# Making Sense of Foreign Language Posts in Social Media

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Many[1] people's social media feeds include posts in languages they do not understand. While previous research has examined bilingual social media users' language choices, little research has focused on how people make sense of foreign language posts. In the present study, we interviewed 23 undergraduate social media users about how they consume and make sense of posts in other languages. Interviewees reported that they often did not pay attention to or engage with foreign language posts, due to a lack of relevance and contextual knowledge. When they did actively engage with foreign language posts, interviewees did not rely solely on machine translation output but instead actively collected and combined various cues from within and outside the post in order to understand what it was about. Interviewees further reported different types of goals for trying to make sense of foreign language posts; some focused on simply extracting and understanding the emotional components of a post while others tried to gain a fuller understanding of a post, including its contextual and cultural meanings. Based on these findings, we suggest design possibilities that could better aid multilingual communication in social media.

CCS Concepts: • **Human-centered computing** → **Collaborative and social computing** → Empirical studies in collaborative and social computing

**KEYWORDS**

Sense making; multilingual communication; social media; machine translation

## 1  INTRODUCTION

Because the user base of many social media sites is multilingual [14, 17], speakers of a particular native language such as English are likely to encounter posts in other languages in their own social media streams. For example, a native English speaker might have bilingual contacts who share in multiple languages or repost information received from one linguistic community in another language [7, 14, 36]. Linguistic and cultural diversity in social media streams provide opportunities for people to encounter and interact with diverse social connections [9, 19]. It is not clear, however, whether people take advantage of these opportunities or whether they instead disregard posts in languages they do not speak, thereby missing out on opportunities for intercultural engagement.

In a previous study, Lim and Fussell [21] used eye-tracking to understand people's visual attention to posts in English vs. a foreign language, with or without associated images, using a mock up Facebook

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newsfeed. As expected, monolingual English speakers spent more time looking at posts in English than in other languages, and more time looking at posts with images than those without. Interestingly, however, the presence of images helped overcome language barriers in that people spent more time looking at foreign language posts with images than English language posts without images. This finding provides initial evidence that features of posts can influence whether or not people engage with foreign language posts. However, because this study used an experimentally constructed timeline rather than the participants' own timelines, they were not able to investigate other interpersonal or contextual factors that could lead more or less engagement with foreign language posts. Also, this study did not address how people make sense of foreign language posts and how this sense making process is related to further interaction with a post such as liking or commenting.

The present study uses semi-structured interview methodology to build on Lim and Fussell's [21] findings. For the purposes of this paper, we use the phrase "foreign language" to refer to any language that a participant could not speak or read at all. We interviewed 23 undergraduate social media users about why they sought to understand foreign language posts in their Facebook feed, the sense-making strategies they use to infer what the post was about, and how this sense-making shaped their decisions about whether to engage with a post via liking or commenting. Interviewees reviewed their timeline with us and for each post written in a foreign language, they answered a series of questions about how they usually consumed and made sense of such posts.

Interviewees reported that they often skipped over or ignored foreign language posts due to a perceived lack of relevance and an inability to understand the post. However, when they did decide to engage with a foreign language post, interviewees reported foraging for information both within the post (e.g., identifying objects in photos) and outside the post (e.g., via Wikipedia or machine translation) in order to understand its meaning. Additionally, we identified different types of sense making goals and strategies. Based on our findings, we explored design possibilities that could better aid cross-lingual communication in social media.

In the remainder of this paper, we first provide a brief overview of previous work on multilingual social media use and outline our research questions. Then, we describe our interview protocol and interviewee characteristics. We then report our findings based on a grounded theory-based analysis of the interview transcripts. Finally, we discuss the implications of our findings for the design of systems to improve sense making when people encounter foreign language posts in social media.

## 2 BACKGROUND

Most popular social media sites such as Facebook present contents from one's connections either in chronological or an algorithmically curated order. Naaman et al. [25] characterized real-time streams of messages as 'social awareness streams', where most of the information is consumed within social media. The affordance of social media streams makes it possible to consume and interact with much content not only from one's own linguistic cluster but also from speakers of foreign languages [15].

However, social media interaction is still heavily influenced by language as people interact with others who use the same language most of the time [15, 35]. Large-scale data analysis of Twitter revealed that heterogeneous spoken languages and cultures among users predicted less communication volume [13]. Also, Lim and Fussell's eye-tracking study [21] found that monolingual English users paid less attention to, and indicated less willingness to interact with, foreign language posts than English ones.

Previous studies of monolingual social media settings examined what aspects of social media posts lead to greater attention. In general, posts from friends attract more attention than those from organizations or news media [6]. Structural characteristics of posts also affect how much attention they receive. For example, people pay more attention to posts with richer content like images or links [6, 37]. Will these relational factors and post characteristics also influence people's attention and interest in foreign language posts? Lim and Fussell's study [21] already revealed that people spent more time looking at foreign language posts with images than English language posts without images. To further explore what determines people's attention to foreign language posts, we posed the following research question:

**RQ1**: What factors determine how much attention people pay to foreign language posts?

When people decide they want to understand a foreign language post, what strategies do they use to make sense of it? Sense making is an iterative process involving foraging information and generating multiple explanations to answer a question or complete a task [29]. People engage in sense making when they encounter something novel, ambiguous, unexpected or confusing [22]. Fairly extensive sense making may be required for understanding foreign language posts since people are likely to have less knowledge about contexts and situations in different linguistic communities [2, 26]. To bridge the knowledge gap, how do people engage in sense making process?

In addition, using machine translation on foreign language posts may be a central way to make sense of them to overcome the language barrier. Many previous studies revealed both positive and negative effects of machine translation in online communication and collaboration [e.g. 6, 30, 31]. However, these studies focused on investigating the influence of machine translation on synchronous text-based communication context. As interaction in social media streams is basically asynchronous and not entirely text based, it may yield novel findings to understand how machine translation plays a part in social media interaction and sense making. Therefore, we posed our second research question:

**RQ2**: How do people make sense of foreign language posts? How does machine translation play a role in this process?

Beyond passive browsing of social media posts, people can contribute to others' contents as more active form of social engagements such as clicking "Like" or leaving comments. Previous literature revealed that structural characteristics of a posts or closer relationships with posters were associated with greater interaction [6, 20, 34]. Lim and Fussell's study [21] showed that while the presence of images could elicit attention to foreign language posts, this visual attention did not correspond to a subsequent willingness to like or comment on the posts. However, since their study did not use participants' actual Facebook timelines there was no consideration of how individual and relational factors influenced users' willingness to interact with a post. Also, they could not show why users were less willing to interact with foreign language post than English ones. Therefore, we posed our third research question:

**RQ3**: How do people interact with foreign language posts?

## 3 METHODS

To investigate our research questions, we conducted semi-structured interviews. Twenty-three participants (7 males, 16 females, age range from 18 to 25) were recruited from a large U.S. university. According to the official statistics of the university, more than 20% of their students were international students. Based on this fact, we assumed that these students were likely to have some linguistically diverse connections in their social networks. Participants were recruited through a university participants pool, and they were compensated with extra class credits. We recruited only participants who visited Facebook at least 3-4 times a week. Of these, 70% of them were U.S. citizens, and the rest held diverse citizenship (e.g. China, India, U.K.) or held dual citizenship (e.g. French-American, Chinese-American). About two thirds of the participants (14/23) spoke English as their native language, while the rest (9/23) used English as their second language. On average, participants had 760.2 contacts on Facebook. Most participants (20/23) reported that they had some foreign connections who posted some of their updates in a language they could not comprehend. As the example of those connections, they mentioned past exchange students from overseas, friends who met when they traveled or studied overseas, relatives who lived in foreign countries, or international students who met here in the college. They self-reported that about 15.2% of posts in their newsfeeds were in foreign languages.

The interview questions focused on participants' social media use, particularly the consumption and sense making of foreign language posts. After participants had reported their basic demographic information and general social media use, we asked them to browse their own Facebook timeline as they usually did. When they encountered a post written in a language they could not understand in their newsfeed, we asked them to think aloud how they usually consumed and made sense of those posts. Also, we inquired about what they would do to get a better understanding of a post. In addition, we asked them to name a friend who often posted in a language that they could not understand and then to visit that friend's

profile page. For the posts in those profiles, we repeated the above interview procedures. For every post that participants showed us, we also asked relationship type and closeness with the posters and their initial impression and perceived difficulties in understanding.

During the interviews, the first author led the conversation while a research assistant took structured notes of each post that participants showed us. For each post, we took notes about the poster, the post language, the format of the post (e.g. text, picture and text), and participants' sense making strategies and barriers. In the last section of the interviews, participants freely addressed some difficulties in sense making and design ideas that could help them to better understand foreign language posts. Immediately after each interview, researchers discussed and added reflective notes about the interviewee's sense making practices. All interviews were audio recorded and transcribed. On average, interviews took about 45 minutes.

Through the interviews, participants showed and explained 109 social media posts overall. Those posts were written in 19 different languages (e.g. Chinese, Korean, Italian, Spanish, Hindi, Norwegian, Turkish). In analyzing the data, we first created the table for data analysis by combining the rows for each post in the structured notes with the portion of transcripts in which the participant talked about the post. Then three researchers coded the table independently before comparing codes. After refining the codes iteratively and resolving disagreements, we could identify some common themes. Based on these identified themes, we recoded the interview data and developed and discussed the emerging themes that did not fit to earlier categories iteratively.

## 4 FINDINGS

The findings from our interview analysis are organized in four main sections. First, we examine what factors determine how much attention people pay to foreign language posts. Next, we characterize the sense making process. Then, we examine how machine translation played a role in participants' sense making processes. Finally, we explore how people interact with foreign language posts after sense making.

### 4.1 Foreign Language Posts and Attention

**RQ1** inquired about what factors determine how much attention people pay to foreign language posts. Interviewees reported that they often skipped over or ignored foreign language posts. They explained why they were often reluctant to engage with foreign language posts.

First, some participants (8/23) felt that the use of foreign language in a post signaled that the post would have less relevance to them. They assumed the poster might intend or expect their post to be understood by their connections who could understand the language of the post. Therefore, they thought that posters did not expect them to understand or engage with those posts. For example, P18 felt he would not be the expected audience of his friend's post that was about Puerto Rican presidential election written in Spanish.

> It's all about audience. If they're writing a very long post in Spanish about something happening to the Puerto Rican government, they know that most people who are not from their country aren't going to go through or even understand the context. (P18, U.S., Male)

In addition, some participants (6/23) thought that foreign language in posts indicated that more cognitive effort would be required to understand them in comparison to English posts. This expected cognitive burden made them reluctant to engage with foreign language posts. P23 explained that the additional cognitive burden of processing foreign language posts was inconsistent with her goal of using social media for entertainment:

> I usually skip foreign language posts. I guess because cognitively I had to think about it harder than usual. I go on Facebook for enjoyment to get away from work, but it's like work again. (P23, U.S., Female)

Most importantly, participants felt the perceived inability to comprehend others' contexts and culture in addition to the language barrier. P21 said that it was likely that he would lack the knowledge about other cultures and contexts needed to understand foreign language posts.

*The language is a barrier. But, beyond language I would say just you generally just have less context with somebody's who's foreign.* (P21, U.S., Male)

However, there were instances where foreign language posts did gain attention. One important factor that could increase attention was relational closeness. Participants reported trying to pay attention and comprehend the posts if they felt close with the poster or if they felt the poster was socially attractive. This tendency was driven by "social interaction" motives [33] that people want to keep in touch with and maintain relationships with their connections through social network sites. To attain these relational goals, participants felt they needed to pay attention to and comprehend the posts from their close connections regardless of language. Participants also noted that the added attention paid to foreign language posts from close relationships was in part due to the added background knowledge they had about the posters, such as where they lived, what they liked to do and what they usually posted about. This added background knowledge helped participants feel confident that they could understand and interact with the post in spite of the additional cognitive burden of processing foreign languages.

Another factor that led participants to pay more attention to foreign language posts was the presence of visual components, as reported by Lim and Fussell [21]. Even when posts were from less close relations or had less perceived relevance to them, participants reported that they were likely to pay more attention to attractive or interesting visual images. P13 explained that a cute photo could attract her attention regardless of relational closeness:

*The only reason the foreign language post about little baby elephant caught my eye was not because I know the guy or like anything about him, it was just a cute picture.* (P13, U.S./France, Female)

## 4.2 Making Sense of Foreign Language Posts

**RQ2** asked about the sense making processes people use when they encounter foreign language posts. Not surprisingly, participants mentioned that they actively used machine translation tools provided by social network sites to make sense of foreign language posts.

However, participants did not rely solely on machine translation output to make sense of foreign language posts, partly because current machine translation technology cannot handle the colloquial nature of social media messages very well. However, even when the translation quality was acceptable, the literal translation of a post sometimes could not give sufficient information for sense making. There were several situations when mere machine translation might not sufficient for sense making.

In some cases, the text contents of social media posts were too short or incomplete. In those cases, although machine translation output was clear, it did not provide much information. Also, as many social media posts include visual elements, just understanding the verbal meaning of a post could not give enough information for overall sense making. P13 echoed the difficulties in interpreting both text and visual components of a post at the same time.

*If there is an image accompanying it, it can imply what the caption is, but some people don't caption anything that's directly related to the picture. Maybe the translations could be more accurate to handle this case?* (P13, U.S./France, Female)

In addition, understanding the context of a post requires holistic understandings beyond the literal translation of the text. Current translation technology cannot adequately consider cultural, contextual and social meanings that foreign language texts may have. P7's account highlighted why getting a translation is not enough for sense making;

*Even if you translate it, you still can't understand it, because you don't understand something cultural or specific situation.* (P7, U.S., Female)

Therefore, it was only in rare cases that simply translating text content was enough for sense making. Rather, participants used machine translation output as a complementary cue while they actively foraged various cues from in and outside of a post.

Another interesting finding arising from the interview data was that people varied in their sense-making goals for foreign language posts. One type of goal was focused on grasping the main emotion or sentiment of a post. For example, both P10 focused on extracting emotional cues:

> *I have no idea. [hits translation button] No, the translation is messed up. Boxes are full of nonsense. I have no idea what that means. But this looks like some family dinner thing, so maybe she is trying to get together with her family. And she's put the emoticons as the heart ones, so she should be happy.* (P10, India, Female)

In other situations, participants tried to understand not only the actual content but also the cultural context of foreign language posts. P3 explained how he made sense of a status update from his friend from India. He focused on understanding the cultural meaning and significance of that event:

> *I know some of them for Indians, once a girl is a certain age, it's like a huge birthday celebration, so similar to some US traditions, but not 100%. So, I googled it to see what the celebration was about. It is just good to know. Usually I found the keywords from the title of the photo album like the name of holiday, and then I just googled it.* (P3, U.S, Male)

As shown above, participants varied in their sense making goals. These differences might be due to individual preferences or the genre of the posts (e.g. sharing travel photos vs. sharing opinion about a political issue). However, even for similar types of posts, participants' approaches varied. For example, some wanted to know whether the poster of a travel photo had a great time or not while others were more interested in gaining information about the place where the photo was taken. Also, for news posts, some focused on making sense of whether this news made the poster happy or angry while others tried to figure out what the news was about.

In the following sections, we describe how people make sense of foreign language posts in more detail. To start the sense making process, users foraged for various cues within a post. Based on these cues, they then added their background knowledge or searched for further information from external sources. Machine translation was used in combination with other cues for various purposes.

### 4.2.1 Information Foraging within a Post

In sense making of foreign language posts, participants first started by observing a post and collected useful cues for sense making. Since people could not comprehend the text contents of the post at sight, they depended on the visual contents of a post in foraging initial cues. Visual images helped them quickly grasp the general genre or topics of a post. Especially when the visual image appeared to be about common social media topics (e.g. food, pets, travel), they believed could make sense of the post easily just based on visual images.

> *The picture helps to capture whether it is a highly personal one or other types of status updates. If it's personal and common stuff, you're traveling, eat food, you have hard homework complaining, I think it's not that hard to understand.* (P11, China, Female)

Also, some participants believed that visual images could give them much more clear and unbiased understandings than the text because language could carry different meanings across cultures and therefore translations could mislead them.

> *I think visuals people in general are able to respond to more clearly. Even the simplest statement can get confused depending on translation and different cultural meanings. You know one word can mean something completely different from different cultures but ultimately a photo can like just be a photo.* (P9, U.S., Female)

Because participants depended heavily on visual images for getting initial ideas about a post, some felt that having no image was as serious a problem in the sense making process as the language barrier itself.

> *I think the language barrier itself is probably the most difficult, but, also without the visual that kind of makes everything fall, because you have nothing to back it up on exactly.* (P15, U.S., Female)

In foraging information from the text content of a post, some participants believed there would not be much useful information before it is translated. However, even without translation, the system provided some cues about the post that could be used for sense making, such as various types of tags (e.g. feeling, activity, geo, people tags) and meta data (e.g. poster, post time, post location). For example, P20 could contextualize the posts in her friend's timeline by foraging information about the poster.

> *I think it's a birthday post for my friend. I don't know who posted here for her. Probably her mother, because they have the same last name. [She looked at the profile picture of the poster] I mean, looking at her age in the profile picture, it's probably her mother. Yeah, her mother celebrated her birthday.* (P20, Female, U.S.)

Because feelings and activity tags are translated based on each user's language setting, it became the evident cues for sense making. Also, emojis in a post provided sense making cues especially for those who sought to understand the main emotion of a post. For example, P23 was sure that the post from her Turkish friend was about something 'light hearted or happy' based on a smiley face emoji.

> *She posted this one with a little caption in Turkish. Because there's a smiley face emojis in both text and comments, it's like light hearted or happy.* (P23, U.S., Female)

Participants reported gaining some useful cues not only from the contents of a post, but from others' responses to it. Especially now that Facebook offers "Facebook reactions" (e.g. Love, Haha, Sad, Angry) [10] as the extension of "Like" button, participants could observe how others perceived and responded to the post. This cue from others' reactions was seen as a very useful and credible resource for making sense of the sentiment and emotion of a post.

### 4.2.2 Machine Translation in Sense Making

As mentioned before, participant rarely relied solely on machine translation output to make sense of a foreign language post. However, participants did view machine translation as a useful tool for sense making. Participants made use of machine translation in different stages of the sense making process, for the different purposes.

When machine translation was used at the beginning of sense making, translation outputs provided initial ideas about the content of the post. Translation results helped participants to pick up emotional cues or keywords even when the translation results were not perfect. For instance, P18 did not get fully understandable translation output, but he could figure out what roughly the post was about and identify some keywords that he could use for further research.

> *It looks like reality TV. But I'm not sure. The translation here there's no connotation, and most of the parts aren't translated well. But, there's at least a lot more to work with.* (P18, U.S, Male)

Sometimes, machine translation output was combined with other clues and guesses that participants had before translating the post. Translation outputs gave them some additional contextual information. For example, P17 thought the post from her friends in Thai would be just about drinking coffee:

> *My friend is tagged in this post. There are some coffee mugs and then something written in Thai. And, it says the mood is "drinking something," which hasn't been translated. But it's probably just drinking coffee. Not very difficult. Oh, the translation said 'Coffee today with the grandkids'. Okay, that made a big difference. I couldn't have guessed "with the grandkids." That's out of left field, she doesn't look like a grandmother!* (P17, U.S., Female)

To get additional cues, some participants translated not only the text content of a post but also the comments on the post. They were particularly likely to do this when the translation of post text was incomplete or the post text was quite short. In the case of P13, she was not able to understand what the poster said in a post even after translating it. However, after translating the comments and tracking them down, she figured out what that post was about.

*This isn't a perfect translation I'm assuming, it doesn't make sense. Okay. [She starts translating the comments from the beginning] "We need to go eat together, the 4 of us", "yeah" that makes sense. And then, "let's do it together this weekend". And the next comment means "yes". I got this one, all the general information I could need from the comments.* (P13, U.S./France, Female)

Some participants used machine translation to verify guesses about the meaning of a post during later stages of sense making. Based on machine translation outputs, they confirmed or made changes to their initial guesses. For instance, P2 initially thought that his friends in Hong Kong was trying to sell safety gear, but the translation output made him dismiss his original guesses.

*I think it might be he's trying to sell something. But on translation, he's just saying that "it's like it's important to wear your safety gear". Yeah, I thought he was selling but that's not what he's doing. Okay.* (P2, U.S., Male)

However, poor machine translation output sometimes introduced more confusion. P18 mentioned that this compounding could be worse if he got only fragmented and partial translations from both the post and the comments.

*Often translation doesn't preserve meaning. I think the biggest problem is that compounds when both post and comments have to be translated too and so you're trying to figure out a translation by using context clues from other translations. So, that's kind of like a compounding error problem.* (P18, U.S., Male)

Participants noted that the current translation often could not handle names of foreign figures, food, and places. Furthermore, sometimes there was no option to translate embedded information within the Facebook interface such as a tagged place or link previews, and this sometimes further hindered the sense making process. For example, P21 showed us a post with a geo tag in Hebrew. He figured out the place was a park based on Facebook's provided place categories, but it was not that helpful.

*I thought this is a picture that requires the context of where. Without knowing the location, it really makes it more difficult. In fact there's no option to translate is definitely likely to make me skip the post. [He hovered over the mouse cursor to the geo tag] It says this place is a park so I guess it's a park. The park thing was useful but it's also nothing truly elucidating.* (P21, U.S., Male)

### 4.2.3 Making Connections with Background Knowledge

After users had foraged some cues from the posts and translations, they combined them with their existing background knowledge about the poster and situation to make further sense of a post. P9's account highlighted the importance of background knowledge about posters in making sense of a post.

*Sort of more knowledge about a person is really helpful, such as whether they are like you, know how they grew up, or things that they were interested in, things that they want to do. Ultimately their identity is what drives their posts.* (P9. U.S., Female)

Similarly, P2 states that he had no difficulty in understanding Chinese posts since he already had background knowledge about the poster and culture from in person interaction.

*He does dragon boat racing stuff, it's like a Chinese dragon boat festival and he manages one of these docks in Hong Kong. So, this must be about that. I know it, because I visited him when I was in Hong Kong, so he told me about that stuff back then.* (P2, U.S., Male)

This background knowledge about posters and situations was sometimes created by repeated exposure to similar types of posts without in person interaction with a poster. In the case of P5, he assumed that the Italian posts from his aunt had something to do with the healthcare in Italy considering her age and her usual topics for status updates.

*I have no idea what this is. It's all in Italian I just see like a doctor here, I'm assuming it has something to do with healthcare. I always expect maybe 1 out of 10 of her posts to be in line with health insurance,*

*healthcare, something along those lines which makes sense because she's getting old, she's in retirement.* (P5, U.K., Male)

However, when people did not have enough knowledge about the poster or context of a post, the sense making process often failed. For example, many participants found it hard to make sense of posts about culture, politics and current news, since they were less likely to have an adequate level of contextual or cultural understanding. For instances, although P14 got the relatively good quality machine translation results for her friend's posts from Peru, she felt she did not achieve full understanding since she had no knowledge of politics in Peru.

> *I think it's something about the president. It translates pretty well. It says 'any other presidential candidate has as clear as #BK as needed as to get Peru ahead, let's start by public safety'. When I just look at the translation, I would say I got the main idea, but I would have to do a lot for me to understand. I might need to read some English article about the Peru presidential election and campaigns if I really wanted to understand.* (P14, U.S., Female)

### 4.2.4 External Information Seeking

If participants failed to make connections with their background knowledge after searching cues internal to a foreign language post, some reported they stopped there, with partial or no understanding. However, other participants tried to gain a better understanding of the post by searching for external information. P5, for instance, aimed at gaining a fuller understanding of his friend's post by searching 'Persian New Year' to know its historical background and meaning. He valued this process as a cultural learning experience.

> *For me, it's more of a learning experience than anything else. That's what I love about having a diversified friend group, you get these aggregations of posts, and some have very unique things, like Persian New Year. I would have never known about until there was a post and I did my research that led me to a holistic understanding. I googled Persian New Year 2016, it gives you a day, and from there, I trail into Wikipedia, or some historical website, sent it on the points and history of the Persian New Year, and before you know it I've spent half an hour just researching.* (P5, U.K., Male)

To begin further information search, participants first needed to figure out keywords, such as names of events, traditions or public figures, to enter in the search engine. Sometimes it was easy to grasp the keywords if they were used in hashtags or in the title of a photo album. Participants could also identify keywords by skimming machine translation outputs. However, figuring out search words was not always easy if the keyword was not very salient as in P23's case or if the machine translation output was bad.

> *I think it is something political, but I have no idea, because it's completely in Turkish. Well there's been a lot of unrest in Turkey so it probably has to do something with that. I'm not very familiar with the details of it. I don't even know what to search.* (P23, U.S., Female)

In Figure 1, we schematize the sense making process for participants with two types of sense making goals: emotional understanding vs. a fuller cultural and contextual understanding. Participants who sought emotional understandings focused on extracting the emotional cues from a post (i.e. image, emoji, feeling tag). Then, they combined these cues with their background knowledge about the poster (e.g. she likes to play tennis) to figure out the dominant feelings of the poster in a post (e.g. she seemed happy). In contrast, participants who aimed for a fuller cultural and contextual understanding focused on figuring out keywords from a post (e.g. Persian New Year) that they could use for further information seeking (e.g. search 'Persian New Year' in Google and Wikipedia). Machine translation output worked as a complementary cue while they actively foraged various cues from in and outside of a post.
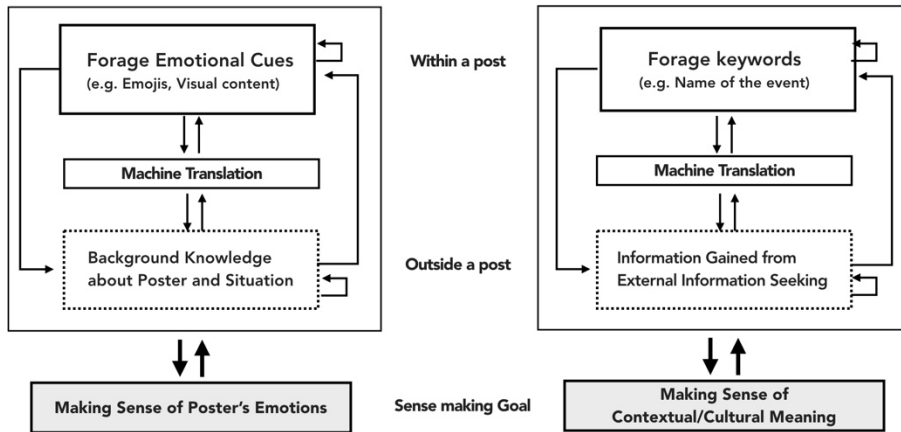
Figure 1 Schematizing sense making process by different sense making goals

## 4.3 From Sense Making to Post Interaction

**RQ3** asked how people interacted with foreign language posts. We asked participants if they had clicked "like" or commented on foreign language posts. About one third of participants answered they had clicked "like" several times while others had not. Even among those who had "liked" foreign language posts, it was very uncommon for participants to comment on a post. This may be because clicking "like" is a light weighted interaction which can be done with less consideration and consciousness [16] than creating comments appropriate for the post context.

Participants who reported they had "liked" foreign language posts explained that they liked those posts because they wanted to express social supports for the poster or to acknowledge viewing the post even though they did not completely understand the posts. However, participants reported needing a certain degree of understanding even for just clicking likes. P21 noted that he clicked likes to posts to show his support of his friends since he thought he had understood what was about "enough", even without much knowledge of the details.

> When my friend running the Chinese cultural events [posted], I just liked it just for showing support. But I don't think I have would have to fully comprehend whatever the historical significance of these things was. But I think I probably understand enough of it because I've heard of it. (P21, U.S., Male)

Participants who focused on extracting posters' emotions reported that they could relatively easily "like" a foreign language post. They felt they had enough understanding to do so once they figured out whether it was positive or negative in tone. P18's accounts gave an example for this case:

> I didn't know what it said but I still throw a like assuming it seemed happy in tone. (P18, U.S., Male)

On the other hand, participants who were more concerned about the fuller understanding of a post were afraid of being offensive or wrong in responding to others. If they thought they did not fully understand the context and cultural meaning of posts, they were reluctant to interact with it. As P5 noted, they usually spent a lot of time and effort to gain a full understanding before they interacted with a post.

> I usually do my research before interacting with a post because it's very important to acknowledge the cultural differences. But that's probably the most difficult because you have to take your time and fully understand what it means. [...] I think all social media posts are associated with the cultural norms. And

> *I truly believe that a lot of people that may seem offensive really just because they lack the knowledge.*
> (P5, U.K., Male)

Some participants felt that it was socially awkward to interact with foreign language posts, especially when all the comments were also in the same language. These participants felt that they were not expected to intrude on others' conversation.

> *If they're written in a different language, most of the comments are in that same language that I don't know. So, it seems weird of me to post or interact anything. If so, I am the only one who speaks English in that conversation.* (P3, U.S., Male)

## 5 DISCUSSION

In this paper, we investigated how individuals pay attention to, make sense of and interact with posts written in foreign languages that they could not comprehend. Our findings shed light on how people consume social media posts in multilingual social media streams.

We first explored how foreign languages in social media posts influence people's attention. Our results suggest that people often pay minimal attention to foreign language posts due to a perceived lack of relevance and the extra cognitive effort needed to understand these posts. At the same time, we identified some factors that help overcome language barriers. First, relational closeness plays an important role. When a post was from a close relation, participants tried to pay attention to, comprehend and engage with it regardless of language. Also, consistent with Lim and Fussell [21], when a post contained interesting visual images or videos, participants focused on these visual components rather than the language the post was written in. This result highlights that visual elements of posts could play an important role in communicating across language communities.

After we identified the factors that could hinder or help people paying attention to foreign language posts, we investigated how people make sense of these posts. We found that interviewees did not rely solely on machine translation but instead actively foraged and combined cues within and outside the post during their sense making. Again, the visual components of a post such as pictures and emojis helped participants pick up many cues that they believed were useful. (It should be noted, however, that our interviewees may have overestimated the transparency of the emojis [23, 24].)

Interviewees did not think the literal translation of the post text gave them much information, in part because the post length tended to be short and in part because many posts had visual elements that were not translated. This finding suggests that higher quality machine translation will not suffice to support multilingual communication in social network sites.

Another key finding was that interviewees differed in their sense making goals and these different goals helped shape their sense making strategies. For example, some focused on extracting the main emotion from a post. They made use of visual cues and background knowledge to understand the affective content of the post. Others aimed for a fuller understanding of foreign language posts, including their contextual and cultural meanings. These interviewees focused on extracting keywords for further information seeking. Further work is necessary to determine whether people tend to use a single strategy for all types of posts or whether they choose different strategies for different types of posts.

Lastly, we addressed how people interact with foreign language posts. Interviewees stated that a complete understanding of a post was not always necessary before interact with it, but at the same time, they felt they needed to have a certain degree of understanding for those interactions even it was just clicking the "like" button. Also, some interviewees were concerned about accidentally being offensive due to a lack of understanding about contextual and cultural meanings of a post.

Taken together, our results suggest that social media users would benefit from tools that better supported sense-making of foreign language posts. If people could understand these posts more easily and accurately with less time and effort, they could interact with their foreign connections more confidently and actively. In the next section, we address several ways that sense making of foreign language posts might be enhanced.

## 5.1 Design to Supporting Sense Making

Based on interviewees' design ideas and study findings, we explored several design ideas for tools to help people attend to, understand, and engage with foreign language posts.

### 5.1.1 Balancing out Asymmetric Attention

As we have noted, our interviewees reported ignoring many of the foreign language posts in their feed due to a perceived lack of relevance and/or need to exert more effort to understand them. People's tendency to overlook foreign language posts can diminish the ability of social media to facilitate communication and information exchange between linguistically or culturally diverse social communities [9, 19], instead creating linguistic clusters [8]. At the individual level, it can result in missed opportunities to build and maintain relationships with diverse social connections. To maximize the capacity of social media as effective cross-lingual communication platforms, system designers of social network sites need to consider the ways to make foreign language posts more accessible and comprehensible with less effort.

In this sense, the auto translation feature that Facebook recently experimented with might be a way to balance out the asymmetric attention between native language and foreign language posts. Because auto translated posts show up in the user's own language without the need to click the "See Translation" button manually, it might reduce the steps to process foreign language posts. Also, by making foreign language posts less distinguishable from other types of posts, users might pay attention to them without much bias or preexisted perceptions toward foreign language posts. At the same time, there is currently wide variation in how accurately languages can be translated into a given language such as English. Auto-translation might help for posts in easily translated languages but it could further reduce attention to those posts that are poorly translated.

Also, system designers could explore different ways of showing foreign language posts to attract people's attention. Since visual components in a post lead to more attention regardless of language, a new kind of curation system could add auto-generated images to posts [e.g. 39].

### 5.1.2 Design Space for Machine Translation for Social Media Posts

It would be helpful for sense making to have better quality of machine translation that could address noisy nature of social media content and preserve the cultural and contextual meanings. Besides the improvements in overall machine translation quality, there is still much space to improve machine translation for social media posts. As pointed out in the findings, the current machine translation on social media only translates the text contents of a post. While embedded information on a post (e.g. tagged place, link preview) could play an important role in foraging useful information for sense making, no option is available to translate those elements except copying and pasting them into external translators. Therefore, social network sites should allow users to translate not only text contents posted by posters but also embedded data for better information foraging processes within a post. Furthermore, as captioned or captured images [18] are popular in social media posts, translation support for the text in those images would be helpful and easily achievable via text detection and recognition technology [e.g. 42].

Furthermore, depending on a person's sense making goals (i.e. emotion focus vs. fuller understanding), different sets of words in machine translation output could be highlighted. Based on Gao et al.'s findings [11], keyword highlights improved clarity and comprehension of machine translation output in general. For those who want to figure out the main emotion of a post, only emotional words could be highlighted. For those who seek fuller understanding of a post, entity words such as the name of places and public figures could be highlighted, so they could use them for further information seeking. Since many recent studies have examined multilingual sentiment analysis [e.g. 2, 3] and entity extraction [e.g. 1, 25] techniques, this suggestion could be a feasible option that system designers could consider. This approach could be useful even when the machine translation output is incomplete.

### 5.1.3 In-situ Information Foraging and External Information Seeking

To provide better contextual information and reduce the burden of seeking more information about a post, a browser or in-app extensions might provide a short description of certain entity words or locations. For

example, when a user sees a post that her friend visited 'Sagrada Família', a system could provide the brief description of that without needs to exit the current newsfeed page or open another application.

In addition to the verbal description, a system might also retrieve and show multiple pictures that are associated with a word. For example, the multiple images of 'Diwali', the Hindu festival of lights, can help users to grasp what it is about visually. This idea is similar to IdeaExpander system [39] which inserted images automatically to clarify the meaning of text messages.

A curation method to cluster and match similar social media posts based on topics and locations could be helpful for contextualizing the posts. For example, a curation algorithm could aggregate multiple posts about 'Eid al-Fitr' at one place. Once people figured out the common topics and their relevance across different posts, it might be much easier to make sense of them. In doing so, system designers could make uses of previous research to automatically detect the cultural events on social media streams by making use of contexts (e.g. time frame, location, language) [e.g. 5, 31].

### 5.1.4 Design for Cultural Sense Making and Learning in Social Media

Cultural sense making and learning are dynamic and ongoing processes which require both culture-specific and culture-general knowledge, skills and attitudes [26, 27]. Cultural-specific knowledge refers information about particular culture groups or communities including both their visible (e.g. food, clothing holiday) and deep (e.g. values, perspectives) cultural components. On the other hand, cultural-general skills and attitudes means the capacity to display respect and interest in the other cultures for effective interaction with individuals from those cultures [27]. Social media may be effective in building cultural specific knowledge by providing users the opportunities to observe and learn other cultures from contents from diverse connections [40]. However, the pitfall of the sense making strategies that we observed is that the audience could not confirm whether their sense making outcome was right or wrong unless they asked in person.

To address these issues, social network sites might encourage posters to add more context to their posts; not only feeling, person or location tags but also tags for culture components such as holiday or food. Automatic events detection technology [e.g. 5, 31] could be used to recommend appropriate cultural tags based on the contents of a post. For example, if the system notices that a poster is about to post that contains 'Eid Mubārak' ("Blessed Eid"), it could automatically suggest a tag such as 'Celebrating Eid'. Once it becomes the embedded information by the poster's discretion, it could guarantee the credibility of information and the tagged information could be linked to other information sources directly.

Another suggestion would be adding new types of light weight interaction that could ask posters to give out more information about a post such as 'Curious' or 'Translate please' button. People might be able to ask to the poster directly by in person or through instant messenger about something they are not sure about. However, it could look 'creepy' or 'socially awkward' if one try to get too much information about someone according to social media norms in relationship maintenance [32]. Therefore, if there are more light-weight ways to indicate that a desire to know more about a post, the audience feel more comfortable asking for this information. Also, the posters could provide more information about the posts such as additional keywords or translation without feeling socially awkward.

### 5.1.5 Post Engagement by Making Use of Others' Responses

It was extremely challenging for interviewees to produce appropriate communicative feedback on a post when they did not have sufficient understanding about the literal and contextual meaning of the post. To increase post engagement, first, better sense making supports should be provided to increase comprehension. Another strategy is making use of others' responses on a post in addition to the information in that post. As found in the findings, participants could get some useful information by looking others' reactions (e.g. Like, Haha, Sad) and comments. Based on both post contents and others responses, recommending appropriate emotion reactions or emojis to response could be starting points in encouraging post engagements on foreign language posts.

## 5.2　Limitations and Future Directions

This study has a number of limitations that we plan to address in future work. First, the participants were drawn from the U.S. undergraduate population who are likely to use social media to fulfill entertainment motives [30]; social media consumption and sense making patterns might be different in other populations or in other cultures. Also, our interviewees focused on Facebook use; future work will be needed to determine generalizability to other social network platforms. Additionally, we focused on the sense making behaviors of people reading posts rather than on the behaviors of post producers, who may undergo their own sense making processes. We also only asked participants about posts in languages they had no knowledge of; since many social media users are bilingual [14, 17] and it is common to have some knowledge of other foreign languages, future work should consider these cases. Lastly, our method of interviewing, 'think aloud', might alter the ways people usually consume and make sense of social media posts, therefore it would be useful to triangulate our findings with results using other methods such as eye-tracking [e.g. 21].

## 6　CONCLUSION

This research explored how people consume and make sense of foreign language posts based on semi-structured interviews with 23 undergraduate social media users. The findings highlighted that users often did not engage with foreign language posts because foreign language in a post indicated a lack of relevance and a need for more effort to understand that post. However, interviewees stated they were more likely to engage with foreign language posts from close relations or the posts contained interesting visual components. Interviewees further reported different types of sense making goals for foreign language posts; some focused on simply understanding the emotional components of a post while others tried to gain a fuller understanding, including its contextual and cultural meanings. These different goals shaped people's sense making approaches. Based on our findings, we suggest several design possibilities for tools that could better aid multilingual communication in social media.

## Acknowledgments

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