BlahBlahBot: Facilitating Conversation between Strangers using a Chatbot with ML-infused Personalized Topic Suggestion

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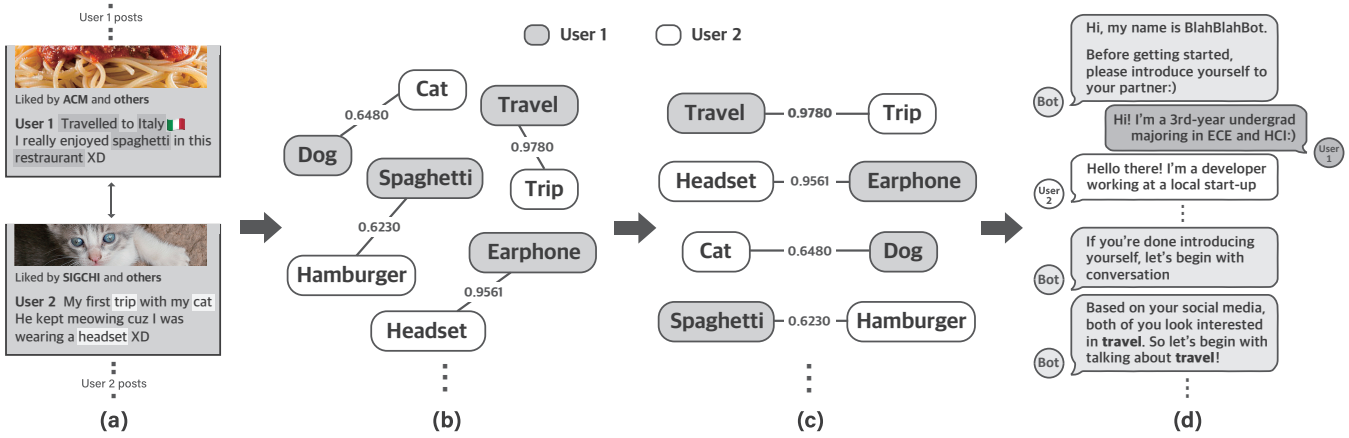

Figure 1: How BlahBlahBot drives topics and moderates conversation between strangers. (a) After extracting keywords from each user's social media posts, the system (b) matches each word and sorts out the closest word pairs, and (c) ranks them by semantic similarities. Then, the highly ranked words are later used as topic candidates for (d) moderating conversation

ABSTRACT

It is a prevalent behavior of having a chat with strangers in online settings where people can easily gather. Yet, people often find it difficult to initiate and maintain conversation due to the lack of information about strangers. Hence, we aimed to facilitate conversation between the strangers with the use of machine learning (ML) algorithms and present BlahBlahBot, an ML-infused chatbot that moderates conversation between strangers with personalized topics. Based on social media posts, BlahBlahBot supports the conversation by suggesting topics that are likely to be of mutual interest between users. A user study with three groups (control, random topic chatbot, and BlahBlahBot; N=18) found the feasibility of BlahBlahBot in increasing both conversation quality and closeness to the partner, along with the factors that led to such increases from the user interview. Overall, our preliminary results imply that an ML-infused conversational agent can be effective for augmenting a dyadic conversation.

CCS CONCEPTS

• **Human-centered computing** → **Interactive systems and tools**; **User studies**.

KEYWORDS

chatbot, topic suggestion, computer mediated communication, chat moderation

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1 INTRODUCTION

Having a chat and building a relationship in online settings is prevalent in the digital age [14]. Since it is convenient to gather online under common objectives or interests, people often try to form and maintain relationships with whom they have never met offline before [11, 14]. For example, users of online chat and blinding dating apps converse with the partner to get familiar with each other, and multiple users in digital communication platforms (e.g., Discord) exchange messages to get familiar and create communities.

In such situations, however, people often find it difficult to initiate and maintain a conversation with new acquaintances due to the lack of predictability [5]. Since they lack information about strangers, it takes time to discover common interests, which often prevents from developing and intensifying a conversation. Although several existing works have explored methods to suggest conversation topics to facilitate conversation [8, 16], they are mostly based on enhancing conversation between strangers in face-to-face settings. Plus, such approaches are limited in efficiency and the extent of self-disclosure, considering that they often require a manual collection of topics from users in advance [16], or simply make use of a limited amount of information such as user's basic profile [8].

Thus, by extending this literature, we designed and developed a chatbot agent that helps strangers converse by automatically suggesting topics that are of mutual interest. Specifically, based upon the idea that user-generated posts in social media reflect the users' daily life interests [3], we present BlahBlahBot, an ML-infused chatbot that automatically recommends conversation topics that are of mutual interests with users' social media posts. BlahBlahBot recommends topics by crawling Instagram posts of each user and creating sets of the most adjacent keywords by measuring semantic similarities with a pre-trained model.

To evaluate the effectiveness of BlahBlahBot, we conducted a preliminary user study with 18 participants consisting of three groups (control, random topic chatbot, and BlahBlahBot) with a mixed-method approach. Throughout the study, we identified that BlahBlahBot group reported higher conversation quality along with the closeness to the conversation partner, and exchanged messages more with the partner compared to groups who used control and random topic chatbot. Based on the quantitative results, we also report factors that attribute to such increase from the interview, along with the possible enhancement and research direction of social media based topic suggesting chatbot.

2 RELATED WORK

In this work, we start by reviewing the previous studies on supporting conversation between new acquaintances and the communication mediated by AI.

2.1 Supporting Conversation between Strangers

People often encounter a conversation with strangers, yet it is often considered difficult to initiate and maintain a conversation in such situations. Under the circumstance where a limited amount of information is available, the lack of predictability between strangers is known to make it difficult to converse [5]. Since a higher level of self-disclosure is essential in developing relationship [1], previous studies have mainly focused on helping stranger communication by suggesting topics on which they are able to disclose themselves with the topics.

Specifically, most of the previous works have focused on the face-to-face circumstance and aimed to develop various methods that draw conversation topics to facilitate conversation between new acquaintances. For example, Jarusriboonchai et al. developed systems that show social media profiles in a wearable device to support stranger conversation in a co-located situation [8]. Nguyen and his colleagues developed a system that offers topics that are pre-defined by users during a conversation via Google glass [16]. Throughout such approaches, researchers aimed to provide strangers with topics that act as information of each person during the conversation in offline settings.

However, although lots of first-time encounters also happen in online settings, these studies are limited to supporting conversations of strangers in face-to-face situations. On top of that, they still heavily rely on users to manually input topics within the system, or only make use of a little amount of user data for personalization (e.g., biography in social media). In this work, to further ensure more efficient personalization and support conversation between strangers in online settings, we propose a topic-recommending system that automatically crawls user-generated posts in social media and suggest topics of common interests. Specifically, considering that chatbots are (i) text-based and (ii) recently featured as a promising medium of mediating communication [9, 13], we considered chatbot to be suitable for examining online conversation, thus utilized as a medium of communication in this study.

2.2 AI-mediated Communication

As machine learning (ML) and artificial intelligence (AI) are introduced to our daily lives, they have also been affecting interpersonal communication. This paradigm, which is represented as a concept of Artificial Intelligence-Mediated Communication (AI-MC), implies the feasibility that interpersonal communication is not only transmitted by technology but modified, augmented, or even generated by a computational agent to achieve communication goals [7].

Recently, researchers have investigated various ways of augmenting interpersonal communication with the use of AI technology. Particularly, mediating and organizing the user-generated contents with the use of natural language processing (NLP) techniques is a representative application of AI-MC, and they have been applied not only to organize and recommend content but also to capture the nuanced interpretation of the conversation [18]. For example, such techniques have been utilized to benefit the moderation of group discussion [9], filtering harmful contents [6], and enriching affectionate messages with the set of music lyrics [10].

In light of these findings from the previous studies, we propose an application of augmenting interpersonal communication between strangers with the use of ML-oriented technique. Specifically by showcasing an ML-infused topic suggestion chatbot, we aim to identify if such an algorithm can enhance interpersonal relationships of strangers by recommending common interests based on their digital data. Furthermore, with letting users make an eventual decision on subjects from the recommended topics for discussion, we seek to focus on a system that is not entirely dependent on the

automated reasoning but also includes the flexibility to ensure the user control.

3 PROTOTYPE DESIGN OF BLAHBLAHBOT

Based on the literature that self-disclosure between strangers on mutually rewarding topics during a conversation might benefit for further developing relationship [16], we structured our idea of a social media-based topic recommendation chatbot that (1) first retrieves user information to drive and recommend topics and (2) mediates conversation between strangers using the driven topics. Specifically, we used users' social media (i.e. Instagram) data to elicit their interest.

3.1 Topic Recommendation

3.1.1 Topic recommendation flow of BlahBlahBot. First, the system crawls posts from each user's social media account. Among the whole text extracted from the posts, the system extracts free morphemes (morpheme that can stand alone with a meaning) from it. In case some unnecessary words might still exist, the system removes stopwords (e.g., *he*, *where*) from the pre-defined stopwords list.

Once the pre-processing is complete, the system matches mutual interests between users based on the extracted data. Specifically, the system embeds each word as a vector and compares every pair from each user by calculating a semantic similarity with a pre-trained model. Once the similarity for each word combination is ready, the system sorts all the pairs by the semantic similarity. Then, the system extracts the top 20 word pairs and randomly chooses one word in each pair. The overall flow of extracting keywords is shown in Figure 1.

3.1.2 Preventing unwanted topic recommendation. Previous studies on topic recommendation found it important to avoid unwanted topic curation of users for the sake of flawless communication [12]. Similarly, we considered that some unremoved stopwords appearing during the conversation might be detrimental to the user perception toward moderation. Plus, since our topic recommendation is driven by users' social media posts, there may exist the possibility of undermining user privacy. As such, we decided to let users first choose topics among candidates recommended by the moderator to avoid proceeding with a conversation with undesired topics.

Prior to initiating the conversation, each user is asked to choose keywords that the user want to deal with during the conversation, among 20 candidates offered by BlahBlahBot. Then, BlahBlahBot first prioritizes mutually chosen topics, then adds topics chosen by only one user to the topic queues of which the system makes use after all the mutually chosen topics run out. Since such mutually exclusive topics are (i) also driven from data of both partners and (ii) appearing after the mutual topics run out, we considered this approach to be safe with little possibility of undermining user privacy and preventing uncanny valley toward the system.

3.2 Conversation Flow

Conversation between strangers is first initiated by the browsing of each other and ice-breaking, which is later maintained and strengthened by topics on self-disclosure [12]. Referring to the procedure, we structured the conversation flow of BlahBlahBot as follows (Figure 1).

Once both of the partners enter the chat room, BlahBlahBot initiates the conversation by briefly describing the role of the chatbot. Then, the system asks participants to introduce themselves for 2 minutes. After the self-introduction time, BlahBlahBot starts suggesting topics by combining topics ordered in a priority with pre-defined sentence templates (e.g., *"Based on your social media, both of you look interested in [topic]. So let's begin with talking about [topic]!"*). Each topic lasts for 4 minutes, and BlahBlahBot suggests four topics in the same way. Once the partners end up having a conversation, BlahBlahBot gives 2 minutes to wrap up the conversation between partners. As such, BlahBlahBot is designed to moderate the conversation between two strangers for 20 minutes.

3.3 Implementation

BlahBlahBot system is implemented as an iOS application, and Instagram was used as a target social media platform. Once users log into Instagram, the app first crawls and sends users' posts to the AWS EC2 server, where the data of two participants are processed to determine the closest topic pairs.

For extracting free morphemes, we utilized KoNLPy [17], the most popular pre-trained NLP library targeted to the Korean language. Once extracted, the system vectorizes them and calculate pairwise similarities using Word2Vec [15] technique based on the pre-trained embeddings from Korean Wikipedia documents. Even though we could have utilized BERT [4] for implementing our task, we decided to apply Word2Vec for the following reasons: (i) BERT may have multiple vector representations for the same word (thus does not fit our objective that words should be derived based on the pairwise distance and combined with our pre-structured questions) and (ii) the network of BERT is heavier and computational cost is accordingly higher, so it may give a negative effect to our goal of immediate topic suggestion.

Above all, we considered user privacy important during the process of deriving topics in our system, since the system makes use of the user data from social media posts that might include personal information. As such, we programmed the server to invalidate user data after sending topic candidates to each user, and user conversation data from the chat interface showing up after the topics are determined is saved with anonymous identifiers.

4 USER STUDY

4.1 Method

4.1.1 Participants. We recruited participants by posting an announcement on the online community website.As a result, 18 participants were recruited in our study (M_{age} = 26.56, SD_{age} = 5.10; 10 female). Once participants completed the procedure, they were compensated with an approximate value of 10 dollars for their participation.

4.1.2 Study design. The study used a between-subject design, assigning six participants to each of the following conditions randomly: **control** (control group), **random topic suggestion** (random topic chatbot group), and **ML-infused topic suggestion** (BlahBlahBot group; M1 ~ M6). In each condition, we randomly formed

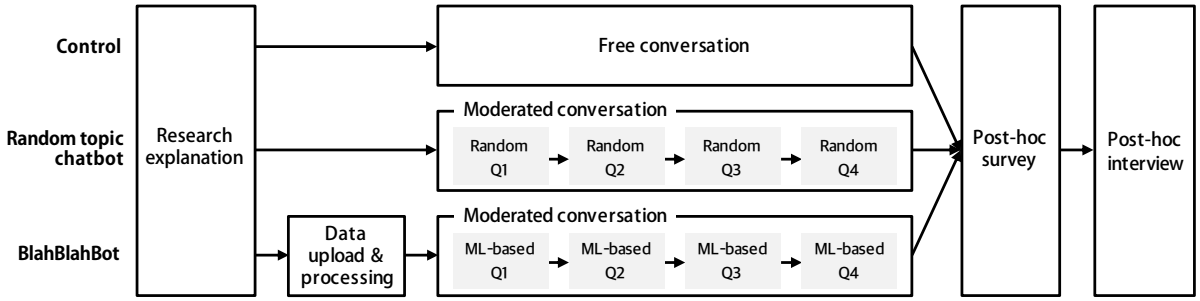

Figure 2: Experimental procedure of each group. Participants in all conditions had a conversation as a pair for the same time period

three pairs each of which was asked to have a conversation under the following details.

In order to understand if BlahBlahBot facilitates conversation between strangers well compared to the other conditions, we designed the conversation moderation of control and random topic chatbot under the same condition of time with BlahBlahBot, lasting for 20 minutes. Under the controlled condition, two participants in each pair were asked to have a conversation without any moderation, and the chatbot agent only offered basic instructions to the participants (e.g., *"Please start the conversation"*). In the random topic suggestion condition, random topic chatbot moderates the conversation similar to BlahBlahBot, except that the chatbot asked each pair to have a conversation on four random, predefined topics (e.g., *"What are you planning to do this winter?"*) without suggesting personalized topics.

4.1.3 Procedure. Two participants who do not know each other were matched as a pair and took part in the online experiment. Before initiating the experiment, two researchers provided a brief explanation about the procedure to each participant through a call. Next, participants were asked to install the application, in which they had the conversation and post-hoc interview. Once setting up the environment, two participants were invited to a chat room to conduct a conversation by entering their unique IDs previously notified by the researcher. When the conversation was over, the participants were then automatically invited to a private chat room by the system, in which only a chatbot agent and a single participant stay for a post-hoc interview. As such, every participant took part in the study remotely.

4.1.4 Measure. The goal of topic suggestions in BlahBlahBot is to support strangers by facilitating conversation and inducing them to be closer. Thus, we decided to measure **conversation quality** and **closeness to the partner** for assessing our chatbot. Specifically, we followed questionnaires from Burgoon and Hale's study that explores the measure of relational conversation [2]. Each participant was asked to rate the questions of each measure based on 7-point Likert scale, and the scores were averaged to measure the overall conversation quality of each participant.

Specifically, five questions were used to assess conversation quality: *"I enjoyed the conversation with my partner"*, *"The conversation was interesting"*, *"I was able to express my opinions"*, *"Finding topics of mutual interest was easy"*, and *"I want to talk with my partner again"*. Similarly, closeness to the partner was measured with the following inquiries: *"I was emotional in the conversation"*, *"During the conversation, I connected with my partner easily"*, and *"The conversation I just had was intimate"*.

We also gathered qualitative responses using open-ended questions to gain richer insight into the user perceptions and attitudes toward our system and the chatbot-mediated conversation system. The participants were asked about their experience of using the chat system and possible enhancements (e.g., *the best and the worst aspects of using the system, idea for the technical assistance to promote online intimacy and relational enhancement*). Two authors coded the responses until the themes were driven, and later translated them into English for reporting.

4.2 Results

4.2.1 Usage pattern. During the conversation, participants who used BlahBlahBot exchanged messages with the partner the most, although the conversation lasted for the same time. They sent 176.3 messages (SD = 34.5) during the conversation on average, which is followed by random topic chatbot group (M = 96.7, SD = 32.3) and control group (M = 93.3, SD = 43.9). This pattern is also correlated with the average time interval between messages. The average time interval between messages is 6.8s (SD = 1.3) in BlahBlahBot group, while those of random topic chatbot and control group are 13.0s (SD = 3.9) and 14.4s (SD = 5.3), respectively.

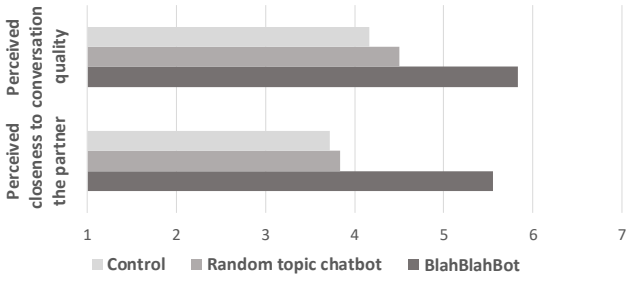

Figure 3: The average score of the survey. BlahBlahBot users showed the highest score in both conversation quality and closeness to the partner, followed by the random topic chatbot groups and control groups

4.2.2 Conversation quality. During the experiment, participants who used BlahBlahBot reported that topic suggestion relieved the burden of finding such shared topics and acted like a mean of sharing personal experience, thus leading them to disclose their experience on their interests more quickly: *"It was really effective that I don't have to spend much time looking for the same interests with my partner"* (M3)

Such reports from the participants are also backed up with the quantitative results. Participants who used BlahBlahBot showed the highest rank for the perceived conversation quality (M = 5.83, SD = 1.23), which is higher than the random topic chatbot group (M = 4.50, SD = 2.02) and control group (M = 4.17, SD = 1.64). Findings from the interview suggest several factors that mainly increased their perception on conversation quality using BlahBlahBot:

- **Satisfaction on the suggested topics**: Since the suggested topics were based on users' Instagram data, participants reported that the topics suggested by BlahBlahBot were highly relevant to their interests. This was reported to be helpful for preventing conversation breakdown: *"The topics that the bot had suggested was very relevant to what I'm interested in (...) I guess this prevented the conversation from the breakdown."* (M4)
- **Prevention of unwanted topics**: In order to prevent unwanted topics, we first let users choose topic candidates that would be later dealt with during the conversation. From the user study, we found that such an agency for users helped participants avoid confusion and have a relevant talk: *"The system first suggested me some topics and choose (...) this made me have a talk on meaningful topics during the conversation."* (M6)
- **Prioritization between common and mutually exclusive topics**: We designed BlahBlahBot to suggest the mutually selected topics first, and the system offers the topics that only one participant chose once the mutual topics ran out. From the interview, participants reported that such topic prioritizing was effective without undermining conversation quality, since they had already talked a lot before having to talk about topics that only one person chose: *"There was a topic that didn't overlap at the end, but we had already talked about common interests so much before then so it didn't matter at all."* (M4)
- **Prior relief on the system**: BlahBlahBot tells that the conversation topic is based on the social media of users (Figure 1d). Such an understanding of participants on how the system works was also reported to make them feel more comfortable in the conversation. Participants reported that this helped them proceed with the conversation without having to worry about the partner's satisfaction on the conversation excessively: *"Since I believed that we were talking about topics that we both are interested in, I didn't have to worry about whether the other person might not like the topic (...) this facilitated the conversation."* (M2)

4.2.3 Closeness to the partner. Along with the conversation quality, BlahBlahBot group also showed the highest closeness to their partner after using the system during the survey. The average score of perceived closeness to the partner was 5.56 out of 7 (SD = 1.71), while the score of random topic chatbot and control group are 3.83 (SD = 1.28) and 3.72 (SD = 1.99) on average, respectively. From the interview, we identified the following factors by which BlahBlahBot induced the increase in closeness toward the partner:

- **Time efficiency**: Without having to come up with unnecessary questions and take time to talk about them for long, they were not exhausted in the initial phase and could have a relatively long time for talking about deeper, personalized topics under the moderation of BlahBlahBot. This led them to become comfortable quickly and have more opportunities to feel closer: *"Being shared with common interests by the bot, the awkwardness between me and my participant didn't last long (...) thus felt comfortable."* (M6)
- **Satisfaction on the suggested topics**: In addition to the conversation quality, satisfaction on the suggested topics was also reported to make participants consider their partner to be more reliable. Specifically, they reported that topics reflected their mutual interests well, which led them to feel like they already knew the partner. This ultimately made them feel more comfortable on the conversation and partner: *"Although my partner was a stranger, I felt as if I knew him already by noticing the common topics (...) This system would work perfectly for chatting in the blind dating app."* (M1)

4.2.4 Future enhancement. Although most of the participants who used BlahBlahBot were satisfied with the system and willing to use the system again, some of them also suggested a valuable suggestion regarding conversation duration for each topic. Specifically, we designed the system to change topics over time in a rule-based manner (fixed time for each topic), but some participants reported that they enjoyed the conversation on specific topics so much that they don't want to move on to the next topic right away. This report implies the need for ensuring user agency of managing time for each topic, such as time add-up command functionality for extending time of the ongoing topic: *"It would have been better if the system gives us an option to prolong the time for the current topic."* (M1)

5 DISCUSSION & FUTURE WORK

During the initial conversation, strangers often start with basic, short-lasting questions that serve as a transition to a deeper relationship [16]. Although more personal questions are needed for deepening the conversation, it is often difficult to find such topics due to the lack of shared information [5]. In this study, we aimed to support conversation after such ice-breaking time with the aid of an ML-infused system. Our results revealed that strangers who were recommended with topics based on their social media data evaluated the quality of the conversation higher and felt closer to the partner they talked to. As such, we could identify an initial insight that automatically generated topics with ensuring users to choose topic candidates beforehand helped facilitate conversation between strangers.

We could also identify the possibility of extending our work to other online-based services. During the study, M1 noted that the system might also work well with a chat in an online blind dating situation. Similarly, considering the modality of the text-based chatbot agent system, we believe that our approach is applicable to other various online services as well, such as gaming platforms

and online communities where the text is a predominant medium of interpersonal conversation.

Still, our study has several limitations to be addressed in the future. First, although we gained valuable insights from our user study, we conducted a user study with 18 participants where more participants might be required in terms of generalizability. Second, since we limited the scope to utilizing data from Instagram, further analysis with other social media platforms is required to find if the result is valid with utilizing contents from other media (e.g., Facebook, Twitter) as well. Finally, since we assumed a text-based online communication as our background, further investigation is needed when other communication methods (e.g., voice, photo) are also available along with the text.

6 CONCLUSION

In this work, we presented an idea of facilitating conversation between strangers with an ML-infused topic suggestion chatbot: BlahBlahBot. BlahBlahBot matches words from the social media data of each user and finds the most closest topic candidates, then moderating conversation with the topics after users select the topics they want to talk about. From the preliminary user study with 18 participants, we identified the feasibility of facilitating stranger communication with an ML-infused topic recommendation chatbot.

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