Masheli: A Choctaw-English bilingual chatbot

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Abstract We present the implementation of an autonomous Choctaw-English bilingual chatbot. Choctaw is an American indigenous language. The intended use of the chatbot is for Choctaw language learners to pratice conversational skills. The system's backend is NPCEditor, a response selection program that is trained on linked questions and answers. The chatbot's answers are stories and conversational utterances in both languages. We experiment with the ability of NPCEditor to appropriately respond to language mixed utterances, and describe a pilot study with Choctaw-English speakers.

1 Introduction

This work describes a text-based bilingual chatbot, named "Masheli" (meaning "fair sky" in Choctaw), intended to be a conversational partner to supplement learners' language education of Choctaw, an American indigenous language. Second language teaching pedagogy has traditionally treated use of the mother tongue in the classroom as taboo, instead emphasizing that the language to be learned should be the only language spoken in the learning environment. However, newer approaches suggest that use of the mother tongue as a reference improves learning outcomes [6]. One reason is that learners are able to process and understand explanations.

While traditional classroom settings may attempt to create conversational opportunities, factors can prevent learners from engaging fully in conversation with a human partner, such as feelings of shyness or fear of making errors [14]. Learners reported feeling more comfortable chatting with a chat bot than with a human interlocutor in previous research [9].

We thus propose a chatbot capable of responding in English and Choctaw as a tool for Choctaw language learners to practice conversational skills. The chatbot

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responds in the language corresponding to that of the user's previous utterance. The chatbot can also repeat its last utterance in the other language, assisting users who may need the English translation to understand. The chatbot is presently limited to the domain of sharing Choctaw cultural stories about animals. The system is oriented towards carrying on a conversation, and thus does not provide corrective feedback to the user about language errors.

2 Chatbot background

A chatbot is software that uses human language to have a conversation with a partner [14]. Chatbots often have a limited knowledge domain, which replicates how conversational learning activities are typically focused on practicing topic-specific vocabulary.

In the chatbot area of second language teaching research, there are two roles for the chatbot. In one, the chatbot acts as a pedagogical agent, providing feedback and correction to the learner's errors. The Taidhgín system for learning Irish [7] is one such example. The second variety are learning companions, where the chatbot takes a non-authoritative role by not providing feedback[8], focusing instead on only carrying on a conversation.

To our knowledge, Vanjani et al. [17] is the only multilingual chatbot deployed to chat informally as a language companion. In this work, the chatbot was connected to Google Translate and could thus respond to user utterances in any language supported by Google Translate. The translated utterance was then given to Tutor Mike[1], a free online chatbot developed in previous work, who responded in English. In several experiments, the English responses from Tutor Mike were translated again by Google Translate to respond to the user in a non-English language.

3 Overview of the Choctaw Language

The Choctaw language is spoken by the Choctaws, an indigenous tribe that originally inhabited the southeastern United States. In the 1830's, Choctaws were forcibly removed from their lands in an event called The Trail of Tears. Choctaws are the third most populous US tribal group, with approximately 195,000 people identifying as Choctaw in the 2010 US census.[2] However, only around 10,000 people are fluent speakers of Choctaw. Revitalization efforts have worked to establish language courses at local schools, as well as online classes and weekly community classes.

[1] http://bandore.pandorabots.com/pandora/talk?botid=ad1eeebfae345abc

[2] https://www.census.gov/population/www/cen2010/cph-t/t-6tables/TABLE%20(1).pdf

The Choctaw language belongs to the Muskogean language family [10]. The language is subject-object-verb order. Choctaw has a complex morphology. Prefixes and suffixes on the verb inflect for tense, and for argument agreement [5], demonstrated in the second and third examples below. Additionally, infixation and vowel reduplication show the verb's aspect, shown in the first example.

1. Shulush isht tʊllakchi ilʊppa tahakchi li.
   Shulush isht tʊllakchi ilʊppa ta<ha>kchi li.
   shoelaces these tie<quickly> 1SG
   I tie these shoelaces quickly.
2. Chik balilo tuk.
   <Chik> balil-<o> tuk.
   not.2SG run-NEG recent-past
   You didn't run.
3. Ish balili tuk.
   <Ish> balili tuk.
   2SG run recent-past
   You ran.

The literature [3, 4, 13] agrees that there are at least three dialect variants in Mississippi, however, it is unclear whether and to what extent those dialects were carried to Oklahoma following the forced relocation. One large source of difference, however, is in orthographic conventions between the Choctaw tribes. Today there are multiple orthographic conventions in use of varying standardization (Figure 1).

Consonants											
p	b	t	k	f	s	h	m	n	l	w	y [j]
[tʃ]		ch, č			[ʃ]		sh, š		[ɬ]		hl, lh, ɬ
Vowels											
[a]		a, ʊ, v, ä			[i]		i		[o]		o, u
[aː]		a, á, aa			[iː]		e, í, i, ii, ie		[oː]		o, ó, oo
[ã]		a̱, an, am, ą			[ĩ]		i̱, in, im, į		[õ]		o̱, u̱, on, om, ǫ

Fig. 1 Choctaw sounds and orthographic variants (from [2])

4 System Components

The Masheli chatbot is driven by NPCEditor, a response classifier and dialogue management system[12]. NPCEditor uses a statistical classifier that is trained on linked questions and responses. The classifier is trained on our question-answer corpus (described in 4.1). For each user input, the classifier ranks all the available responses.

NPCEditor also contains a dialogue manager, which selects an appropriate response from the ranked responses (detailed in 4.2).

Previous applications of NPCEditor have been used for interactive characters in domains such as museum guides[15], entertainment experiences[11], interviews with Holocaust survivors[16], and to answer sexual health questions [1].

4.1 Question-Answer Corpus and Domain knowledge

Seventeen stories were selected from ChoCo, a Choctaw language corpus [2], to form the chatbot's responses. All stories are originally in Choctaw and have English translations, and are about animals. Stories were entered in their original orthography.

We created the questions in the QA corpus. In order to support the different possible orthographic standards from the user, each training example in the corpus of was written in multiple formats. For example, the sentence "Do you know a story about a woodpecker?" could be written as:

1. Biskinik am anumpa nan anoli chi ishi?
2. Biskinik a anumpa nan anoli chi ishi?
3. Biskinik a anumpa nan anoli chi ishi?
4. Biskinik a anumpa nan anoli chi inshi?

The QA corpus also includes questions and responses about the chatbot itself, as well as utterances that maintain dialogue flow, such as greetings and management of off-topic questions.

There is no explicit module for recognizing which language the user is communicating in. Rather, the language is detected by determining which output has the best matching score, given the training data that always matched outputs to the same language as inputs.

4.2 Dialogue manager

The dialogue manager functionality within NPCEditor chooses a response in the response portion of the QA corpus. The dialogue manager is the same for both Choctaw and English responses. All of the responses in the QA corpus have a label denoting the dialogue-type of the utterance. There are nine dialogue types; three dealing with pleasantries ("personal", "greeting", "meeting"), four to manage domain knowledge ("don't know", "don't have story", "knowledge stories", "off topic"), "repeat" for handling repeat requests, and story type. The story dialogue type contains 17 stories. Each dialogue-type has a Choctaw and English version. The English version is differentiated from the Choctaw by a tag "E" at the end of

the dialogue-type label. For example, one greeting is labeled “01greeting” for the Choctaw version, and “01greetingE” for the English.

The dialogue manager works by choosing the response that was ranked highest by the classifier. It can choose a lower ranked response to avoid repetition. If the score of the top ranked response is below a threshold that is selected during training, the dialogue manager will instead select an a response that indicates non-understanding, or that aims to end a conversation topic. For example, the expression “Mihacha?” (“It really is, isn’t it?”) might be selected as a response when no other response scores above the threshold. A counter keeps track of the number of consecutive times the chatbot has used an “off topic” response, and on the third instance, a “knowledge stories” response is given to suggest asking for a story about a given animal. The counter restarts after giving a “knowledge stories” response.

The dialogue manager also tracks which language its last utterance was in through the use of the tag on the end of the dialogue type labels. If the user requests for the system to repeat its previous statement in the opposite language, the system bases its next action upon the presence or lack of “E” tag. An example dialogue is in Figure 2, demonstrating some of the greetings, as well as telling a story in Choctaw, and then repeating the story in English when requested.

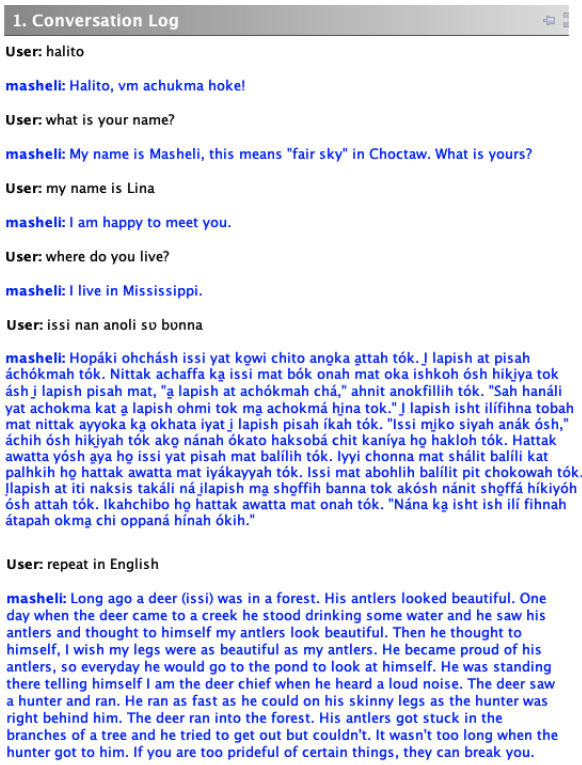

Fig. 2 Example conversation with the chatbot

5 Preliminary Evaluation

We use two methods to evaluate the chatbot: demoing the chatbot with English-Choctaw bilinguals, and conducting language experiments.

5.1 Pilot user study

Masheli was informally demoed to four English-Choctaw speakers of varying fluency in a community Choctaw language class. The first author briefly informed the participants of the capabilities of the system. All were encouraged to speak naturally to the system, and to speak to Masheli for as long as they chose.

Three users explored the "personal" and "greeting" types of dialogue in the system. Future work could include more of these small-talk types dialogue acts, as the system did not have responses for some of the questions asked, such as questions about the weather. All users asked for a story; two users asked for more than one story. All users interacted for four or more turns with the system, the maximum number of turns was eleven. The shortest interaction was approximately five minutes, the longest interaction was approximately fifteen minutes. In the longest interaction, the user only completed four turns with the system, but then spent the majority of the interaction time reviewing new vocabulary in the story.

Two participants spoke to the system only in Choctaw. These users asked the system to repeat the last Choctaw utterance in English once, and they reported that they asked for the translation to see the function, not necessarily to aid comprehension. The other two users spoke to the chatbot almost entirely in English. In order to access the Choctaw stories, these users asked for a story first in English, then asked for a translation into Choctaw.

All of the speakers who demoed the system have learned the Oklahoma orthography, however no users found it unusual for the chatbot to employ multiple writing systems. Three of the users did not report issues with reading stories in the Mississippi orthography, the final speaker did report issues reading the variant's writing system.

All speakers reported that it was an enjoyable experience overall, from enjoying the stories to being able to alternate between languages. One critique was that it was uncomfortable for the system to give an entire story in one dialogue turn. They reported that it would be more comfortable for reading and more natural in pacing to have the story broken into multiple turns.

5.2 Language experiments

As noted in Section 4.1, there is no language detection within the chatbot. Responses are selected based on how similar words in the user's input are to words in the

question-answer pairs. In the majority of the tested cases, the system responded in the language corresponding to the input. However, errors and code-switching in a conversation turn are typical behaviors of language learners. We thus experimented with the chatbot's ability to cope with non-standard language utterances.

Figure 3 shows that the system could not handle sentences with code-switching. In the first turn, the user asks for a story about a deer, but the system responds with an off-topic response in Choctaw, meaning "that's it". In the second turn, the system responds in English when the user's input is only one-third English. When the sentence is exactly half English and half Choctaw, the system responds in Choctaw, offering a list of story topics. Using the word *deer* in Choctaw produces an off-topic response (turn four), but using it in English (turn five) results in a deer story response.

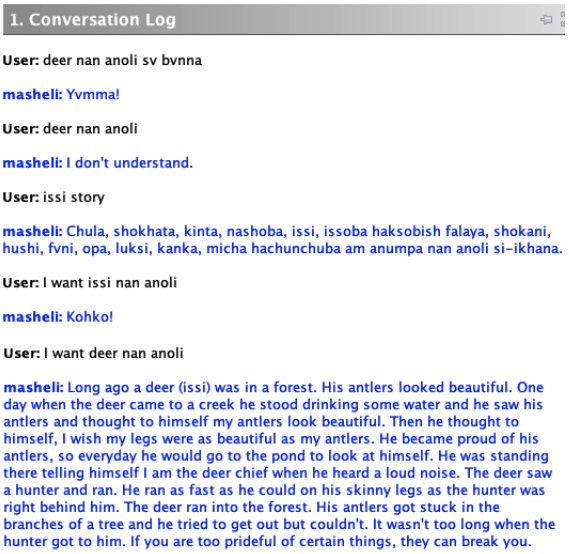

Fig. 3 Example of code-switching within one turn

A second consideration is that learners' input may contain errors. In Figure 4, the user requests to hear a story about a beaver. However, the input uses a non-standard spelling for *beaver*, and placed it at the end of the sentence, producing an ungrammatical sentence. In the second turn, the user makes the same grammatical error, and uses a non-standard spelling for *possum*. In the third turn, the syntax improves, but the word for *possum* is still a form not in the QA corpus. In turns 5-7, the system is unable to cope with the different spellings for *beaver* ("kinta"), *deer* ("issi"), and *wolf* ("noshoba").

Fig. 4 Errors in user input in Choctaw

6 Conclusions

This paper described the initial implementation of Masheli, a Choctaw-English bilingual chatbot. We described the motivation for a bilingual system, the chatbot's components, a pilot study, and experiments testing the system's language capabilities. As this is a first implementation, many areas could be developed further in future work. First, the system was not proficient at handling code-switching. This could be addressed through training on code-switching examples in the QA corpus. The language response would be predetermined through the linked responses in the corpus. Alternatively, a language recognition model could be added to recognize words in the user input, and rules could be implemented in the dialogue manager that dictate which one of the languages should be used in the response.

We also showed future directions for building a more robust system to support the nonstandard language of language learners. Our experiments showed that a future system will need to have more examples of misspellings in training, as even a one letter difference in the spelling causes the system to not understand. The language experiments also showed that despite the system not utilizing any Choctaw-specific resources, it was nonetheless sensitive to grammatical errors.

We leave it to future work to investigate the human learning outcomes from interacting with a bilingual chatbot. Our work indicates users have favorable experiences with such a chatbot, but it remains to be seen if it is a meaningful tool for second language instruction. Future work could include a survey item to measure knowledge of the domain before and after the interaction.

Acknowledgments

This work was supported by the U.S. Army. Statements and opinions expressed do not necessarily reflect the policy of the United States Government, and no official endorsement should be inferred.

References

1. Brixey, J., Hoegen, R., Lan, W., Rusow, J., Singla, K., Yin, X., Artstein, R., Leuski, A.: Shihbot: A facebook chatbot for sexual health information on hiv/aids. In: Proceedings of the 18th Annual SIGdial Meeting on Discourse and Dialogue, pp. 370–373 (2017)
2. Brixey, J., Pincus, E., Artstein, R.: Chahta anumpa: A multimodal corpus of the Choctaw language. In: Proceedings of LREC 2018. Miyazaki, Japan (2018)
3. Broadwell, G.A.: Choctaw. In: J. Scancarelli, H.K. Hardy (eds.) Native Languages of the Southeastern United States. U of Nebraska Press (2005)
4. Broadwell, G.A.: A Choctaw Reference Grammar. U of Nebraska Press (2006)
5. Broadwell, G.A.: Parallel affix blocks in choctaw. In: S. Muller (ed.) Proceedings of the 24th International Conference on Head-Driven Phrase Structure Grammar, pp. 103–119. CSLI Publications, University of Kentucky,Lexington (2017)
6. Butzkamm, W., Caldwell, J.A.: The bilingual reform: A paradigm shift in foreign language teaching. Narr Francke Attempto Verlag (2009)
7. Chiaráin, N.N., Chasaide, A.N.: Chatbot technology with synthetic voices in the acquisition of an endangered language: motivation, development and evaluation of a platform for irish. In: Proceedings of the Tenth International Conference on Language Resources and Evaluation (LREC'16), pp. 3429–3435 (2016)
8. Chou, C.Y., Chan, T.W., Lin, C.J.: Redefining the learning companion: the past, present, and future of educational agents. Computers & Education **40**(3), 255–269 (2003)
9. Fryer, L., Carpenter, R.: Bots as language learning tools. Language Learning & Technology **10**(3), 8–14 (2006)
10. Haas, M.R.: Southeastern languages. In: L. Campbell, M. Mithun (eds.) The Languages of Native America: Historical and Comparative Assessment, pp. 299–326. University of Texas Press (1979)
11. Hartholt, A., Gratch, J., Weiss, L., et al.: At the virtual frontier: Introducing gunslinger, a multi-character, mixed-reality, story-driven experience. In: International Workshop on Intelligent Virtual Agents, pp. 500–501. Springer (2009)
12. Leuski, A., Traum, D.: Npceditor: Creating virtual human dialogue using information retrieval techniques. Ai Magazine **32**(2), 42–56 (2011)
13. Nicklas, T.D.: The elements of choctaw. Ph.d. dissertation, University of Michigan (1972)
14. Shawar, B.A., Atwell, E.: Fostering language learner autonomy through adaptive conversation tutors. In: Proceedings of the The fourth Corpus Linguistics conference (2007)
15. Swartout, W., Traum, D., Artstein, R., Noren, D., Debevec, P., Bronnenkant, K., Williams, J., Leuski, A., Narayanan, S., Piepol, D., et al.: Ada and grace: Toward realistic and engaging virtual museum guides. In: International Conference on Intelligent Virtual Agents, pp. 286–300. Springer (2010)
16. Traum, D., Jones, A., Hays, K., Maio, H., Alexander, O., Artstein, R., Debevec, P., Gainer, A., Georgila, K., Haase, K., et al.: New dimensions in testimony: Digitally preserving a holocaust survivor's interactive storytelling. In: International Conference on Interactive Digital Storytelling, pp. 269–281. Springer (2015)
17. Vanjani, M., Aiken, M., Park, M.: Chatbots for multilingual conversations. Journal of Management Science and Business Intelligence **4**(1), 19–24 (2019)