply because the Swedish Academy was unable to decide whether his Third Law belonged in the chemistry or physics division. Had Nernst been an ethnompharmacologist whose work spanned the social and natural sciences, the decision might have taken considerably longer.

The notion of individual scholars and team members is a recurrent theme in the production of symbolic boundaries between the social and natural sciences. The personal, individualized model is characteristic of the social sciences, while the positional group model characterizes the natural sciences. The social science student is usually not part of a research group, but has a more individualized relationship with their supervisor such that they are usually free to choose their own topics, theories and methods for their theses. The thesis is usually a unique individualized intellectual odyssey, producing enough data and material for books and articles. The thesis is oftentimes seen as the candidate’s life work providing data that remains valid for years or decades (Delamont et al., 2000). The manuscript-style thesis undertaken by most natural and applied science students on the other hand, is regarded as more...
time-efficient than the traditional final research dissertation that constitutes the cornerstone of the existing structure (Monaghan, 1989; Duke and Beck, 1999).

Conversely, work in the natural sciences is usually prescribed by the supervisor or lab head, performed as part of a group, and the data produced more ephemeral (Delamont et al., 2000). The frontiers of many research areas move quickly such that research topics are important for a short term and are soon superseded by new research. In view of this, work in the natural sciences requires completion within a stricter timeframe. A delay of a year or more can leave the study overtaken by new discoveries if not pre-empted by publication in another laboratory. This is in contrast to the social sciences, where the need to keep up with a moving frontier of discovery does not exist, so time restrictions are usually an external requirement imposed by the department or graduate school (Leyerle, 1986; Acker et al., 1994).

In addition to social position (individual versus group), the social and natural sciences can be differentiated on the basis of research environment (fieldwork versus benchwork). Fieldwork is of particular significance to the social discipline of anthropology and may comprise as much as eighteen or more months of the degree. Generally, the culture studied during graduate research forms the basis of specialization on which the anthropological career is built. In contrast, laboratory work is characterized by practical laboratory activity, marked by routine and repetition. Experiments are performed alongside colleagues, requiring coordinated use of departmental and laboratory equipment in order to reduce time delays. Moreover, shared facilities entail physical constraints such that there is usually a limit to bench space, necessitating a lab work schedule at a given bench station to maintain proper laboratory operations (Leyerle, 1986; Babtie, 2010).

The different approaches to conducting research in the social and natural sciences not only represent a choice of research method, but essentially involve an intellectual and personal commitment. Fieldwork is regarded as a fundamental process in the induction of the scholar into the domain of anthropology, while in the natural sciences experimentation is an absolute requirement, not only of departmental and laboratory equipment, but also of the scientific study of the research site to ensure that the study can be replicated and verified. In the laboratory, the level of specialization is achieved through the acquisition of skills and knowledge in a specific area of research, which is often accompanied by fieldwork.

### 3.1. Time-to-completion

Disparities between the social and natural sciences result from their respective differences in epistemological styles of thought, characteristic modes of discourse, pedagogical paradigms and modes of social organization (Snow, 1964; Kemp, 2009). Most evident is the difference in their respective academic timetables. Over the last three decades, doctorate completion times have increased in virtually every disciplinary field (Cude, 2001). The rate of increase, however, has not been constant throughout all fields but varies in part according to the differences in expectation about the rate of progress through the degree program and the intended purpose of the dissertation (Tuckman et al., 1990; National Research Council, 1995). In the natural sciences, where students are generally engaged collaboratively with the faculty in research projects, time to doctorate completion is shortest. In the social sciences, however, where research activity is less collaborative and more individual, doctoral completion is considerably longer.

In the U.S., the median registered time to obtain a doctoral degree in the life sciences increased from 5.9 years in 1979 to 6.9 in 2003. For the humanities, this increased from 7.5 to 9.0 years during the same time period (National Science Foundation, 2006). In Canada, the 2003 final report of the Graduate Students Association of Canada noted that the median registered time-to-completion of the Ph.D. for chemistry and biology was 7.2 and 7.6 years, respectively, and that of sociology 8.2 years (Elgar, 2003). These numbers for North America represent the summation of both Master’s and doctoral programs since the former is usually, but not always, a prerequisite for the latter. It should also be noted that these figures reflect only registered time-to-degree, not total time-to-degree which does not account for temporary leaves of absence or time off between degrees.

In the UK, students specialize in a subject at an earlier stage in their education and consequently have shorter time-to-completion rates. This is also due to a policy adopted by several UK funding agencies since the early 1950s to penalize departments with large numbers of Ph.D. students who fail to submit their thesis after four years (HEFCE, 2007). The percentage of students who needed to revise substantially after a quick submission had been noted by some British universities, raising legitimate questions as to whether faster completion should be forced at all (Cude, 2001, p. 21). This also raises concerns regarding the quality of disciplinary research that can be accomplished within reformed time constraints.

The majority of manuscripts submitted to the JEP originate from China, followed by India. The rich and complex traditional medical systems of these nations present near-limitless research venues for ethnopharmacologists. However, most of the initial submissions from China and India do not include adequate ethnographic background. Oftentimes, a statement that the plant (or organism or compound preparation) of interest has been used for centuries to treat a certain disorder is all that is included. Since Traditional Chinese Medicine and Ayurveda are well documented systems, literature sources can be consulted to provide more detailed context. Doing so substantially reduces costs associated with ethnological field research and reduces the duration of graduate studies without compromising interdisciplinarity.

Because of China and India’s important contribution to ethnopharmacology, their higher education systems in relation to time-to-degree differences between the social and natural sciences warrants examination. Unfortunately, such data is not readily available. In China, the average time to complete a Master’s degree in all disciplines is three years, and for a Ph.D., between three and seven years. Since 1997, the State Education Department had revised the number of undergraduate disciplines from more than 600 to 270 in the hopes of addressing the limitations of discipline-based systems and providing students with a broader range of knowledge. Consequently, in most Chinese universities, students who major in natural science and technology are asked to obtain 10 credit hours in the humanities and social sciences, while humanities and social science majors require 6 credit hours in the sciences (Ouyang, 2004).

In India, a Master’s degree normally takes two years to complete, followed in some subjects by the Master’s of Philosophy (M.Phil.), a pre-doctoral program that is either research-based or can include some course work. The Ph.D. degree is awarded two years after the M.Phil. or three years after the Master’s degree (Agarwal, 2006). Although up-to-date statistics for time-to-degree could not be found, 45.1% of students who entered higher education enrolled in arts whereas 20.4% and 7.2% enrolled in science and engineering & technology, respectively, during the 2004/2005 academic year. In that same year, 42.1% of all Ph.D. recipients were awarded a doctorate in arts, 31.0% in science and 5.4% in engineering & technology. This reflects in part the growing participation of
women in higher education and their interest in such social science fields as economics, finance, art, communications and media (University Grants Commission, 2006).

The contemporary educational system of China and India is particularly notable for the internationalization of its universities. China has more students studying abroad than any other country in the world, encouraged by the prestige of holding a postgraduate degree from one of the more prominent universities in Europe, North America or Australia (Brandenburg and Zhu, 2007). China was the leading place of origin for international students in the U.S. in 2009/2010, a 30% increase from the previous year, followed by India which was up 2%. The top fields of study were business and management (21.1%), engineering (18.4%), physical and life sciences (8.9%), math and computer science (8.8%), followed by social sciences (8.7%) and fine arts (5.2%). Interestingly, social science (21.5%), humanities (13.3%) and fine arts (8.4%) were the top fields of study for U.S. students studying abroad (Institute of International Education, 2010).

The increase in total time needed to complete a Ph.D. in social science cannot be attributed to a single factor, but rather to a combination of six broadly based theories according to Tuckman et al. (1990) (Table 1). Although these factors may explain the trend of increasing total time to the doctorate across all fields, they do not adequately address the large discrepancies between the social and natural sciences. In relation to the epistemic factors, it seems unlikely that growth in the knowledge base alone can explain a large increase in total time in one field and a relatively small increase in the other. Likewise, it is not clear how institutional factors, such as declining enrollment in some institutions which create an incentive to keep students longer, explain inter-field variability. Among demographic variables, age is an important factor to consider since older students spend more time registered in graduate school than their younger counterparts (Tuckman et al., 1990). Indeed, the average age of students in the social sciences at graduation was 38 (95% CI = 37–39), compared to 32 (95% CI = 32–32) for those in the biological sciences, which may be partly due to social graduates being older when they begin their doctoral programs (Gluszynski and Peters, 2005).

The financial variable on the other hand is significant in that funding sources and policies differ between the social and natural sciences. Several foundations, fellowships and awards have strict guidelines and limitations concerning the scope of research which can be undertaken when considering potential grants and proposals. Adhering to these guidelines can be tricky for interdisciplinary research proposals. For example, Prance (1991) recounts how an interdisciplinary approach to conduct a quantitative ethnobotanical inventory among the Kuikuru Indians was rejected by the U.S. National Science Foundation on the grounds that it was too anthropological for consideration by the systematic biology section, while at the same time, too botanical for the anthropological section. Consequently, the project was postponed for eight years, the population of interest was eventually substituted with other South American groups, and funding was finally obtained from a private foundation.

### 3.2. Financial considerations

While some students in the natural sciences obtain funding from external sources through competitive processes, significant portions are funded under their supervisor’s grant. Indeed, the major form of graduate student support for American science and engineering agencies is indirect, through research assistantships rather than direct fellowships or traineeships (National Science Foundation, 2008). Grant applications must be submitted at set intervals and their success depends on the completion of research and its publication supported by previous applications. The student supported therefore has a direct financial interest in the successful and timely completion of their work. The cost of the work in social sciences, however, is rarely covered from research grants obtained by the supervisor. Instead, most funding is from government, private foundations or universities in the form of fellowships and bursaries. Since social science students are infrequently supported under their supervisor’s grant, timely completion of work is irrelevant in regards to the validation of the next grant application (Leyerle, 1986). Indeed, the type of financial support the student receives largely influences their time-to-completion. Students with fellowships and research assistantships have higher completion rates and shorter time-to-degree than students with teaching assistantships, tuition waivers, or those who support themselves (Ehrenberg and Mavros, 1995; Siegfried and Stock, 2006). This was also observed in Germany even when parental or private transfers and student aid recipients were awarded the same amount of financial aid (Glocker, 2011).

For funding bodies that support graduate research, recognition of longer completion times in the social sciences has invoked a discrepancy in the period of time eligible for financial support. In Canada, the Social Science and Humanities Research Council of Canada (SSHRRC) offers financial support to a PhD candidate for up to four years whereas the duration of a Ph.D. award from the Natural Science and Engineering Research Council of Canada (NSERC) is between two and three years (CIHR, 2009). The Evaluation & Analysis Branch of the Canadian Institutes of Health Research (2009) acknowledged that funding duration was far too short for average time-to-completion rates but expected this to increase incentives to complete studies within a certain time period. Indeed, a 2003–2004 survey of earned doctorates report that on average, doctoral graduates completed their degrees in about six years and for those in the humanities and social sciences, in about seven years (Gluszynski and Peters, 2005). However, the report found that funding duration had little effect on the likelihood of shortening the time-to-completion but rather had a measurable impact on student total income. This suggests that once direct funding is exhausted, students rely on indirect funding (through their supervisor’s grant), paid work or personal funds.

### Table 1

Factors that influence time-to-completion for a university degree.

<table>
<thead>
<tr>
<th>Factor</th>
<th>Description</th>
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<tr>
<td>Epistemic</td>
<td>Assumes that students need more time to learn, absorb and retain information from an increasing body of knowledge.</td>
</tr>
<tr>
<td>Institutional</td>
<td>Assumes that factors such as goals and commitments, student-faculty interactions, sociability of students as they relate to the university and/or departmental environment, affects time to doctoral completion.</td>
</tr>
<tr>
<td>Student preference-based</td>
<td>Assumes students consciously extend their graduate years because they prefer the university environment and student lifestyle such that more time is allocated to nondoctorate-related activities.</td>
</tr>
<tr>
<td>Financial need-based</td>
<td>Assumes that students are faced with increased financial pressures which are not adequately met by federal or university financial aid, requiring students to seek outside employment and consequently extend their thesis work.</td>
</tr>
<tr>
<td>Demographic and ability-based</td>
<td>Assumes that total time to a doctorate is affected by the trend of increased percentage of older, foreign, minority and women students in attending university today.</td>
</tr>
<tr>
<td>Market-based</td>
<td>Assumes that total time to a doctorate is affected by employment opportunities, the absolute salaries of doctorate holders, relative salaries and the rate of return to alternative careers.</td>
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</table>
In the UK, some postgraduate positions in both the natural and social sciences come with funding attached. These studentships are primarily funded by the seven UK Research Councils and are often included as part of the university application process. In their 2007 report on Ph.D. completion rates, the Higher Education Funding Council for England reported that although the most common source of sponsorship for full-time students was the Research Councils, the majority (58%) of students beginning their Ph.D. program had no financial backing at all. When factors such as the student’s age, ethnicity, domicile, disability status, previous qualifications, and subject area were taken into account, a large discrepancy in completion rates was observed between sponsored and non-sponsored students. Whereas 84% of those with Research Council funding completed their Ph.D. in less than 10 years, only 68% of those with no financial backing had completed their degrees (HEFCE, 2007). The report also noted longer completion rates in the social sciences relative to the biological sciences but did not measure the source of funding according to subject area of study.

Data on funding differences between the social and natural sciences in China and India were not readily available, but as two of the world’s largest emerging markets, the links between their economies, market forces, and higher education systems have tightened significantly. This means that students need to calculate the costs and benefits of higher education very much more carefully. Since students and their families are generally unable to afford higher education, China has introduced five types of student assistance programs that form the entire student financial aid system: scholarships, grants, work-study, tuition waivers, and loans. Scholarships are offered by central and local governments, institutions, social organizations, and individuals to students with excellent performance and not necessarily to those in financial need. Two types of grants on the other hand, the state and the institutional grant, are specially provided for those in financial need. In a survey of 100,000 students, Shen (2009) found that more than half (57%) received loans that averaged 4739 Yuan (US$ 720), 28% received grants averaging 843 Yuan (US$ 128), and only 12% received competitive scholarships that averaged 1201 Yuan (US$ 183). Considering that tuition is on average 4507 Yuan (US$ 685), the national loan and scholarship scheme has a narrow coverage that bestows a limited, often inadequate, amount to borrowers and recipients.

In India, decreased public funding and increased enrolments in higher education institutions have deteriorated academic standards, introduced and raised tuition fees, and prompted the emergence of a number of private institutions that are not properly regulated. Consequently, the opportunities for higher education are beyond the reach of a large section of the population. A large variety of grants, scholarships, free-ships and student loan programs are available to students, although like China, the overall coverage is considered insignificant. Scholarships sometimes do not cover full tuition or are sometimes not received on time. Differences in the amounts granted to social versus natural science students, and their duration, vary according to the type of award. Scholarships may be offered based on merit, need-based, are student-specific or career-specific. India offers more than 100 scholarships and fellowships, and about fifty international scholarships. As for student loans, less than 100,000 out of 3.5 million students in 2005 received one, a mere 2–3%. In comparison, 85% of students in the UK and Sweden, 50% in the U.S. and Canada, and 77% in Australia made use of student loans. As part of its 11th Five Year Plan 2007-2012, the Parliamentary Standing Committee of the central government has recommended the urgent formation of an Educational Development Bank of India to help those in financial need (Government of India Planning Commission, 2006). However to date, little progress has been made. Currently, India has one of the world’s lowest public expenditure per student. While developed countries spend close to US$10,000 per student per year, developing countries spend less than US$1000. Taking currency adjustments into account, India spends a mere US$400 per student while China spends US$2728 per student (Agarwal, 2006).

Regardless of the university or the country it finds itself in, the type and amount of funding will have considerable impact on a student’s time-to-degree and this will have presumable consequences on the degree of interdisciplinarity that can be achieved for a thesis. For any ethnopharmacologist who wishes to collect ethnographic data first-hand, the most expensive, time-consuming venture they can undertake is fieldwork.

3.3. Fieldwork

International fieldwork is a time-consuming endeavor regardless of whether it is conducted by a social or natural scientist since it entails extensive preparatory work in addition to on-site data collection. Since standard protocol usually requires collaboration with a host institute prior to the commencement of any intended international study, it usually falls upon the graduate student to set up and arrange for the appropriate documentation and required permits to conduct fieldwork, research, collection, and exportation of plant or animal material. Once on site, it is usually recommended that the field investigator spend time gaining entry and establishing rapport with the indigenous group in order to create an atmosphere of trust before any actual fieldwork takes place. Once commenced, the successful collection of anthropological and ethnobotanical data requires a close and sustained engagement with the population, which can only be achieved by long-term participation in local customs and daily life. Any biobehavioural patterns and plant use in relation to seasonality, special events or festivals, can also be identified through prolonged fieldwork (Alexiades, 1996). Studies carried out in a few weeks or months have an increased risk of producing misleading results (Cotton, 1996).

Ethnobotanical fieldwork has two broad components: the collection of biological material and the acquisition of information on how these materials are traditionally employed, prepared and viewed. A natural science student is obliged to produce quantitative data in order to fulfill degree requirements, and so it is crucial to acquire biological specimens as experimental substrates. The acquisition of qualitative data on the other hand, is rarely a degree requirement. In light of shorter timeframes and limited funding, collection of adequate ethnographic data is the most expensive aspect of an ethnopharmaceutical investigation. Consequently, what was originally positioned as ethnopharmacology becomes a straightforward pharmacologic inquiry, utilizing indigenous plants as potential leads.

The most effective means to remedy this pattern is to alleviate some degree of temporal and financial pressure, particularly for the natural science graduate student. One approach is for funding agencies to provide additional support for projects entailing international fieldwork. The U.S. National Science Foundation fellowship program, for example, offers a one-time international research travel allowance for fellows who plan to study or conduct research full-time at a foreign site for at least three continuous months. In addition, for fellows wishing to conduct research in close cooperation with a host country investigator, the NSF Division of International Programs considers additional support for foreign travel and subsistence and for other expenses related to the international collaboration. In Canada, the International Development Research Council offers a variety of competitive awards to support 3–12 months of international fieldwork. These and similar supplements offered by funding agencies are granted on a competitive basis and should be considered seriously by postgraduate students undertaking fieldwork.

Collaboration is another means to ensure adequate ethnographic context to laboratory data. Although technically a
multidisciplinary approach, collaboration pools resources to leverage the cost of expensive scientific equipment, trained specialists, and fieldwork. Analysis of publication patterns show that collaboration between researchers from different professional backgrounds. Leschenault de la Tour, a botanist who published his account of the Javanese dart poison *Opus tietué* (Strychnos sp.) in 1811 had collaborated with pharmacologists Pelletier and Caventou who had isolated strychnine as the active component in 1824, having previously isolated the compound in 1819 from *Strychnos nux-vomica* (Holmstedt, 1991). Although the term ethnopharmacologist had not been coined until 1867, neither scientist would have been considered one, since such a designation implies a scientist qualified to bridge the gap between the social and natural sciences.

4. Approaching interdisciplinarity from a disciplinary framework

The ability to think across disciplines is an important attribute that must be developed by the interdisciplinary student and should be encouraged in face of the strict discipline-oriented infrastructure of contemporary academia. This encouragement is not necessarily contingent on administrative-structural changes but rather in the cultures and attitudes which are only partly embodied in policy. Anyone who wishes to be involved in interdisciplinary work, whether faculty staff or student, must begin with change in thought and action. Not only will this develop tolerance and understanding in an individual interdisciplinary researcher, but in collaborative team efforts allow the researcher to see themselves as a part of a network that attaches respect to relationships, connections and community.

The strategy we recommend to students would be to formulate their interdisciplinary research from a home discipline, allowing them to tailor their courses and training according to their thesis topic. Pre-designed interdisciplinary graduate programs have the potential pitfalls of privileging breadth over depth. Certainly some interdisciplinary programs provide a solid foundation for specialized learning, link theoretical and applied learning, and engage in real-world problems, cultures and environments. However such programs carry the risk of jeopardizing the career prospects of young scholars who lack a required depth of knowledge. Ultimately, the deciding factor is not how interdisciplinarity is practiced, but how successful one finds a job, whether in academia, non-government organizations, or in private industry. Would a trained ethnopharmacologist have more success at securing employment compared to specialist members of a collaborative research team? There are no pat answers to these questions.

In regards to financial and time constraints, until ethnopharmacology becomes its own university department, students must maneuver within their home departmental policies and procedures to procure the necessary means and resources to conduct fieldwork and obtain adequate ethnographic data to properly contextualize laboratory findings. The interdisciplinary standards of ethnopharmacology can be maintained successfully whether it is practiced by a single researcher with cross-disciplinary training, or a collaborative effort between researchers in different departments. The decision is up to the student, their supervisor, and their department.

The ideal goal of a postgraduate student is to work in an area that is personally, academically and professionally rewarding. Few disciplines allow the opportunity to expand one’s experience into other fields and encourage close relationships with foreign cultures more than the ethnosciences. Such experiences allow greater insight into the human condition and inevitably enrich one’s personal growth. The fact that ethnopharmacology is interdisciplinary is attractive for many students; however, it is precisely this attribute that makes this science more challenging and as a result requires careful attention to design, execution and analysis.

Conflict of interest statement

The authors have no conflict of interest.

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