

Experimental Onomatopoeia Research in a Language Contact Situation: Some Methodological Considerations

Olga Lovick*, Rosalie Tsannie-Burseth, and Alora Bazylak
University of Saskatchewan, Canada

In this paper, we report on our experiences conducting experimental research on onomatopoeia in Dēnē Sųlíné, an Indigenous language spoken in northwestern Canada. The experiment, aiming to investigate aspects of onomatopoeia in a typological perspective, was designed by researchers at a European university and successfully piloted with students there. However, running this experiment with speakers of Dēnē Sųlíné in Saskatchewan (Canada) necessitated several adaptations due to intertwined issues of bilingualism, Indigenous language literacy, and the legacy of Canada's assimilative policies toward Indigenous peoples. We show that relatively small adaptations (moving away from written experiment instructions; audio-recording participant responses; utilizing the participants' bilingualism to improve response accuracy) result in a setting that ensures the participants' cultural safety while maintaining experiment integrity. We suggest that using such a self-reflexive approach is a promising tool to counter the persistent underrepresentation of Indigenous language in experimental research, and encourage designers of cross-linguistic experiments to remain open to methodological adjustments.

Keywords: Dene/Athabaskan languages; onomatopoeia; experimental research; cultural safety.

1 Introduction

Indigenous languages remain underrepresented in experimental research, as pointed out over a decade ago by Anand, Chung, et al. (2011). They observe that experimental methods¹ rely on what they term 'cultural felicity conditions': research conditions that are natural to the individuals designing the experiment but not to the potential participants from different cultural backgrounds. This dearth of experimental research in Indigenous languages is particularly pronounced in North America, with only a handful of published studies outside the area of phonetics/phonology. To our knowledge, the causes (in addition to the 'cultural felicity conditions' mentioned by Anand et al. 2011) are addressed explicitly only by cognitive linguist Sally Rice, who points to a lack of Indigenous language literacy (a concern echoed in Sedarous and Namboodiripad 2020), a participant pool that includes a wider age-span of speakers than in majority languages, and the polysynthetic nature of many Indigenous languages, which has implications for experiment design (S. Rice et al. 2002:483). These three challenges are present in all published accounts of experimental research for Indigenous languages of North America that we were able to access (see, e.g., McDonough and Willie 2000 for Navajo; S. Rice et al. 2002 for Dēnē Sųlíné; Christianson and Ferreira 2005 for Odawa; or Sherkina-Lieber et al. 2011, and Sherkina-Lieber and Helms-Park 2015 for Inuttitut): all address explicitly the polysynthetic nature of the language studied as a factor in experiment design (and often an investigation into word formation is the experiment's objective); all rely on auditory rather than written stimuli; and the participant pool for all include middle-aged and older speakers. These

* Corresponding author.

¹ They discuss experiments in the context of psycho- and neurolinguistics, but their points are applicable more broadly.

studies additionally had in common that all participants are bilingual with English or French, and that the experiment was designed explicitly for research on this particular language, i.e., not part of a larger cross-linguistic study with comparable research protocols applied to other languages. As we show in the present article, adapting such a cross-linguistic experiment to Dënë Sųlíné involves not only tackling the issues identified by S. Rice et al. (2002), but also confronting additional challenges. Specifically, the particular type of bilingualism resulting from linguistic marginalization and colonial policies, which is present for most speakers of Indigenous languages of North America, creates further obstacles for including these languages in experimental research. Taken together, these factors may be responsible for the low level of representation of Indigenous languages from this continent in cross-linguistic experimental studies.

Our goal here is emphatically not to critique the original experiment's methodology, but to offer the lessons we learned from our attempts of running this experiment to others who are adapting cross-linguistic experiments to Indigenous research settings. Grounding ourselves in the concept of *cultural safety*, we describe a reflexive methodology that emphasizes the well-being of experiment participants while safeguarding the integrity of the experiment. We also offer recommendations for future work. On the one hand, we believe that this reflexive process can be adapted to other situations where cross-linguistic experiments have to be modified for local context. On the other hand, we echo Sedarous and Namboodiripad (2020) and the contributions in Kutlu and Hayes-Harb eds. (2023) in interrogating how linguistic experiments are initially designed so as to ensure broad representation of participant groups.

2 Background

2.1 Positionality

Author 1: I have spent almost equal portions of my life in Europe and North America. The first half, which includes my formal education as a linguist, was spent in Germany; the second half, which includes my practical experience working with Northern Dene languages, was spent in Alaska (USA) and Saskatchewan (Canada). I am on an on-going learning journey of how to do linguistic research in a good way. As a new Canadian, I make an effort to step lightly on these lands and to build respectful and strong relationships with its original stewards.

Author 2: I grew up in Wollaston Lake in northern Saskatchewan and am fluent in Dene, both speaking and writing using Roman Orthography. My parents immersed me in a Dene cultural environment until I attended St. Michael's Residential School in Duck Lake, where my fluency was disrupted because I was forbidden to speak Dene. As a result, I have dedicated myself to revitalizing and strengthening the Dene language and culture. In Wollaston Lake, when I first began to teach, all students arrived at school speaking only Dene. Now, primary school aged children are using English more frequently than Dene; subsequently, I collaborate with teachers and Dene language advocates to promote and enrich our language.

Author 3: I approach this research as a citizen of the Métis Nation–Saskatchewan and a recent graduate with a Bachelor of Science in biomedical neuroscience with an additional focus on linguistics. This fall, I will begin my master's in Speech-Language Pathology at the University of Saskatchewan. Although I am an Indigenous Canadian and participate in Métis cultural events and practices, I am not a native speaker and approach this research primarily from an academic perspective. I recognize that the experiences of Dënë Sųlíné people are distinct from my own, and that sharing culture in an academic setting can be a vulnerable and challenging experience that requires respect and reciprocity.

2.2 Cultural safety

Our approach to conducting experimental research is grounded in the concept of *cultural safety*.² This concept originates in health care, where it seeks to “eliminat[e] Indigenous and ethnic health inequities” (Curtis et al. 2019:2) by analyzing power imbalances, institutional discrimination, colonization and colonial relationships between patients and their care providers (National Aboriginal Health Organization 2008:3). Drawing on the First Nations Health Authority framework, we adapt several key elements of cultural safety to experimental linguistic research as outlined in Table 1.

Table 1: Cultural safety in Indigenous health (left column) and Indigenous language work (right column)

Key elements of cultural safety from First Nations Health Authority (First Nations Health Authority n.d.: 12)	Adapted to linguistic research
Recognizing the role of history and society and past traumatic experiences, and their impacts in shaping health, wellness and health care experiences;	Recognizing the role of history and society and past traumatic experiences, and their impacts <i>in shaping individuals’ linguistic repertoire and experiences relating to language</i> ;
It requires having an understanding of how colonization has impacted and continues to impact First Nations peoples’ health, rather than just having an understanding of specific cultural practices ...;	It requires having an understanding of how colonization has impacted and continues to impact <i>Indigenous peoples’ languages</i> , rather than just having an understanding of specific <i>Indigenous languages</i> ...;
An understanding of what health and wellness means to First Nation individuals with recognition of the diversity of these understandings;	An understanding of what <i>Indigenous languages</i> mean to First Nation individuals with recognition of the diversity of these understandings;
Health care professionals’ self-reflection on their own assumptions and positions of power within the health care system;	<i>Linguists’</i> self-reflection on their own assumptions and positions of power within the education system;
Emphasizing peoples’ experiences of safety within the health care system and during interactions with health care professionals....	Emphasizing peoples’ experiences of safety within the <i>education</i> ³ system and during interactions with <i>linguists</i> ...

In developing our methodology, we also paid attention to what might constitute *unsafe cultural practice*, i.e. “any action that diminishes, demeans, or disempowers the cultural identity and well-being of an individual” (Wepa 2003:340). As we discuss below, there were places where the cultural safety of participants was potentially threatened.

² Research with human participants in Canada is generally governed by the Tri-Council Policy Statement (TCPS2 2022); research pertaining to Indigenous issues ideally additionally adheres to the First Nations Principles of OCAP(R) (First Nations Information Governance Centre 2026). These frameworks inform our research process but are not further discussed in this paper.

³ As discussed further in 2.3, the education system is heavily implicated in the situation of Indigenous languages in Canada; hence we changed “health system” to “education system” in Table 1.

2.3 *Socio-cultural context*

Research with Indigenous language communities in Canada involves navigating the complex and lasting impacts of federal assimilation policies. These policies continue to shape trust, community well-being, language vitality, and relationships between Indigenous communities and researchers, making culturally safe research practices essential.

Most notorious among those policies is the Residential School System, where Indigenous children were forcibly removed from their families and sent to distant schools which forbade traditional languages and practices. These schools were “a systematic, government-sponsored attempt to destroy Aboriginal cultures and languages and to assimilate Aboriginal peoples so that they no longer existed as distinct peoples” (Truth and Reconciliation Canada 2015:153). From 1831–1997, Indigenous children endured widespread abuse in residential schools, contributing to intergenerational trauma and disrupting language transmission. As a result, present-day Indigenous language speakers often have varying levels of fluency and differing opportunities to learn and use their traditional languages.

Residential schools were only one component of many broader colonial policies designed to suppress Indigenous languages. The Indian Act (1876) reinforced colonial assimilation policies through highly restrictive measures that pressured Indigenous peoples to abandon their traditional languages and cultures. The Official Languages Act (1969) recognized only English and French as official languages, further marginalizing Indigenous languages. Although the Indigenous Languages Act (2019) aimed to support language revitalization, it is criticized for failing to provide Indigenous languages with equivalent recognition and support, limiting Indigenous language use in education, public services, and employment.

These colonial policies contribute to intergenerational trauma and disrupted Indigenous language transmission. After decades of punishment for speaking their languages, many Residential School Survivors came to rely on English and encouraged their children to assimilate to protect them from further harm (Twitchell, 2018). As a result, many Indigenous languages are now severely endangered or have required significant revitalization efforts, despite having a central role in Indigenous identity (see Meek 2007, 2010; Twitchell 2018). These impacts highlight the importance of culturally safe research that respects Indigenous histories and perspectives.

2.4 *Dëñë Sų́líné*

2.4.1 *Sociolinguistics and bilingualism*

Dëñë Sų́líné is a Dene (Athabaskan) language spoken in the Northwest Territories, Alberta, Saskatchewan, and Manitoba (all Canada). It is one of the most vital Indigenous languages of Canada; the latest census reports around 10,000 speakers, about half of whom reside in Saskatchewan, where the study was conducted. Dëñë Sų́líné speakers can be found both in remote northern communities and in urban centres. Even ten years ago, Dëñë Sų́líné was learned as a first language in some communities in that province (Jung et al. 2018) and Dëñë Sų́líné remains the main language in several remote communities. Bilingualism with English is widespread to the point of there being now very few monolingual Dëñë Sų́líné speakers. Wiens (2014: chap. 5) analyzed Dëñë Sų́líné-English bilingualism by domain. Her findings are summarized in Table 2:

Table 2: Domains of Dënë Sųłiné and English in Dillon, SK following Wiens (2014: chap. 5)

Domains associated with use of Dënë Sųłiné	Domains associated with use of English
Tradition, culture and the land	Schooling and education
Elders and the old days	Technology and devices (radio, TV, internet)
Spirituality	Government (federal and provincial, sometimes local)
Local communities (especially remote/northern ones)	The world outside Dënë Sųłiné communities
Mainly restricted to oral language use	Used extensively in writing

The last of these points—the lack of written Dënë Sųłiné—merits more discussion, as it has direct implications for our methodology. Jung et al. (2018:59) observe that “Dene Sųłiné has no entrenched tradition as a written language”, noting that differences in writing systems, linguistic variation due to dialects and language change, incomplete standardization of local varieties, and the general perception that Dënë Sųłiné is an oral (rather than written) language are contributing factors to the dearth of written Dënë Sųłiné materials. Finally, as Dënë Sųłiné literacy is generally much lower than English literacy, the written Dënë Sųłiné of many fluent speakers is heavily influenced by English spellings. We return to the challenges this poses for our methodology in section 4.

2.4.2 Linguistic overview

Dënë Sųłiné has the large phoneme inventory typical of a Dene language. It distinguishes voiceless unaspirated (b, d, ddh, dz, dl, j, g, ʔ), voiceless aspirated (p, t, tth, ts, tł, ch, k), and ejective (t', tth', ts', tł', ch', k') oral stops and affricates and has a voicing distinction in fricatives (dh/th, z/s, lł, sh, gh/hh, h). There are two nasal consonants (m, n) and two approximants (w, y). It has six-vowel system with five full (i, e, a, o, u) and one reduced (ě) vowel which varies phonetically [ɛ~ə~ʌ] depending on speaker and surrounding consonants. High tone (marked by acute accent) and nasality (marked by an ogonek) are phonemic, while vowel and consonant length are not distinctive. All data in this paper is presented in the practical (albeit only partly standardized) orthography used in Saskatchewan.

The Dene language family is renowned for its complex verbal morphology. It is polysynthetic, overwhelmingly prefixing, and up to three arguments can be marked on the verb. Most relevant for the current paper is the fact that Dene languages tend to have very small inventories of lexical roots. The largest inventory recorded is that of Koyukon with 1,778 roots (Jetté and Jones 2000:xiv); scholars working with other related languages report similar numbers. Roots combine with lexical and derivational prefixes to form discontinuous lexical entries called *verb themes*. As shown by K. Rice (2020), these verb themes are not necessarily compositional as both stems and prefixes often have very abstract meanings. This is illustrated in (1).⁴

⁴ Abbreviations: AREAL—areal participant marker, ASRT—assertive, CNJ—conjugation marker, CONT—continuative, EMPH—emphatic marker, IPFV—imperfective, LEX—lexical prefix, NEG—negative, ONOM—onomatopoeia, PFV—perfective, PL—plural, PO—postpositional object, QUAL—qualifier, UNSP—unspecified, S—subject, SG—singular, VV—voice/valence marker.

Glossing note: many categories are formally unexpressed; these are not represented in the morpheme breakdown and glosses. See Hargus et al. (2020) for discussion of different considerations in glossing Dene languages.

- (1) *yě-k'ě-ná-dhër*
 3S>3PO-on-CONT-SG.experiences.IPFV
 ‘s/he is bothering/fighting him/her, s/he is engaging in sexual activity with him/her, s/he is harrassing him/her [e.g. on social media]’

The stem *dhër* is very abstract; (Kari 1990:457) glosses its Ahtna cognate as “sg S experiences event involving abstract process (time, environment, emotion); time passes; cause event to happen to sg O”. He further notes that “a wide range of meanings are obtained in derivatives” (ibid.). In Dënë Sųliné, this verb stem occurs in lexemes meaning ‘sg. start (itr., tr.), sg. die, sg. kill, sg. be leftover, sg. become sick’ and many others.

The small morpheme inventory has several consequences that are important to the present paper. First, as illustrated again by *yěk'ěnádhër* ‘s/he is bothering/fighting him/her, s/he is engaging in sexual activity with him/her, s/he is harassing him/her [e.g. on social media]’, lexical entries can be highly polysemous, such that the appropriate meaning can only be determined from context. We return to this point in section 4.5. Second, most lexical entries are built through layers of derivation, which is often predictable and regular. As we show in the following section, these derivational processes are involved extensively in the creation of sound-describing words.

2.5 Onomatopoeia in Dene languages

Most Dene languages have (at least) two types of onomatopoeias. There are unanalyzable words imitating sounds (called ‘primary onomatopoeias’ in Körtvélyessy and Štekauer (2024)) as well as a verb class of onomatopoetic verbs characterized by a particular set of prefixes and a verb stem imitating the sound. Both are illustrated in (2), taken from Upper Tanana Dene (Lovick 2024:710).

- (2) Upper Tanana Dene
 a. *tsqot*
 ‘squeaking sound of a mouse’
 b. *shahtsadrn de-l-tsqot*
 mouse QUAL-VV-squeaking.sound.IPFV
 ‘the mouse goes ‘tsqot’, the mouse squeaks’

Example (2) illustrates that the same stem can be used in both types of onomatopoeias, but Lovick (2024:710) notes that it is unclear whether this is true of all sound-imitative stems in Upper Tanana.

Both types of onomatopoeia are attested in Dënë Sųliné, sometimes even within the same utterance. Examples are given in (3). Example (3a) illustrates an onomatopoetic verb, (3b) a primary onomatopoeia, and (3c) contains both types for the same sound event. All examples in (3) come from the Talking Dene corpus (see Willems and Lovick forthcoming for a description of the corpus).

Corpus data is cited with its corpus identifier consisting of speaker abbreviations separated by hyphens, the recording date, and the utterance number. E&E refers to data gleaned from Elford and Elford (1998). The remaining data comes from elicitation with the second author.

- (3) Types of onomatopoeia in Dënë Sųliné
- a. *ě-rě-l-dzēs* *ó ja*
UNSP.S-QUAL-VV-shattering.noise.ipfv ASRT here
‘there was a shattering noise [from smashed windows] here’
RAN-ETM-2022-11-28:1056
- b. *yazē hi-t’ús á llp⁵ há-s-lá*
a.little PFV.1SG.S-lick:PFV ASRT ONOM LEX-PFV.1SG.S-do.PFV
ú ěsjie thē-kam s’
and wow CNJ-be.tasty.IPFV EMPH
‘I licked a little bit, I went **llp** [slurping noise], wow was it ever so good!’
SUH-NET-2020-03-28
- c. *bbbúdhhdh sē-k’ě ě-r-ě-l-júr hōsa*
ONOM 1SG.PO-ON UNSP.S-QUAL-PFV-VV-boom.PFV ASRT
hotié darłt’éth hicho
very loud.sound big
‘**Bbbúdhhdh**, something **boomed** next to me, really loud.’
ITR-UHC-TOR-ETM-2022-10-30

Onomatopoeic verbs such as the one in (3a) are quite common in the Talking Dene corpus, whereas primary onomatopoeias such as *llp* ‘slurping noise’ and *bbbúdhhdh* ‘sound of gun going off’ in (3b, c) occur mainly in dramatized speech situations. Commentary from the second author confirms this impression: onomatopoeic verbs are sound descriptors used in everyday speech, while primary onomatopoeias have expressive functions and occur more frequently in storytelling and other dramatized contexts.

(3c) has another interesting property: the primary onomatopoeia *bbbúdhhdh* ‘sound of gun going off’ was omitted from the original transcript. The verbal onomatopoeia *ěrěljúr* on the other hand was included, with the gloss ‘loud bang’. There are some other instances in the corpus of ‘missing’ primary onomatopoeias, while verbal ones are usually represented. Transcribers are instructed to include all linguistic items; the omission of primary onomatopoeias, along with non-verbal cues such as laughter or groaning, may suggest that at least some transcribers view primary onomatopoeias as being less central to their language.

As noted above, derivational processes are highly productive and often regular. There are strategies to derive sound-describing verbs from other words. Example (4) illustrates how such verbs can be created from stative verbs expressing property concepts.⁶ The sequence *darł-* in (4) is what (Kari 1979) calls a *prefix string*, i.e. a set of prefixes with identifiable meaning (in this instance ‘a sound event with the properties expressed in the stem’) and particular grammatical properties (in this instance, another stative verb).

(4)	Basic verb	Derived verb
a	<i>ně-zų</i> QUAL-be.nice.IPFV ‘it is nice, good’	<i>da-r-l-zų</i> sound-QUAL-CNJ-be.nice.IPFV ‘it is a pleasant, melodious sound’
b	<i>ně-cha</i> QUAL-be.big.IPFV	<i>da-r-l-cha</i> sound- QUAL-CNJ-be.big.IPFV

⁵ This onomatopoeia was originally transcribed as *lúupa*, which reveals transcriber judgments about acceptable syllable structure.

⁶ Dene languages tend to have very few adjectives; most property concepts are expressed by verbs.

	‘it is big’	‘it is a big (=loud) sound’
c	ně-chilë QUAL-be.big.IPFV.NEG ‘it is small’ (lit.: ‘it is not big’)	dar-čhilë sound-QUAL-CNJ-be.big.IPFV.NEG ‘it is a small (=quiet or low-pitched) sound’
d	n-ɪ-tl’édh QUAL-CNJ-be.strong.IPFV ‘[it is] strong and great, mighty and powerful’ (e&e 1998:202)	da-r-ɪ-tl’édh sound-QUAL-CNJ-be.strong.IPFV ‘it is a strong (=extremely loud or high) sound’
e	ho-r-ě-l-yə areal.S-QUAL-CNJ-vv-be.fun.IPFV ‘it is fun’	bě-da-r-ě-l-yə 3SG.PO-sound-QUAL-CNJ-be.fun.IPFV ‘it sounds beautiful’

(5) illustrates that the prefix string *děl-* or *děl-*⁷ can derive sound descriptors from non-stative verbs (5a, b), stative verbs (5c) and nouns (5d). And while in most instances a derivational pathway from the left to the right columns can be assumed in (4) and (5), the opposite pathway may be appropriate for (5b), as cracking logs in a fire significantly pre-date guns.

(5)	basic verb/noun	derived verb
a	ná-ɪ-dzēs LEX-PFV-shatter.PFV ‘it (leg bone) shattered’ (ITR-UHC-TOR-ETM-2022-10-30:1011)	ě-rě-l-dzēs UNSP.S-QUAL-VV-cracking.noise.IPFV ‘there was a shattering noise (e.g., smashed glass)’ (RAN-ETM-2022-11-28:1056)
b	ɪ-ɪ-k’éth PFV.1SG.S-VV-shoot.PFV ‘I shot (with a gun)’ E&E 278	ě-rě-ɪ-k’éth UNSP.S-QUAL-VV-one.cracking.noise.PFV ‘something made one loud crack (e.g. log in fire); he shot himself’
c	dě-júr QUAL-husky.IPFV ‘s/he is obese’	ě-rě-l-júr UNSP.S-QUAL-VV-boom.IPFV ‘there was a booming sound (e.g. bass or loud gunshot)’
d	tlēs ‘grease, lard, oil’	ě-rě-ɪ-tlēs UNSP.S-QUAL-VV-grease.noise.PFV ‘something makes the sound of sizzling grease’

This section shows that the description and, to a lesser degree, the depiction of sound events is important in Dënë Sųliné, with multiple strategies available to speakers. Coupled with the large number of Dënë Sųliné speakers in different age groups, this makes it a good candidate for experimental research on onomatopoeia.

⁷ The difference between the strings *děl-* and *děl-* is broadly related to transitivity: *děl-dzēs* would mean ‘it made a cracking sound’ while *děl-dzēs* is ‘there is a cracking sound’ (see also Kibrik 1993).

3 Experimental research on onomatopoeia

The research on Dënë Sųliné onomatopoeia described below was done as part of a crosslinguistic project including twelve typologically diverse languages. The overarching goal of this project was to investigate the influence of individuals' creativity and hearing sensitivity upon the formation and interpretation of onomatopoeic words in a convenience sample of 12 typologically and geographically diverse languages. The experiment had three parts: a hearing sensitivity test, a drawing test (to measure creativity), and three onomatopoeia experiments. Only the three onomatopoeia experiments are described and discussed further.

3.1 *Experiment design*

Experiment 1 was designed to elicit spontaneous onomatopoeias in the participants' language. After listening to a recorded stimulus, participants were asked to write the sound event using the writing system of their native language. They were asked explicitly not to describe the sound but to transfer the sound shape of the event into a written version—a written onomatopoeia. The same stimuli were used for all participants; the stimuli were: a buzzing phone, a thunderstorm, strong wind, a (old-style cash register) bell, a trumpeting elephant, a person slurping their food, bird song, insects, and a person chewing noisily.

Experiment 2 used the same set of stimuli. After listening to each sound again, participants were asked to select from a list of entities that could have caused this sound. They were then given a list of semantic descriptors of the sound event. The semantic descriptors were grouped according to different parameters (sound duration, sound continuity, loudness, pitch, etc.), each with its own set of descriptors. Participants were asked to select one descriptor from each group; thus the sound of the buzzing phone could have been described as “electronic device; moderate loudness; moderate pitch; repeated; uniform loudness; uniform pitch”. They were then asked to pick three additional descriptors from a list.

Experiment 3 used a different set of stimuli: a male voice pronouncing onomatopoeias taken from different languages. Participants were given a list of sound events to choose from. There were 15 stimuli in this experiment and the list comprised 15 items.

The experiment had been developed by Pavol Štekauer and Lívía Körtvélyessy and piloted by them at P.J. Safarik University in Košice, Slovakia, using a participant pool of Slovak-speaking students.⁸ To ensure data comparability, researchers were provided with standardized equipment and detailed instructions on how to conduct the experiment. There was also discussion of how to adapt the methodology for communities without internet access or reliable electricity, primarily spoken (rather than written) languages, and bi- or multilingual populations. Consequently, a lot of the challenges we describe below were identified well before we even started our application to the Research Ethics Board at the University of Saskatchewan. Others became apparent only when we piloted the experiments. The pilot participant is a woman in her early 50s who grew up speaking only Dënë Sųliné and learned English later in life. While she prefers Dënë Sųliné to English, her English is at the near-native speaker level. She teaches occasional Dënë Sųliné classes in Saskatoon and is a personal friend of the first author. This last point is important. Our interpersonal relationship is such that the pilot participant felt safe in critiquing the methodology and in suggesting improvements.

⁸ While Slovak certainly is underrepresented in the linguistic literature, it is the official language of Slovakia and the main language used in the education system of this country.

3.2 Data collection

Ethical approval for the Dēnē Sųlíné portion of the study was granted by the Behavioural Research Ethics Board of the University of Saskatchewan. 13 speakers of Dēnē Sųlíné (10 women, 3 men) participated in the study. They ranged in age from 29 to 70 years; the median age was 47 years. Data from 9 participants was collected at the Saskatoon campus of the University of Saskatchewan; the remaining four speakers participated on the reserve of the Clearwater River Dene Nation. Participants were paid an honorarium of \$50. All participants completed all project activities.

4 Challenges and solutions

In this section, we describe some of the challenges in conducting this type of research with Dēnē Sųlíné.

4.1 Study participants

The participants for experimental research are typically undergraduate students. This is sometimes done simply for reasons of convenience, as college students are easily accessible for university-based researchers and many institutions have a “participant pool” where undergraduate students earn course credit for their participation in research studies. In the context of the present research project, the instructions explicitly called for participants aged 18–25 to ensure a homogenous participant population across different languages.

Challenge: Although there are quite a few Dēnē Sųlíné undergraduate students enrolled at the University of Saskatchewan, many are older than their non-Indigenous peers.⁹ First Nations youth are “more likely to be young parents, live in low-income households, and live in rural areas than their non-Indigenous counterparts” (Layton 2023). These challenges, shaped by longstanding systemic barriers, make it more difficult for Indigenous youth to pursue postsecondary education immediately after high school.

Additionally, recruitment through university channels only resulted in four participants; the remaining nine participants were recruited through our personal networks and over a Facebook announcement shared by the Clearwater River Dene School, which is located on a reserve in northern Saskatchewan. We personally know many Dēnē Sųlíné speakers in their late teens and twenties, but only one individual younger than 30 expressed an interest in participation. This reflects a language ideology common to many North American Indigenous languages which highly valorizes the speech of Elders over that of young people (cf. Lokosh 2019 for Chickasaw, Bird and Kell 2017 for SENĆOŦEN, Palakurthy 2022 for Diné Bizaad, or Willems and Lovick forthcoming for Dēnē Sųlíné). Palakurthy (2022:606) notes further that “young people are criticized at times by older speakers for a lack of perceived competence in Diné Bizaad”. The present authors have made similar observations about Dēnē Sųlíné. It is thus maybe not surprising that young speakers (i.e., those younger than 25) did not volunteer for this study.

Solution: We are grateful to all speakers who responded to our recruitment efforts and accept that this group has a different age profile than that of parallel studies.

⁹ Between 2021 and 2025, a total of 72 self-identified Dene students were enrolled in the Indigenous Student Achievement Pathways program at College of Arts & Science at USask. Their mean age was 24 years. A conservative estimate suggests that there are 3–4 times as many Dene students at the entire University, but exact numbers are not available.

4.2 Bilingualism

As discussed in section 2.2.1, there is extensive Dënë Sų́líné/English bilingualism, such that almost all Dënë Sų́líné speakers are competent in English as well. In a careful study of code-switching in Dënë Sų́líné in northern Saskatchewan, Wiens (2014) further demonstrated that the two languages are used in different domains. Dënë Sų́líné is associated primarily with tradition, culture, and the land; Elders and the old days; (traditional) spirituality; remote or rural community settings; and oral language use. English on the other hand is associated with modern life; technology and government; schooling and education; the world outside Dene communities; and written language use.

Challenge: All aspects of the study setting predispose a bilingual speaker toward using English rather than Dene: it is conducted by non-community members (Bazylak and Lovick); takes place at a university or school; uses technology (iPad, headphones); and relies at least partially on written language. Some of these aspects could not be changed; e.g. the use of technology and a standardized protocol were essential.

Solution: The ideal solution would have been to have testing done by the Dënë Sų́líné author or another research assistant fluent in Dënë Sų́líné, but this was not feasible for logistical reasons. Instead, the Dënë Sų́líné author translated the experiment instructions into Dënë Sų́líné. The resulting translation was checked and back-translated into English by several other Dënë Sų́líné speakers to ensure accuracy and comprehensibility. Participants were also reminded to “tap into their Dene brain” when thinking about their responses. We believe that this was mostly successful; only two of the 117 total responses to experiment 1¹⁰ were clearly inspired by English.

4.3 Indigenous language literacy

Related to the issue of bilingualism is that of Dënë Sų́líné-literacy, which posed several challenges for our study. As noted above, English is the language used in the education system and it is generally strongly associated with written language use. Dënë Sų́líné on the other hand is conceived of as a primarily oral language, although a weakly standardized orthography exists. The standard roman orthography¹¹ for Dënë Sų́líné that has been adopted by all communities in Saskatchewan is a relatively shallow writing system, allowing readers and writers to sound out words. Even individuals who have had some Dënë Sų́líné literacy instruction tend to be much more comfortable in spoken Dënë Sų́líné or in written English than they are in written Dënë Sų́líné. This posed two separate challenges.

Challenge 1: Reading the instructions. Even a set of brief instructions such as those used for Experiment 1 result in a relatively large block of text as shown in Table 3 below. Sedarous and Namboodiripad (2020:3) observe that “[e]ven in languages which have standardized writing systems [OL: more on this issue below], access to written language is not available to all.” This is certainly the case in Dënë Sų́líné: there is not a lot of reading material available for Dënë Sų́líné, so even individuals that are comfortable writing the language may not be very proficient readers due to lack of practice. This became apparent during piloting when we piloted the written version: it took the pilot participant a long time to sound out the text¹² and she became visibly frustrated by the end.

¹⁰ 9 stimuli X 13 participants = 117 responses.

¹¹There is also a syllabics-based writing system which many Elders learned but which has not been taught for several decades.

¹²We did not time her, so we do not know how long it took.

Table 3: Written Dënë Sų́líné instructions for Experiment 1

İlaghě	One
Nědzaghě k'e hěł horıłthą ha k'enılye.	Please wear headphones for the following task.
Łotą ası dıth'agh ts'ętaı t'arot'ı hıłchu. Dirı t'a ası dıth'agh sı elk'ęts'a arot'ı. Dirı tsątsąnę bęnı k'e bek'ılnı dę ası dıth'agh ha sı.	You will be presented with 9 recordings. Each recording contains a sound. You will hear the recordings by clicking on the links in the individual tasks.
Hotię horıłth'ą dę, něba t'arot'ı sı Dene yatię t'a ěkórųnı. (Tot'ınę t'a ızıle/ Dënë yatię t'a!). Olga t'a rınnı sı něba yęřętl'is ha sı. Nęn tth'ı Dënë yatię t'a dıtl'is asqızıle sı (Dene SRO).	Your task is to listen to each recording and to then say the sounds in Dënë Sų́líné (not in English). Olga will audio-record what you say. If you wish, you may also write the word using the Dënë Sų́líné alphabet.
T'a dıth'agh nıthęn sı eyı tsątsąnę bęnı k'e bek'qınnı. Holą bek'ınnı asqızıle sı, hotię horıłth'ą ha.	Your task is to capture the sound using Dënë Sų́líné in a way that most accurately represents what you hear. You can replay the recordings as many times as necessary.

The lack of standardization raises a different concern. Written words can look incorrect to speakers who learned a different spelling system or who speak a different dialect, who may then criticize (more or less respectfully) the writing. This can lead to community collaborators such as the second author feeling exposed, worrying that others will judge their spelling or dialect (see also Twitchell 2018:96–97 for discussion of lateral violence in Indigenous language revitalization).

Solution: Upon further discussion, we determined that relying exclusively on written instruction put the cultural safety of the study participants and the Dënë Sų́líné co-author at risk, as participants might be led to feel inadequate for not being able to read Dënë Sų́líné at the same speed as they read English, and as the Dënë Sų́líné co-author's knowledge of Dënë Sų́líné might be denigrated. We addressed this issue by asking the second author to record the Dënë Sų́líné instructions, which we then played to the participants over headphones. This seemed to sufficiently predispose participants to switch to Dene in doing the first task while ensuring their cultural safety but also shielding the second author from criticisms of her word choice or spelling.

Challenge 2: Writing down responses. Most people in English-speaking Canada use the QWERTY keyboard, which does not contain Dënë Sų́líné letters such as Ł/ł or ʔ/ʔ.¹³ The numerous diacritics needed for vowels likewise are cumbersome to type, especially when they have to be stacked: á, q, á, ě, ě, ě, ě. Multiple keyboards have been developed to address this issue but crucially, writers differ in the choice of their preferred keyboard. Typing Dënë Sų́líné on a keyboard different from the one they are used to is quite challenging, and we would have had to prepare a laptop with three or four different keyboards for participants to use. More importantly, the orthography is only weakly standardized, and individual speakers use slightly different interpretations of the orthography. Particularly challenging to writers are consonants that do not occur in English (the ones mentioned above plus most affricates) and all vowels. The Dënë Sų́líné orthography uses (roughly) IPA values for the vowels *i*, *e*, *a*, *o*, *u*, but this

¹³Ł/ł is used to represent the voiceless lateral fricative (and is used in the representation of the aspirated and ejective lateral affricates), ʔ/ʔ is used to represent the glottal stop. Dënë Sų́líné follows English capitalization rules; thus there is a distinction between an upper-case and a lower-case glottal stop.

differs from the way these vowels are pronounced in English, the dominant literacy language of the study participants. Consequently, there is significant variation in how vowels are written, as illustrated in Table 4. Additionally, writers both over- and underuse diacritics.

Table 4: Common spellings for Dënë Sų́líné vowels

Target vowel	Common spellings
/i/ <i>	i, ee, u
/e/ <e>	e, ě, a, ay
/ə/ <ě>	ě, e, a, ay, u
/a/ <a>	a, ah, u, uh
/o/ <o>	o
/u/ <u>	u, oo, ou

Some consonants are just as variable in writing. Table 5 shows an incomplete list of common representations.

Table 5: Variability in the spelling of some Dënë Sų́líné consonants

Target consonant	Common spellings
ʔ/ɀ	ʔ, ɀ, ‘, not written at all
tʃ	Gl, kl, g’ł, gł, k’ł, ‘kł, t’ł, tł’...
ddh	Ddh, dh, d’h, ddh’, ‘th, th’, ..
...	

The resulting variation makes the interpretation of written Dënë Sų́líné well-nigh impossible without an auditory record.

Solution: We resolved the issue of a cumbersome writing system with weak standardization by asking speakers to “say” the onomatopoeia rather than write it. When Lovick was present during the experiment, she would transcribe the result on the spot; in the other instances, Bazylak made a recording which was transcribed by Lovick later. This approach also allowed us to address one problem that had not occurred to us ahead of time, as described in the following section.

4.4 *Description rather than production*

Challenge: Participants initially tended to describe or label sounds rather than produce sound imitations. For example, when presented with a recording of birdsong, participants would often say the (English) word *chirp* or the Dënë Sų́líné verb *hějĕn* ‘it is singing’ instead of mimicking the sound itself. This issue was observed consistently across participants and suggests that the confusion may have been influenced by how the instructions were interpreted in Dënë Sų́líné where the concept of mimicking a sound may not have been directly translated. We additionally hypothesize that the ready availability of sound-describing verbs in Dënë Sų́líné may have predisposed participants to choosing this strategy: as we observed earlier, sound description is common, while sound imitation is much rarer and more marked due to its association with storytelling and expressive, dramatic speech. Additionally, the unfamiliar

research paradigm may have contributed to participants' difficulty with this aspect of the research.

Solution: To address this challenge, we explicitly reinforced instructions by asking participants to reproduce the sound rather than describe it. We did so by crumpling a piece of paper and explaining that the expected response should be something like *krr krr krr* rather than *crumple* or *crinkle*. After this clarification, participants understood the direction and were generally able to produce an onomatopoeic response. We stress here that, had we used the original methodology of asking participants to write their onomatopoeias, we would not have noticed this issue until after the fact. By asking them to respond orally and giving feedback on their responses, we were able to ensure that participants fully understood our instructions.

4.5 Describing sounds

One ancillary finding of this experiment was the observation that many sound descriptors are only weakly lexicalized and quite ambiguous without context. This became a problem for Experiment 2, where participants first listened to a stimulus and then were asked to select from a list of sound descriptors. Originally, we had planned to do this portion of the experiment in Dënë Sųliné, asking people to pick from a list of Dënë Sųliné descriptors. However, translating sound descriptors unambiguously proved surprisingly difficult. For example, *ts'ětthē* often means 'slow'; in sound descriptions, it can be used to mean 'quiet, low-pitched, gentle, soft'. Particularly the conflation of quietness and low pitch caused problems. The descriptor for the other end of both these spectrums is just as ambiguous: *darıtl'édh* can be used to mean both 'loud' and 'very highly pitched'. Such challenges are of course not limited to Dënë Sųliné; English 'low' likewise can be used to describe pitch or loudness, depending on the context, but additional disambiguating vocabulary items such as *quiet* or *low-pitched* are available. In Dënë Sųliné, this is not the case; the small inventory of lexical stems does seem to result in significant ambiguity.

Moreover, we found that the ready availability of morphological strategies for the formation of sound descriptors meant that many of them are only weakly lexicalized and thus hard to interpret by other speakers outside of context. One translator suggested *danagis* for a sound that goes off and on again; this word was understood by a translator speaking a different dialect to mean 'shut up!' *Yarolthi*, *ndarēdhı*, and *darēdhı* were all intended as potential translations of 'rhythmical', but not all speakers understood these words without context.¹⁴ In addition to the weak lexicalization already mentioned, we suspect that this is due in part to minor dialect differences that hamper understanding of decontextualized lexical items.

Challenge: weak lexicalization of sound descriptors. After almost two months of consultation with several experienced translators, we were unable to settle on a set of translations for the sound descriptors that resulted in accurate and consistent back-translations. Even so, community collaborators reported feeling frustrated with this task, as they felt that their feeling of competence in Dënë Sųliné was threatened by this approach. When we piloted a list that the translators grudgingly agreed on with the pilot participant, she laughed uproariously at *danagis* 'oscillating sound event, shut up', but, more importantly, became quite frustrated because she had to keep asking us for clarification of the words. When the first author asked if the participant would prefer to use the English descriptors instead, she agreed immediately and commented afterwards that this was much easier.

¹⁴ The exact meaning of these three words is unclear at this time but according to the second author, all of them have to do with making regular or frequent noise.

As noted above, the pilot participant is in her 50s and grew up as a monolingual Dënë Sų́líné speaker; she is thus very confident in her skills. We however feared that younger speakers, most of whom grew up bilingually, could be made to feel insecure regarding their own knowledge of Dënë Sų́líné, which could in turn impact their willingness to continue using Dënë Sų́líné and pass it on to their children. In other words, we felt that continuing to try to do this part in Dënë Sų́líné put the cultural safety especially of younger participants at risk.

Solution: We used English for experiments 2 and 3.

5 Discussion and conclusion

In this paper, we reflect on the methodological adaptations we undertook to adapt a cross-linguistic experimental study of the creation of primary onomatopoeias to Dënë Sų́líné, an Indigenous language spoken in Canada. Some of the adaptations were due to the prevalence of Dënë Sų́líné/English bilingualism and to the low level of Dënë Sų́líné literacy. Others were done because the original design had the potential to put the cultural safety of study participants or the community collaborators at risk, such that they might feel that their knowledge of Dënë Sų́líné was inadequate. A crucial piece of identifying these issues was careful consideration of the historical and sociolinguistic situation of Dënë Sų́líné in Saskatchewan, and on-going conversation between the first two authors about how to avoid harm to participants. But as our pilot run demonstrated, it is impossible to anticipate all potential issues. It was through working with this highly fluent, confident speaker of Dënë Sų́líné, and through her willingness to give frank and honest feedback, that we were able to adapt the methodology such that participants felt safe and supported. At the end of each session, we checked in with participants, all of whom reported enjoying the study. Many also asked to be contacted about future research. We feel that this is a strong endorsement.

This leads us to some intentionally weakly-formulated recommendations for other research teams. For those designing the experiment, it may be helpful to consider from the outset how it can be adapted to communities where the cultural felicity conditions identified by Anand et al. (2015) are not met, or where research conditions differ radically from those found in university labs. This includes the determination of which aspects of the design are essential to experimental integrity as opposed to those that are desirable but can be adapted to local contexts. For the teams adapting the experiment, we recommend including a member of the language community in the research team and using their guidance in developing the experiment protocol. Finally, it is crucial to have a pilot participant who provides frank, honest feedback on aspects that frustrate them or do not work.

In closing, we find that we learned two lessons of equal importance. First, we found that grounding ourselves in considerations of safety enabled us to do this research in a good way, guided by principles of respect and reciprocity. While our solutions and recommendations are far from ground-breaking, we learned that we need to tailor our methods precisely to the community where our work takes place. This approach means paying attention to all aspects of the experiment: the instructions, the materials and technology, the role of writing, and the relationships and power differentials between academic researchers, community collaborators, and study participants, so the work can be done respectfully. Second, we found that experimental research on a Canadian Indigenous language is feasible despite Canada's colonial history. In fact, Author 2 (the Dene co-author) stresses that the continued exclusion of Indigenous languages from experimental research could be construed as a new, different form of marginalization of these languages, and advocates for more work of this type.

References

- An Act Respecting Indigenous Languages (2019).
- An Act Respecting the Status and Use of the Official Languages of Canada (1969).
- An Act to Amend and Consolidate the Laws Respecting Indians (1876).
- Anand, Pranav & Chung, Sandra & Wagers, Matthew. 2011. *Widening the Net: Challenges for Gathering Linguistic Data in the Digital Age*. Unpublished manuscript. Response to NSF SBE.
- Bird, Sonya & Kell, Sarah. 2017. The Role of Pronunciation in SENĆOŦEN Language. *The Canadian Modern Language Review* 74(4). 538–569.
- Christianson, Kiel & Ferreira, Fernanda. 2005. Conceptual Accessibility and Sentence Production in a Free Word Order Language (Odawa). *Cognition* 98. 105–35.
- Curtis, Elana & Jones, Rhys & Tipene-Leach, David & Walker, Curtis & Loring, Belinda & Paine, Sarah-Jane & Reid, Papaarangi. 2019. Why Cultural Safety Rather than Cultural Competency Is Required to Achieve Health Equity: A Literature Review and Recommended Definition. *International Journal for Equity in Health* 18. 1–17. <https://doi.org/10.1186/s12939-019-1082-3>.
- Elford, Leon W. & Elford, Marjorie. 1998. *Dene (Chipewyan) Dictionary*. Northern Canada Mission Distributors.
- First Nations Health Authority. 2016. *#itstartswithme: FNHA's Policy Statement on Cultural Safety and Humility*. https://www.nccih.ca/634/View_External_Publication.nccih?id=828
- First Nations Information Governance Centre. 2026. *The First Nations Principles of OCAP®*. <https://fnigc.ca/ocap-training/>
- Government of Canada. 2008. “Roadmap for Canada’s Linguistic Duality 2008-2013: Acting for the Future.” Unpublished manuscript.
- Hargus, Sharon & Lovick, Olga & Tuttle, Siri G. 2020. Glossing Dene Languages. In Begay, Kayla & Palakurthy, Kayla (eds.), *Working Papers in Athabaskan Languages 2020. Proceedings of the 2019 Dene Languages Conference in Davis, California*. Alaska Native Language Center.
- Jetté, Jules & Jones, Eliza. 2000. *Koyukon Athabaskan Dictionary*. Alaska Native Language Center.
- Jung, Dagmar & Klein, Mark & Stoll, Sabine. 2018. Language Transition(s): School Responses to Recent Changes in Language Choice in a Northern Dene Community (Canada). In Wigglesworth, Gillian & Simpson, Jane & Vaughan, Jill (eds.), *Language Practices of Indigenous Children and Youth: The Transition from Home to School*. Palgrave Studies in Minority Languages and Communities. Palgrave MacMillan.
- Kari, James. 1979. *Athabaskan Verb Theme Categories: Ahtna*. Alaska Native Language Center Research Papers, Number 2. Alaska Native Language Center.
- Kari, James. 1990. *Ahtna Athabaskan Dictionary*. Alaska Native Language Center.
- Kibrik, Andrej A. 1993. Transitivity Increase in Athabaskan Languages. In Comrie, Bernard & Polinsky, Maria (eds.), *Causatives and Transitives*. John Benjamins.

- Körtvélyessy, Livia, & Pavol Štekauer (eds). 2024. *Onomatopoeia in the World's Languages: A Comparative Handbook*. Walter de Gruyter.
- Kutlu, Evan & Hayes-Harb, Rachel (eds.). 2023. *Applied Psycholinguistics* 44(3-4).
- Layton, Jaelyn. 2023. *First Nations Youth: Experiences and Outcomes in Secondary and Postsecondary Learning*. Nos. 81-599-x No. 18. Statistics Canada.
- Lokosh (Hinson, Joshua D.). 2019. *Nanna Ittonchololi' Ilaliichi (We Are Cultivating New Growth): Twenty Years in Chikashshanompa' Revitalization*. Ph.D. thesis, University of Oklahoma.
- Lovick, Olga. 2024. Onomatopoeia in Upper Tanana Dene. In Körtvélyessy, Livia & Štekauer, Pavol (eds.), *Onomatopoeia in the World's Languages: A Comparative Handbook*, 709-721. Berlin: Walter de Gruyter.
- McDonough, Joyce & Willie, MaryAnn. 2000. Allowable Variability: A Preliminary Investigation of Word Recognition in Navajo. In *University of Rochester Working Papers in the Language Sciences*, vol. 1. University of Rochester.
- Meek, Barbra A. 2007. Respecting the Language of Elders: Ideological Shift and Linguistic Discontinuity in a Northern Athapaskan Community. *Journal of Linguistic Anthropology* 17 (1). 23–43.
- Meek, Barbra A. 2010. *We Are Our Language: An Ethnography of Language Revitalization in a Northern Athabaskan Community*. The University of Arizona Press.
- National Aboriginal Health Organization. 2008. *Cultural Competency and Safety: A Guide for Health Care Administrators, Providers and Educators*.
- Palakurthy, Kayla. 2022. New Speakers and Language Change in Diné Bizaad (Navajo). *International Journal of Bilingualism* 26(5). 601–619.
- Rice, Keren. 2020. Morphology in Dene Languages. In *Oxford Research Encyclopedia of Linguistics*.
- Rice, Sally & Libben, Gary & Derwing, Bruce. 2002. Morphological Representation in an Endangered, Polysynthetic Language. *Brain and Language* 8. 473–86.
- Sedarous, Yourdanis & Namboodiripad, Savithry. 2020. Using Audio Stimuli in Acceptability Judgment Experiments. *Language and Linguistics Compass* 14 (e12377). 1–21.
- Sherkina-Lieber, Marina & Helms-Park, Rena. 2015. A Prototype of a Receptive Lexical Test for a Polysynthetic Heritage Language: The Case of Inuttitut in Labrador. *Language Testing* 32(4). 419–42.
- Sherkina-Lieber, Marina & Pérez-Leroux, Ana T. & Johns, Alana. 2011. Grammar without Speech Production: The Case of Labrador Inuttitut Heritage Receptive Bilinguals. *Bilingualism: Language and Cognition* 14(3). 301–317.
- TCPS2. 2022. *Tri-Council Policy Statement: Ethical Conduct for Research Involving Humans*.
- Truth and Reconciliation Canada. 2015. *Honouring the Truth, Reconciling for the Future: Summary of the Final Report of the Truth and Reconciliation Commission of Canada*. Truth and Reconciliation Commission of Canada.

- Twitchell, X'unei Lance. 2018. *Haa Dachxánx'i Sáani Kagéiyi Yis: Haa Yoo X'atángi Kei Naltseen* (For Our Little Grandchildren: Language Revitalization among the Tlingit). Ph.D. thesis, University of Hawai'i.
- Wepa, Dianne. 2003. An Exploration of the Experiences of Cultural Safety Educators in New Zealand: An Action Research Approach. *Journal of Transcultural Nursing* 14(4). 339–348.
- Wiens, Jeanette R. P. 2014. *Code-Switching and Language Ideology in a Northern Dene Community*. Master's Thesis, University of Regina.
- Willems, Nial A. & Lovick, Olga. 2026. Innovating Morphology: Double-Marked Impersonals in Dëñě Sų́liné. *International Journal of American Linguistics*, 92(4). 337–370. <https://doi.org/10.1086/742346>

Olga Lovick
University of Saskatchewan
9 Campus Drive
Saskatoon, SK
S7N 5A5
Canada
e-mail: olga.lovick@usask.ca