Exploring the mechanisms of AI message generation: A chatbot development activity for students

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ORIGINAL TEACHING IDEAS—SINGLE

Exploring the mechanisms of AI message generation: A chatbot development activity for students

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Courses: Health Communication, Public Communication Campaigns, Public Relations, Introduction to Communication.
Objectives: By the end of this workshop, students will be able to: (1) understand how artificial intelligence–based large language learning models work and be able to explain core concepts such as word embeddings, neural networks, and prompting; and (2) apply what they have learned by building and improving an expert health chatbot. Overall, the workshop aims to empower students with the necessary knowledge to use rapidly advancing artificial intelligence responsibly for health communication.

Introduction and rationale

The idea that computers could mimic a natural conversation with humans has fascinated people for decades (see, e.g., Eliza—Weizenbaum, 1966; A.L.I.C.E.—Wallace, 2003). With the deployment of ChatGPT by OpenAI in 2022, students and researchers alike have become familiar with using artificial intelligence (AI) technologies for text generation. This has led to many debates about the potential and dangers of AI technologies (e.g. Kung et al., 2023; Pavlik, 2023; Thorp, 2023; van Dis et al., 2023). Although barely addressed in these debates, AI could significantly impact health communication. On the one hand, AI could be used to improve the efficiency of the message-generation process after the researchers have conducted solid formative research. On the other hand, as already addressed by researchers in other fields, blind use of AI technologies without awareness of how they operate and without proper fact checking of the generated messages could accelerate the spread of health-related misinformation (Liebrenz et al., 2023). Thus, we need to include well-grounded content in our communication classrooms that teaches students about the basic principles of AI technologies, the inner workings of systems such as ChatGPT, and how to use this knowledge effectively and responsibly for health communication.

The Build-a-Bot workshop strives to equip students with knowledge about the under-the-hood process of large language models (LLMs) and ChatGPT and to teach them hands-on skills to build their own simple health expert chatbot via the popular, free, and easy-to-use Jupyter notebook (Kluyver et al., 2016). The workshop will first teach theoretical concepts, including word embeddings, prompting, and reinforcement

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learning. This is accomplished via short lecture segments and mini activities. In the second phase, students engage with a Jupyter notebook[1] template to build a simple chatbot (Bird et al., 2009) that is able to discuss a specific health topic with users. The workshop then ends with a discussion about use cases of these AI-based technologies to improve communication competencies, as well as the ethical considerations of using them for health messaging.[2]

The Build-a-Bot workshop aims to bridge the gap between applied health communication (i.e. campaign message creation) and emerging technologies (i.e. AI-based chatbots). As AI-based technologies become more frequently used, it is important to increase students' understanding of how these technologies work and how to use them ethically. Especially in the context of health communication, AI-based technologies can create and disseminate misinformation if not used carefully. Thus, this workshop trains students to become more technologically literate so they can harness the cultural phenomena of AI message generation for effective health communication.

The activity

The full Build-a-Bot workshop comprises two parts: an introductory lecture with mini exercises and then a hands-on activity that involves building a DIY-ChatGPT (in reality, the chatbot is just a simple rule-based chatbot and not a LLM based on neural networks because this cannot be done in such a short time). Overall, the activity is intended to last about one hour. However, if needed, the workshop can be condensed to about 30 minutes. To our knowledge, this is the first published workshop that enables communication students to leverage AI-based technologies for message generation and develop critical media literacy, technological competency, and scientific creativity. This aim differentiates the workshop from few other existing original teaching ideas about technology (e.g. Pelzer & Turner, 2022).

We ran this Build-a-Bot workshop during a methods-focused course about health communication. To ensure that students understand the purpose of the AI-message generation, we presented the workshop after multiple sessions that address formative research in health communication (e.g. content analysis of previous campaigns—Slater, 2013; audience analysis—Slater, 1996; cross-sectional survey to plan messaging—Hornik & Woolf, 1999). Recently, we also adapted parts of the workshop during a hackathon on computational communication science. Thus, while the workshop is primarily geared toward AI and health communication, it can be modified to the goals of other communication courses. For instance, an introductory undergraduate communication course can merge this workshop into the health communication or technology and communication day of the course. Similarly, courses on computer-mediated or even interpersonal communication could adopt and integrate especially the chatbot exercise.

A key benefit of this workshop is that it can take place at the start of a course to increase students' interest, in the middle of the course as a fun exercise to give students a break from intense course content, or at the end to have students apply everything they have learned throughout the workshop.

The first part of the workshop addressing the theory behind AI message generation was inspired by our prior work (Lim & Schmälzle, 2023; Schmälzle & Wilcox, 2022).

The second part of the workshop about building a chatbot was inspired by an assignment in an applied machine learning course that the first author attended. The present workshop modified both precedents slightly in the following ways. For the AI message-generation part of the workshop, specific information and a mini exercise about using prompting to generate messages via Bloom (an open-source language model based on the similar transformer neural network architecture underlying ChatGPT; Scao et al., 2022) was added to keep up with the most up-to-date technological developments in natural language processing (NLP). In addition, while the in-class assignment from the applied machine learning course allowed students to build any type of chatbot (e.g. rude, friend, lover, therapist, informative), this workshop specifically instructed the students to build a chatbot programmed to discuss a specific health topic. The full structure of the workshop follows the technological layers involved in ChatGPT (see Table 1 and slides in the supplemental material).

We began the workshop by presenting a combination of short lectures and a mini exercise that illustrated how the words in texts get converted into a mathematical representation that neural networks can process. The short lectures included word embeddings (i.e. converting words into numerical vectors based on dimensions of the means of the word) and word2vec (i.e. NLP technique in which words are transformed into numerical vectors that capture semantic relationships; Alammar, 2019). For the mini-exercise 1, students applied what they have learned by generating simulated embeddings (see slides in the supplemental material).

The next series of lectures and mini exercise delved deeper into how language models work. We addressed next word prediction, sequential modeling (i.e. next word prediction based on a sequence of words; Campion, 2018), and prompting (i.e. inputting a word or sequence of words into the language model so the model can complete the next sequence of words). Then, for the second mini exercise, we provided a short example of AI message generation using prompting and Bloom from a published paper (Lim & Schmälzle, 2023). Next, students practiced AI message generation by downloading the Jupyter notebook template with codes (see link: https://github.com/nomcomm/communication_teacher_nlg) for message generation via the Bloom language model (see Figure 1).

The second part of the workshop involved the main activity of building and training a simple chatbot. First, students learned the concept of reinforcement learning, which refers to how an agent (person or machine) masters the connection between a situation

Table 1. Outline of the Build-a-Bot Workshop

Part I: Background	
Lecture 1:	Word embeddings, word2vec
Mini exercise 1:	Generate word embeddings
Lecture 2:	Next-word prediction, sequence modeling
Lecture 3:	Prompting, language models
Mini exercise 2:	Generate messages via Bloom language model
Part II: Let's Build a Health Bot!	
Lecture 4: Main Activity:	What is reinforcement learning?
	Build-a-Bot
	1. Get into teams and pick a health topic
	2. Download chatbot Jupyter notebook template
	3. Update code to cater to health topic
	4. Test chatbot with another team
	5. Continue steps 3 and 4 as many times as needed
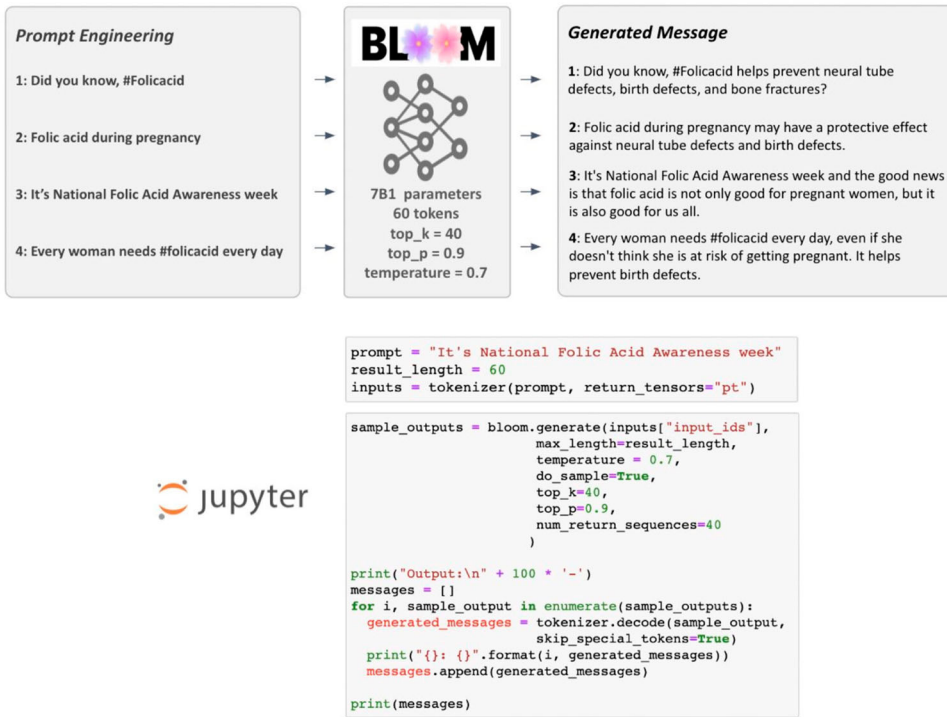
Figure 1. Conceptual Figure of Bloom Message Generation via Jupyter Notebooks (Folic Acid Used as Example).

and action based on the maximization of reward and the minimization of punishments (Palminteri & Pessiglione, 2013). We explained that in the case of AI message-generation technologies such as ChatGPT, reinforcement learning involved people providing feedback to the machine if the response was "good" (reward) or "bad" (punishment). For instance, ChatGPT allows users to provide a thumbs up or down as feedback to its responses. This is a simpler illustration of reinforcement learning. Then, as the main activity, the students got into pairs and opened the Jupyter notebook template of the classical chatbot dubbed "Eliza" (Bird et al., 2009). The template included the code for pairings of potential user inputs and chatbots' responses. Each student pair picked a health topic and then updated the codes to adapt the chatbot's language repertoire so that it could engage in a conversation about the chosen health topic (see example Jupyter notebook for more details). This presentation, along with the ensuing discussion about implications, ethics, and the importance of AI media literacy, marked the end of the workshop.

Debriefing

At the end of the workshop, we invited students to share their experiences. Most students were already familiar with ChatGPT, and they were excited to be able to build something similar that they could own and continue to improve. Even the abstract theoretical concepts, such as the idea of using vectors as representations of word meaning or the notion of next-word prediction, were received with great interest because students were well

Table 2. Potential Debriefing Questions for the Workshop

1. What is one main thing that you learned today?
2. How does what you learned today change your understanding of communication?
3. How could we use AI to improve communication?
4. How can AI be used to improve health-prevention efforts?
5. What are the ethical implications of these AI-based technologies?
6. How can we use AI carefully to prevent the spread of misinformation?

aware of the importance of these topics not only for their professional lives but also for understanding at least part of the hidden mechanisms of verbal communication. Another important part of the discussion was the questions about the social implications of these technologies, particularly the use of bots for marketing as well as in counseling. Overall, the feedback was positive (Table 2).

In addition, some students provided constructive criticism. Although the executable Jupyter notebook provided a low-threshold platform for teaching students about text generation, some faced installation issues because their school's Google account conflicted with their private Google account. Similarly, some students broke the code by executing the programs in a different sequence than intended. However, with minimal help from the teacher, they were able to get back on track quickly. Based on this feedback, we included an improved description for the code and how to execute it. Finally, while interesting and potentially helpful for health applications, some students expressed concern about the widespread misuse of AI-based technologies such as chatbots. These ideas could be implemented in future Build-a-Bot workshops.

Appraisal

The current Build-a-Bot workshop was implemented successfully in an undergraduate-level course about emerging methods for health communication. Three versions of the course were previously taught using a similar but less well-developed version of the content. However, given the recent boom of AI-related topics, we decided to expand on this model and create the current workshop. Students participated actively in the discussion, and they enjoyed gaining hands-on experience with language models and chatbots. Overall, the workshop was a success, which is a good sign for communication instructors who are interested in implementing this activity or similar hands-on content about emerging interactive technologies.

The workshop is primarily geared to ignite students' enthusiasm for the intersection between AI and communication, particularly health communication. However, communication instructors can adopt and modify this workshop. For instance, the activity could be varied to focus on whether the exchanges between a human and AI bots can count as communication, which could be included in the introduction to communication or interpersonal communication lectures. It would also seem promising to adapt the workshop to focus more on critical media literacy or embed the activity in a political communication instead of a health communication context. Likewise, variations in computer-mediated or strategic communication courses seem promising and easy to accomplish.

In sum, the Build-a-Bot workshop allows communication students to learn about the nuts and bolts of AI message-generation technologies. It also encourages them to explore

AI-based communication technologies in the context of health. Thus, the workshop aims to bridge the gap between two merging areas of study: AI and communication (specifically applied health communication in this workshop).

Notes

1. Jupyter notebooks blend textbook-style explanations with executable code cells. They have become immensely popular as a platform for teaching computational skills, especially to newcomers who would struggle with installations and writing the code. Instead, notebooks allow users to run prewritten code, inspect the results, and learn by changing the code (Kluyver et al., 2016).
2. The lecture slides with resources and the code templates (Jupyter notebooks) used for the Build-a-Bot workshop are available online at https://github.com/nomcomm/communication_teacher_nlg.

References and suggested readings

Alammar, J. (2019). *The illustrated Word2vec*. https://jalammar.github.io/illustrated-word-2vec/

Bird, S., Loper, E., & Klein, E. (2009). *Natural language processing with python*. O'Reilly Media Inc.

Campion, D. (2018). Text generation using bidirectional LSTM and Doc2Vec models. *Medium*. https://medium.com/@david.campion/text-generation-using-bidirectional-lstm-and-doc2vec-models-1-3-8979eb65cb3a

Hornik, R., & Woolf, K. D. (1999). Using cross-sectional surveys to plan message strategies. *Social Marketing Quarterly*, *5*(2), 34–41. https://doi.org/10.1080/15245004.1999.9961044

Kluyver, T., Ragan-Kelley, B., Pérez, F., Granger, B. E., Bussonnier, M., Frederic, J., Kelley, K., Hamrick, J., Grout, J., Corlay, S., Ivanov, P., Avilah, D., Abdalla, S., Willing, C., & Jupyter Development Team (2016). Jupyter notebooks – A publishing format for reproducible computational workflows. In F. Loizides, & B. Schmidt (Eds.), *Positioning and power in academic publishing: Players, agents and agendas* (pp. 87–90). IOS Press. https://doi.org/10.3233/978-1-61499-649-1-87

Kung, T. H., Cheatham, M., Medenilla, A., Sillos, C., De Leon, L., Elepaño, C., Madriaga, M., Aggabao, R., Diaz-Candido, G., Maningo, J., & Tseng, V. (2023). Performance of ChatGPT on USMLE: Potential for AI-assisted medical education using large language models. *PLOS Digital Health*, *2*(2), e0000198. https://doi.org/10.1371/journal.pdig.0000198

Liebrenz, M., Schleifer, R., Buadze, A., Bhugra, D., & Smith, A. (2023). Generating scholarly content with ChatGPT: Ethical challenges for medical publishing. *The Lancet Digital Health*, *5*(3), E105–E106. https://doi.org/10.1016/S2589-7500(23)00019-5

Lim, S., & Schmälzle, R. (2023). Artificial intelligence for health message generation: An empirical study using a large language model (LLM) and prompt engineering. *Frontiers in Communication*, *8*, 1129082. https://doi.org/10.3389/fcomm.2023.1129082

Palminteri, S., & Pessiglione, M. (2013). Reinforcement learning and tourette syndrome. *International Review of Neurobiology*, *112*, 131–153. https://doi.org/10.1016/B978-0-12-411546-0.00005-6

Pavlik, J. V. (2023). Collaborating with ChatGPT: Considering the implications of generative artificial intelligence for journalism and media education. *Journalism & Mass Communication Educator*, *78*(1), 84–93. https://doi.org/10.1177/10776958221149577

Pelzer, E., & Turner, B. O. (2022). Interactions with a machine teacher: Effects of wiley's daila on student learning outcomes and teaching effectiveness. *Communication Teacher*, *36*(4), 314–329. https://doi.org/10.1080/17404622.2021.2001551

Scao, T. L., Fan, A., Akiki, C., Pavlick, E., Ilić, S., Hesslow, D., … Manica, M. (2022). Bloom: A 176b-parameter open-access multilingual language model. arXiv preprint arXiv:2211.05100.

Schmälzle, R., & Wilcox, S. (2022). Harnessing artificial intelligence for health message generation: The folic acid message engine. *Journal of Medical Internet Research*, *24*(1), e28858. https://doi.org/10.2196/28858

Slater, M. D. (1996). Theory and method in health audience segmentation. *Journal of Health Communication*, *1*(3), 267–284. https://doi.org/10.1080/108107396128059

Slater, M. D. (2013). Content analysis as a foundation for programmatic research in communication. *Communication Methods and Measures*, *7*(2), 85–93. https://doi.org/10.1080/19312458.2013.789836

Thorp, H. H. (2023). ChatGPT is fun, but not an author. *Science*, *379*(6630), 313–313. https://doi.org/10.1126/science.adg7879

van Dis, E. A., Bollen, J., Zuidema, W., van Rooij, R., & Bockting, C. L. (2023). ChatGPT: Five priorities for research. *Nature*, *614*(7947), 224–226. https://doi.org/10.1038/d41586-023-00288-7

Wallace, R. (2003). *The elements of AIML style*. Alice AI Foundation.

Weizenbaum, J. (1966). ELIZA—a computer program for the study of natural language communication between man and machine. *Communications of the ACM*, *9*(1), 36–45. https://doi.org/10.1145/365153.365168