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Master's Thesis
Academic Year 2021

Notie: A Design of an Assistant Bot for
Collaboration in Online Breakout Room Situation

Keio University
Graduate School of Media Design

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A Master's Thesis
submitted to Keio University Graduate School of Media Design
in partial fulfillment of the requirements for the degree of
Master of Media Design

Yian He

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Abstract of Master's Thesis of Academic Year 2021

Notie: A Design of an Assistant Bot for Collaboration in Online Breakout Room Situation

Category: Design

Summary

The pandemic has brought school classes online, and both faculty and students need to adapt to the new environment and technology. The change from onsite to online did not simply mean a change in the location of the class, it also had an impact on lifestyle, classroom-related activities, relationships among classmates and so on. Trying to maintain an active and productive communication environment in such a dramatic change to ensure good class and group work is a challenge.

In this paper, I tried to solve a specific problem: the "freezing state", a problem of awkward silence before online breakout room group discussion starts. An assistant bot is designed to give appropriate instructions to group members to let them actively discuss and help them better understand the situation and their role. 3-5 people were invited to participate in a made-up online class where they were asked to have group discussions with other strangers. During the discussion they were facilitated by the assistant bot. The test result shows that the addition of an assistant bot can avoid the awkward silence at the beginning of the discussion. We will continue to discuss and explore the possibility of robot assistant discussion and collaboration online.

Keywords:

online class, collaboration, small group facilitation, social-robots

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This year I have been struggling to find a balance between research and life, trying to stay productive in the pandemic. Without the help and support of my teachers and peers, I really would not have been able to come through on my own. Faced with challenges not only from research and academics but also from all aspects of life, I believe that I have grown in different ways after this year's journey. I am happy to have this thesis as a stage of achievement and conclusion.

I would like to solemnly thank my supervisor, Professor Keiko Okawa. Thank you for your dedicated guidance and constant attention to the status of my research. I had too many times when I was confused and didn't know whether I should give up or not, but it was your guidance that kept me from losing my way.

Thanks to Global Education, the family where we support each other. Thank seniors and students from our batch, we always keep communicating and encouraging each other through the journey.

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Finally I would like to thank my family who has always supported me, you are my permanent backing, Ping, Xing and Blackie.

Chapter 1
Introduction

In the spring of 2020, a pandemic changed our lives and I started taking classes at home and doing all my studying and socializing on the Internet. With the Internet so accessible, everything naturally shifted toward online after the pandemic. While it seemed that online technology was sufficient to support all of our learning and classroom activities, the full service was not actually in place. Various details that were not previously considered and arranged created uncertainty for the online classroom.

1.1. Background

At the time of this sudden outbreak of the pandemic, there were already a number of video conferencing platforms on the market that could provide quality web video services, such as Zoom, Google meet, Microsoft team, Skype, etc. Schools mostly choose one of these services to gather teachers and students to change the class to a web conferencing format during the original lecture time for real-time teaching and discussion. In addition to the basic lectures, some classes adopt group discussions to promote students' understanding of the topic [1]. Students are given specific tasks to discuss with each other in order to efficiently share information, utilize their professional strengths, and brainstorm ideas. On the video conferencing platform, there is a function to divide participants into several small rooms to achieve online small group discussion. Take the "breakout room" of Zoom as an example, students will be separated from the original main room and temporarily assigned to a breakout room. This is a separate, private room that cannot be supervised by the teacher. With the exception of the meeting host, who can move from room to room (and can only be in one room at a time),

meeting participants can only choose whether to enter the breakout room or return to the main room. All the functions such as video calling, screen sharing and text chatting are available in the breakout room as in the main room. The video and microphone switches are set as they were in the main room.

When enter the breakout room right after listening to the lecture and ready to have a group discussion, a special problem always happens. It's obvious that the occasion requires a high level of participation of all people, but there may be a freeze - no one comes forward to speak, and the room falls into an embarrassing silence. This sounds unusual because it only takes a little noise from anyone to lift the silence. And in past experience, if the group is a little awkward, we usually look at each other, maybe laugh, and then someone coughs and starts to say something. In the online environment, we can't transmit eye contact or subtle vocal signals, this silence happens and can persist abnormally long. I have named this state ***"freezing state"***, which describes a state where **no one is speaking up, no one is taking action, and no one is able to move the class discussion forward**. This research will discuss and design around the freezing state in the online breakout room situation.

1.2. Goals

In light of the fact that optional courses are often a mix of students from different batches, and breakout groups are randomly assigned (in some face-to-face cases students are able to form their own groups), the moment students join the breakout room may be the first time they meet each other. Often school programs are designed with icebreaker activities for the new semester to help everyone get acquainted with their environment and classmates [2]. In the case of the pandemic, however, the critical "first meeting" was not given the attention it deserved. The lack of facilitation allowed the freezing state to occur uncontrollably. This freeze not only makes the atmosphere awkward and wastes valuable class time, but also lowers the evaluation of classmates and even affects the outcome of the discussion. Even if, after the freezing state, a group member makes an effort to break the ice and everyone starts a discussion with good results afterwards, it is still important to note that a bad experience may affect students' attitudes toward group work

in the future [3].

To better describe this situation, here is a representative scenario:

> A graduate student is taking his class online. He selected an optional course in the new semester.
>
> During the optional course there is a group discussion. The students from different batches and backgrounds are assigned randomly to breakout rooms of 3-5 people. Even though they all have motivation to talk and discuss with their classmates, it seems that the conversation could not start because no one began to talk. Someone broke the silence after a few minutes, but there was still one member who was slow to join the discussion.

In this scenario, each group member is silent at the same time, and the online environment makes it difficult for them to identify the status of the other members and to know what action to take. They may experience the following emotions: the confusion of not knowing why no one is talking, the anxiety of not being sure if they should say something, the embarrassment of knowing that others are present and waiting for others to speak, etc. It is difficult to break the ice with a single individual, and it takes a lot of courage for the person who finally makes the effort to speak up. Even if someone makes the effort to break the ice, undoing the negative effects of these emotions and experiences and negative attitudes toward cooperation remains a challenge.

In response to such a situation, I would like to design an assistant robot like an facilitator to externally push the group out of the freezing state. The best way to do this is to prevent the group from going into a freeze from the beginning. I need to find out what is causing such a particular freeze in online classes and address potential pitfalls in advance. If the previous design does not succeed in avoiding all the pitfalls and the group discussion still freezes, then we need to get rid of it quickly and remove the tension and awkwardness to diffuse the negative effects. This will contribute to a smooth online breakout room collaboration, efficient and meaningful cooperation.

1.3. Research questions

How can an assistant bot get the students to talk smoothly when they enter the breakout room thus shorten the awkward freezing state?

1.4. Thesis structure

This paper is divided into 5 chapter,

Chapter 2 will introduce the literature review, divided into three main parts: firstly, to understand the group activity from the pattern of group communication and cooperation, find out the crux of why it will freeze; Then, based on the concepts of facilitating and assistant, we should find the reasons for using robot, what kind of changes robot will bring; Third, study of the difference between online and onsite will let us know how the new environment make our psychological and physical changes. This allows us to leverage the strengths of the online environment and avoid the weaknesses.

Chapter 3 is my design, the concept of assistant bot and it's prototype. Include my claim of the design and all the features I want it to have, as well as the way it functions.

Chapter 4 will evaluate tests that I created a virtual class and invited participants to participate a online discussion. Participants were asked to fill out a questionnaire and give feedback in a semi-structured interview after interacting with bot.

Chapter 5 is the conclusion, the limitations of this research, the future possibilities and how I want bot to develop in the future.

Chapter 2
Literature review

2.1. Small group collaboration

2.1.1 Production blocking

While investigating the negative status of the group related to the freezing state, I found that there is "production blocking" when brain storming is conducted within a group. Production blocking occurs when more than one member cannot productively contribute or be heard at the same time [4]. Compared with Brian storming individually, the number of ideas that individuals come up with in a group becomes smaller [5]. On the one hand, when analyzing the reasons for this phenomenon, I think the reason for allowing only one person to speak at a time during the discussion [5] is also applicable when analyzing the freezing state. In particular, the situation became worse in online situation because the chaos caused by multiple speakers in a video conference. Usually the classroom is controlled by having only one teacher open the microphone and the students close it. When students need to speak or ask questions, there is usually only one person speaking or some of them chatting in the chat. Even in breakout room, to avoid the confusion of two people talking at the same time, the intended speaker will be more careful to make sure that the other person is finished speaking. Due to the fact that all participants in the meeting will be able to hear clearly once they speak, participants will be more careful to deliberate whether they need to speak in order not to cause unnecessary interruptions.

On the other hand, social loafing, which is often mentioned together with production blocking, also caught my attention. Social loafing, a phenomenon in which the individual puts less effort into achieving a goal in a group [6], seems to explain the freezing state to some extent. Everyone assumes that someone else will take

responsibility for the opening, then no one takes action. There are many reasons for social loafing, ranging from a lack of understanding of individual contributions to tasks of uncomfortable difficulty [7]. Team members may feel that their efforts are unnoticed or that the effort is unnecessary. In a related **collective effort model** (Karau and Williams, 2001) analysis, individuals will be more motivated to participate in team activities and less likely to be socially inactive when they perceive the goal to be easy to achieve and very rewarding [8]. Analyzed from this perspective, individual short-term goals should be clear and simple in the early stages when the group is just forming, while ultimately the team's goals need to be challenging, while the individual contributions needs to be emphasized in the process [9].

2.1.2 Stages of small group development

Inspired by the idea that even in short group work, goals can be dynamic and changing, I researched the group formation process. The 5 stages of group development [10] are:

- **forming**: testing and dependence

- **storming**: intragroup conflict

- **norming**: development of group cohesion

- **performing**: functional role relatedness

- **adjourning**: seperation

As the first stage was observed to be characterized by fear and anxiety and rather strong positive expectations [11], I think it is very appropriate to focus all my attention on the first stage. I hope that students can quickly move past the discontented second stage and begin the third stage of discussion and production.

2.2. Human and robots facilitation

2.2.1 Small group facilitation

Before researching how to facilitate small groups, I tried to recall my previous experiences as a student myself, many of the students around me had negative attitudes toward group work. Where did this negativity come from? According to James L. Cooper's reasoning in "Implementing Small-Group Instruction: Insights from Successful Practitioners [3]" students' discontent with small-group discussions comes mainly from previous bad experiences. Examples include the following.

> Lack of clarity in small-group assignments; unclear or unfair grading of small-group work, often associated with excessive group grading without individual accountability for each team member's contributions; inequitable commitments to teams by individual members; poor planning and organization of the group activities; and inadequate introduction or rationale for group work.

This warns us to be careful when trying to facilitate small groups. We have to ensure that tasks are communicated effectively and grades are fair. Most importantly, do not overdo it and leave a negative impression. Take the very common example of icebreaker activities, where questions about personal privacy cannot be set, which can stimulate self-protection among participants.

Next, during my research on icebreaker activities, I found that psychological safety is a very important indicator to look at. psychological safety is a state of being able to present oneself confidently to the team and take risky actions without fear of negative criticism or punishment [12]. In icebreaker activities, it can manifest itself in the form of participants engaging in weird and funny behaviors together, bringing them closer together while making people feel included and trusted.

Other than icebreaker activities, interpersonal immediacy behaviours have been proven useful in classroom communication with student motivation and satisfac-

tion increasing.(P21,2017) [1]

2.2.2 Robot assistant

Now that digital technology can automatically capture and analyze student data, technology offers great possibilities for learning and facilitating [13]. It's easy to imagine applying robots to assist teaching. In a research done by Rinat B. Rosenberg-Kima, they compared robots, tablets and human instructors as teaching assistant for higher education small group facilitation [14]. The result shows that robots can well control the time and they are non-judgemental. Even the participants comment that robots are lack of communication skills and responses, I do think robot is fully qualified for the job of teaching assistant and they are best fit the online situation that every student is connected to the internet. Also the robot gives an objective record which could contributes to a fair grading.

2.2.3 Taking responsibility

From all the previous discussions, we can gradually draw an important conclusion. Based on what Salomon, G. and Globerson, T. stated in "When teams do not function the way they ought to. [15]" I conclude it as taking responsibility. To avoid the "Free Rider" effect all the students should contribute the same to the group, it's can be different task based on personal abilities but the amount of effort should be balanced. In other words everyone is accountable and everyone is responsible for the final result. When balancing the participation, it had a stronger effect for over participators to reduce their participation than for under participators to increase their participation. [16]

2.3. Online environment

Prior to the pandemic, online classes were not mainstream, and online classes could be understood as online learning, mostly as a type of supplemental classroom outside of the basic school classroom [17]. Students learn extracurricular

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1   https://www.battelleforkids.org/networks/p21

content of interest or supplemental learning of classroom content via the internet in addition to the existing school curriculum, while people who do not have student status can also participate in online classes to learn what they want to know. These online classes are hobby-based, not compulsory, have a decentralized schedule, a large student base, and are connected only by the Internet. Students can use free time to participate in the course with a great deal of flexibility in starting and ending. In contrast, the online classes discussed in this research are different from the above-mentioned online learning, which refers to the transfer of the usual university graduate courses to online classes, where the participating students are all enrolled in the same university or department, have passed specific entrance exams, have certain professional knowledge and background, and have chosen the school and professional courses for more complex reasons such as personal expectations and social pressure [18]. Compare with the prior type of online class, student go to a school program for more than just a hobby. At the same time, the classes are mandatory and more compact, like once a week for a fixed period of time. Also the number of students is smaller and fixed. The two types of online classes mentioned above are both online so they have some common features, such as the lack of sense of community compared to face-to-face classes [19]. However, it is important to note that the second type of class has only become widely available after the pandemic, and much of the experience and discussion of online classes may not be fully applicable to the second type of class, which is a new challenge.

2.3.1 Social presence

Compare with on site activities, socialization among classmates is greatly lacking in online classes. In a face-to-face class, there is a great possibility that students gathered in the same classroom before and after class will be able to communicate with each other. Even if some students are not actually talking, the conversations and actions of other students in the classroom will be visible, and everyone is in a social environment. After moving the classroom online, although the length of the class remains the same, there is less preparation time (social time) before and after class, and students have fewer opportunities to talk and communicate than in a traditional on site classroom. The relationship between students and

their classmates is limited to a general conversation about course-related content, which can lead to a sense of alienation.

We need to take any opportunity we can to chat and get students to start small talk with each other, thus creating the atmosphere of being social now, rather than being alone at home.

2.3.2 Zoom fatigue

Zoom fatigue is tiredness, worry or burnout associated with the overuse of virtual platforms of communication, particularly videoconferencing. [2]

Bailenson who published *Nonverbal Overload: A Theoretical Argument for the Causes of Zoom Fatigue* [20] has identified four consequences of prolonged video chats that he says contribute to the feeling commonly known as "Zoom fatigue."

The four main causes are listed as follows:[3]

- Excessive amounts of close-up eye contact is highly intense.

- Seeing yourself during video chats constantly in real-time is fatiguing.

- Video chats dramatically reduce our usual mobility.

- The cognitive load is much higher in video chats.

I think creating an attention grabbing target other than a human face in a zoom environment would be an effective solution. For example, when we have documents such as google dots that need to be work on together, we would move to our familiar work environment where the screen is no longer filled with the big faces of our classmates or ourselves.

Although the Long-term and uninterrupted physical arousal [21] cause by verbal and visual cues in this paper has bad effects, in the first meeting, if the physical arousal is done beforehand, the freshness excitement of the new classmates you are going to meet is very favorable. With the proper preparation time to meet

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2 `https://www.psychologytoday.com/intl/blog/the-desk-the-mental-health-lawyer/202005/virtual-platforms-are-helpful-tools-can-add-our-stress`

3 `https://news.stanford.edu/2021/02/23/four-causes-zoom-fatigue-solutions/`

a new environment, people will mobilize their whole body to make themselves perform well.

2.4. Summary

Integrating the three major perspectives of the group itself, the external forces supporting the group, and the online environment, the following key elements can be roughly summarized:

- If we want students to be prepared in advance,

  Psychological safety and relaxed emotions; **physical preparation** like move body, clear throat, drink a sip of water, try to make a little sound; **implication**: next will soon meet people, will soon talk, consider what to say when you meet people next; **social presence** that you are not alone in your room.

- If we want to make it easy for students to talk,

  Use **simple common words** so no need to think and hesitate, even if not ready can just repeat at once; **small number** of people, not talking to everyone at first so will not be so nervous; **determined dialogue** goals and scenarios, know who you are talking to and when you are supposed to talk, there is no one else can rely on, we have **full responsibility** to communicate, **diverting attention** other than to the human face.

- If we want to have a high quality group discussion:

  Timely feedback, responding, acknowledging; clear communication of the **mission**; each member has the **same level of participation**.

I hope to make some new contributions to this field with the knowledge I got from literature review. Since there is no virtual assistant bot for online small groups for the time being, this will be the first time an online assistant bot is being tested.

The freezing state phenomenon is not yet taken seriously, as schools generally do not pay attention to the efficiency of each classroom discussion, and there is

a lack of questionnaires to confirm students' specific feelings after online classes. If we rely on the teacher's feelings alone, he may not be able to identify where the problem of inefficient and unproductive group discussions lies. Even this research is from student perspective, the experience and results obtained from it can also guide teachers in their classrooms and help them better understand our state of affairs. A effective group work cannot be achieved without the teacher's instruction.

It is true that there is no one design or tool that can solve all the problems, and it is ultimately up to the various people to decide how the group discussion will go. But in this new environment of the internet may magnify some shortcomings, I hope that my design can help compensate or beautify some shortcomings and make people understand each other more. People who have difficulty communicating may be surprised to find that communication seems to be easier across the Internet. The online situation is actually an opportunity for change. I hope all people can give full play to their strengths and find their place in this cooperative society regardless of their extroverted and introverted personalities.

Chapter 3
Design

3.1. Claim

The addition of this assistant bot can prevent the small group from entering the freezing state and increase the sense of responsibility and participation of group members in the online breakout room situation.

3.2. Design concept

My design is a multi-functional virtual assistant bot who joins the breakout room along with students. The bot will give instructions at specific designed moments to prevent the group from entering freezing state when students first join the breakout room.

A total of six functions are implemented before and after they join, which will facilitate single or multiple key elements to achieve the goal. For example, it will be able to arouse students, get them into a social mood, and keep their minds active and ready to participate in the discussion. In addition to this basic function, it can have the function of facilitating group discussion, controlling the discussion time and so on. I also wanted it to have some humor or hilarity so that students could face the discussion and collaboration in a relaxed mood.

3.2.1 Functions

From the analysis in Chapter 2, we have obtained a set of key elements. In order to achieve my goal, I need to use my designed functions to facilitate these key elements in online groups. These elements are mostly subjective, such as social

presence which is a psychological feeling of the participants. And because the feelings have degrees and lengths, like we can feel very intense pleasure or prolonged pain, we need to stimulate and sustain feelings through constant stimulation and cues. This means that my design is not just for the moment when students join the breakout room, but any place before and after that where the robot can play its role. I used user flow to analyze the process of group members joining the breakout room, and used the timeline to sort out the touch points where I could design and intervene. At the same time, the relationship between the group members will evolve over time, and the features I design can be implemented in stages with different key elements. So in chronological order, the robot would have the following six key functions.

- **Introduce members**

  When the pop-up window appeared in the zoom that was "joining the breakout room", I want the bot to appear along with it and introduce the group members who would be meeting next. Knowing who is in the group ahead of time allows for psychological preparation, and the robot's unique speaking voice stimulates the students' senses and reminds them that there are more new encounters to come. It is also the only opportunity to remind students to turn on the camera and microphone, which, as previously described, is generally turned off during classroom lectures. The act of "turning on the microphone" means a very important transition into a social mood.

- **Delay entering**

  Zoom asks each member if they want to join the breakout room, and I would like to make this process more passive by adding a little more time between when each member actually joins the breakout room by clicking the join button in that order. This move effectively avoids the situation where everyone joins the room and is suddenly confronted with multiple strangers. Having enough buffer time means that you can observe the person who is in the room now, open the microphone and say hello to them individually, or comfortably type hello in the chat. Attention will be distributed to each member in order. Getting to know each one slowly, one by one, is also an effective step in remembering new classmates.

- **Welcome message**

  From the perspective of someone already in the room, the bot will greet
  each new addition affectionately in the room. The robot's voice ensures
  that every time someone joins, it is noticed by all, and the robot serves
  as the first example of a greeting that can prompt others to give a brief
  greeting to the new member. The first word is the most common greeting
  and minimizes hesitation to open the mouth. If someone is given enough
  attention when they first join a group, the overall impression of the team
  will rise and the attitude toward cooperation will tend to be positive.

- **Opening by clarify task**

  Once everyone has arrived, the robot will conduct an opening statement to
  guide everyone into the discussion. At the same time, the opening statement
  will ask what the task of the session is, to make sure that everyone has a
  good understanding of what is to come. Asking about the task at this point
  ensures that the topic is communicated effectively, and if someone does not
  understand it, it should be explained on the spot. The robot will encourage
  people to take turns with words such as "who wants to begin?" and "You
  can choose the next one."

- **Make to-do list**

  While stating the topic of this discussion, the bot will put a to-do list in
  the background. A short list of tasks can always remind group members of
  what they need to do now. Asking participants about tasks and showing
  what to do at all times ensures that each participant has a clear intention
  throughout the discussion.

- **Roll call and time control**

  If all goes well, now is the time to turn the initiative over to the students.
  The robot will start the timer and control the overall length of the discussion.
  If occasionally no one speaks, the robot can randomly call on students to
  speak in a more forced manner.

3.2.2 Character

After finishing the functional design, I need to implement these functions on a character. The action and sound of a character would help better convey instructions. Inspired by Microsoft's Office assistant Clippit, my bot looks taken from the coil notebook and named Notie.
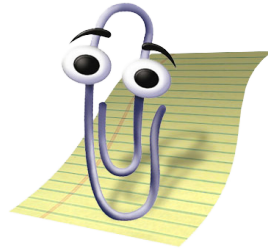

Figure 3.1   Clippit

Notie is a little girl with some notebook coils on top of her head. Her name has three meanings, one is notebook. She is a functional tool, and usually just quietly helps the group to make notes. Second, Notie can be written as no tie (is worn), which means now is not a formal occasion, there is no teacher and no teaching assistant giving any judgment, it is a place where you can speak freely. Another thing is that notie is pronounced similarly to naughty, and she is a somewhat playful robot. I hope that her occasional funny behavior will make participants relax and not be afraid to make mistakes.
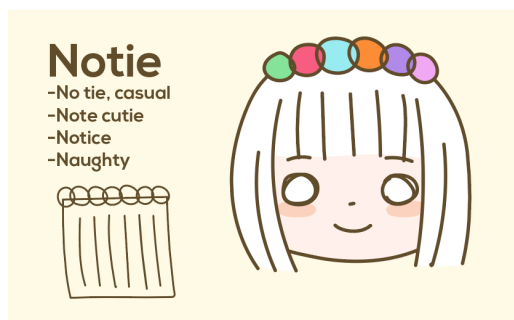

Figure 3.2   Notie

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3.3. Prototype implement

With specific functions and character in mind, I need Notie to be able to participate in zoom meetings, move around in Zoom, and perform the previously mentioned functions. I used Adobe character animator to create Notie's puppy, Microsoft's text to speech service provided by Azure to create Notie's voice, and a series of software to enable her to appear in the zoom. Below is a breakdown of what these programs do and how they fit into my design.

3.3.1 Pre-recorded video

Figure 3.3 A frame of pre-recorded video

For the "Introducing members" feature, I decided to use a video to show the results of this feature since a pop-up window cannot be implemented well in the Zoom and the content needs to change according to the viewer.

When the teacher presses "assign breakout room", a pop-up window for Notie will appear on the student's zoom screen. Notie will briefly introduce her name, then explain the group the student will join and who will be waiting in the breakout room. At this point, Notie will only mention the members who were in the

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breakout room before the student, not the ones who will join later. If the student is the first to respond and will be the first to be allowed to join the breakout room, he will only be given information about the total number of people in the group.

At the same time, Notie will indicate that the breakout room will be automatically joined in a few seconds, asking if he wants to turn on the microphone and camera now.

3.3.2 Character animation

Notie needs to be able to generate live animations with zoom, so I mainly tried live2D and Adobe Character Animator. Since Notie itself is designed to be more flat and doesn't require much side angle, and live2D doesn't perform well with zoom, Character Animator has good lip sync, etc., I finally chose to make a puppy of Notie in Character Animator.
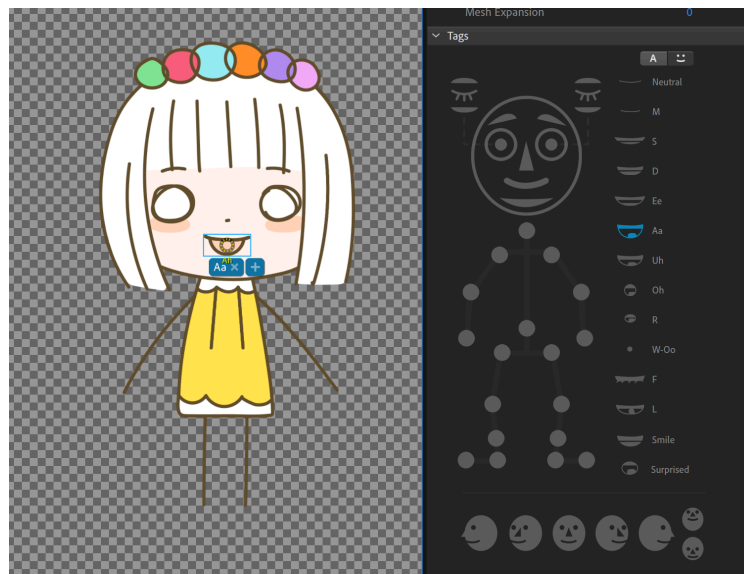

Figure 3.4 Lip sync settings

First, I used AI to make a layered Notie full body portrait, and then imported it to Character Animator to bind bones and set expressions. After it setted up, the animation of the puppy can be calculated in real time by the camera capturing

my facial expressions in the software.

By setting the mouth shape for different pronunciations, Character Animator can intelligently lip sync. My speech sounds from the microphone input can be fed back to the puppy's mouth in real time to look like the puppy is talking.

The above movements and mouth shapes can not only be generated in real time, but can also be exported to other video software with pre-made animation data. In this way, I can easily control Notie's movements and expressions according to the content of the conversation.

Figure 3.5 Facial expressions

3.3.3 Coding

Once I have the animation, all I need is Notie's voice. I made use of the text to speech feature. There are many similar services available on the market today, I chose Microsoft Azure, which requires a little knowledge of programming. I used Visual Studio to code and the language is Python. I finally chose a child's voice as the database based on Notie's playful and cute image of a little girl.

While Azure offers text to speech, they also have a speech to text service. I also tried to implement speech to text because Notie might need to reply to some

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questions in the speech, and being able to understand the conversation means she can also implement the function of taking notes.

3.3.4 Voice and sound

Notie not only has to transmit what she says to both Zoom and Character Animator, but also needs to be able to hear what others in Zoom are saying. Since Zoom doesn't have real-time audio output, in the process of looking around for a solution, I came across the perfect solution to all my audio-related problems in the Mac environment, Loopback.

Figure 3.6 Loopback for Mac

By creating a virtual environment, Notie's voice can be transmitted to both the Zoom and the character animator, ensuring that students in the Zoom can hear the voice and see Notie's mouth moving at the same time. The voice in the Zoom can also be recognized by speech to text and converted to text in real time.

3.3.5 Zoom environment

Finally all these settings need to be implemented in Zoom. As already explained about the sound, for the video part I used a tool called NDI. This time the video signal is sent by Character Animator and received by Zoom via NDI.

Here is a graph showing how those software works and send different signals to Zoom.

Also, in order for Notie to send messages in chat, it is possible to use selenium and the web Zoom to do the relevant settings, but in this test the relevant functions were not used, so I won't introduce them here.
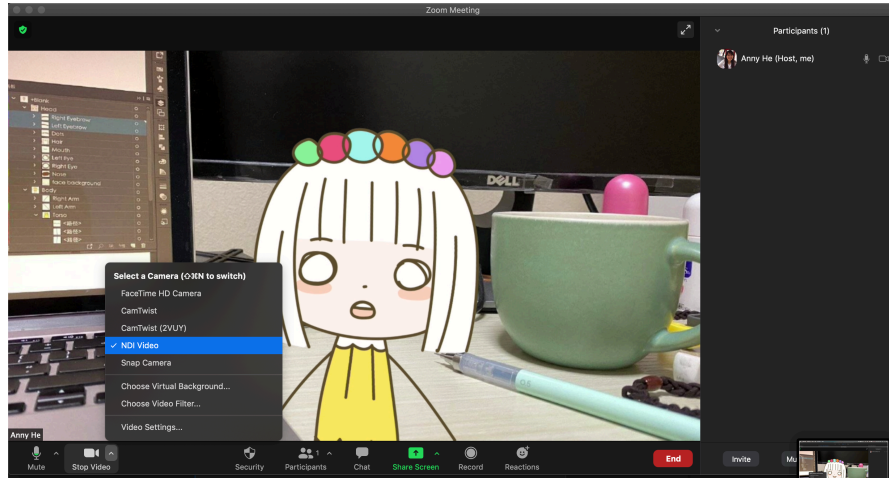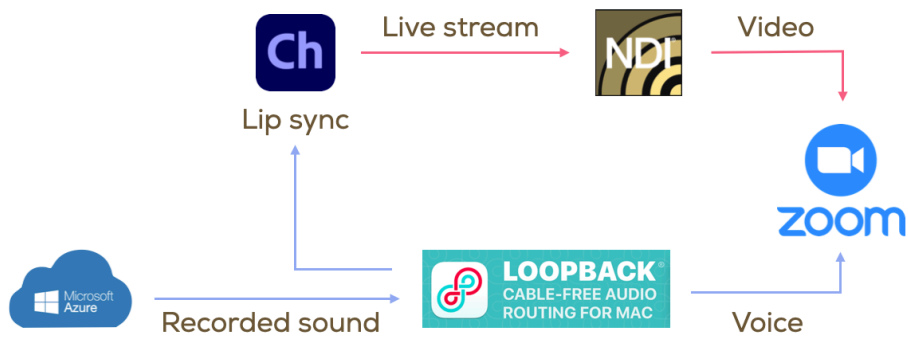
Figure 3.7 Select NDI as video source in Zoom

Figure 3.8 Software being used to implement

Chapter 4
Evaluation

4.1. Set up

All tests were conducted online, utilizing zoom and multiple messaging apps. I joined the same meeting room earlier than every participants as Notie. Because Notie can set only once by one Zoom account, each time the meeting room will only have one testing group, and the main room is considered as breakout room. The action of watching the class video is treated as being in the main room for the class, and the action of clicking on the link to join the Zoom meeting is treated as joining the breakout room.

4.1.1 Participants

The testing was conducted with 11 people from different backgrounds, with 8 females and 3 males. The participants were grouped into 3 groups of 3 or 4, one male each. Acquaintances are separated into groups to ensure that in each group they are all strangers who never met any other participants before.

The first group have 1 native English speaker and 2 fluent English speakers, second and third group are both composed of four native Chinese speakers. According to the composition only the first group had discussion in English, others are in Chinese.

4.1.2 Discussion topic

In order to create a sense of taking class online, I created a fake online class and a discuss topic. Inspired by the pipeline class we took in KMD, I came up with the main topic "pains in your life". According to the group discussion in class usually do not take a long time, and my design is mainly about the state

before they begin to talk, I decide to have a 8 minutes discussion. I prepared some slides and recorded a video for participants to watch before hand. This class video explained the topic "pains in your life" and asked audience share their experiences in 8 minutes with a group. At the end of the class video, participants will see Notie in the pop up window and giving them information. I asked all participants to watch two videos first, then use a link to join Zoom meeting.
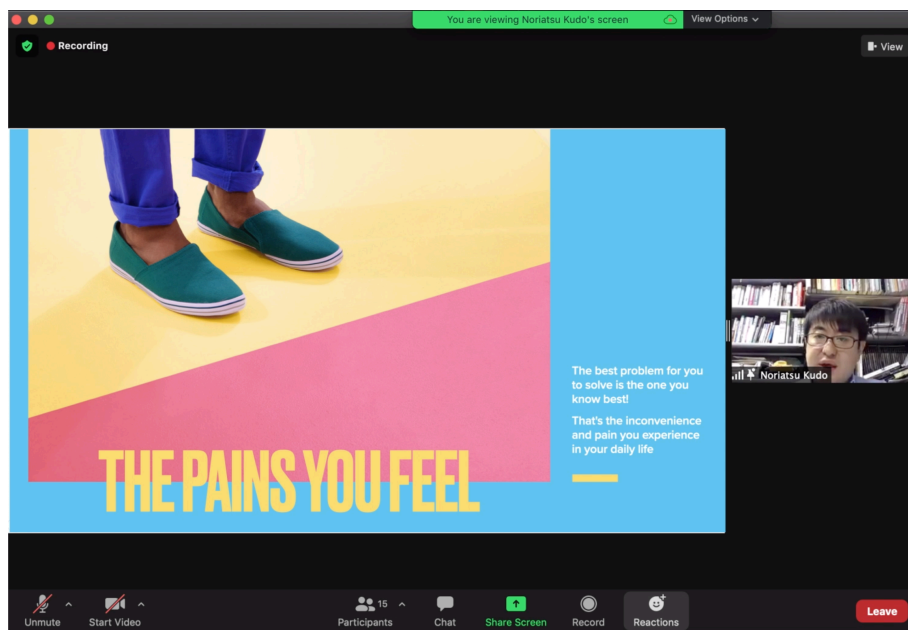
Figure 4.1   A frame of the class video participants will receive

Participants will receive the class video, the Notie video (differ from everyone) and a Zoom link in order to join the Zoom meeting.

4.1.3   Procedure

First, participants are informed they will have a online group discussion using Zoom. According to different levels of knowledge about my research, some participants knows there are an assistant bot in advance.

At the agreed upon time, participants watched the videos sent by messaging apps. After watching, they clicked the provided link and joined Zoom meeting.

In my point of view, when I confirmed everyone is in Zoom waiting room, I let them in one by one according to a decided sequence. At the same time, I let Notie say hi. For example, depends on the time we had testing, Notie said "Good morning, Name A."

After everyone joined "breakout room", Notie said "Now everyone is here. Can anyone share what is the topic today?". After someone said the topic, Notie reply "Good." or "Perfect." and show a simply information on the background to remind participants of discussion's topic.

During the discussion, Notie could say "Who wants to go first?" "How about Name B". Differ from three groups, Notie merely gave instruction in Group1, she only asked and made sure the topic. In group 2, Notie was more active and asked 2 participants to speak by calling their names. In the third group Notie called everyone to speak and some participants are being called twice or more. Notie also did note taking in Group 3.

After 7 minutes discussion, Notie said "Last one minute.". Depends on the situation, Notie didn't say it in group 3 because they were having intense discussion. And when the time is up, Notie said "Now it's the end of the discussion. Let's go back to the main room."

Then I sent the questionnaire link, and had a discussion about how the session is with all the participants together. After checking the questionnaire answers, I had semi-structured interview with them to explore the reason why they give such special answer.

4.2. Results

All the groups answered Notie's question and move to discussion right after the answer, and following are some aspect of answers to the questionnaire.

For Notie itself, three groups both give positive and good answers. According to the results, all the participants can understand what Notie is saying and most of the participants (10 of 11) trust what Notie said. Most of participants feel comfortable with Notie and 10 of them likes her.

For Notie's facilitation, 8 of the participants neutral on whether she provides quality help. According to the semi-structured interview afterwards, this result

basically cause by the lacking of her instructions. Participants from group 1 thinks that she is active at the beginning, but became quite during the discussion. Other participants have the opinion that she is not giving timely instructions or feedback.

For the discussion, most participants (8 of 11) thinks they participates 3-4 times in the test session, at the same time 8 of them experienced varying degrees of embarrassment and speechlessness.

For the equality question, it's vary from groups so we will discuss it in next section.

In summary, Notie's character design is good, even participants said they are satisfied with the discussion, they still think Notie could be more active. Although the freezing state before the discussion does not exist anymore, participants experienced awkward silence afterwards for some reason.

4.2.1 Semi-structured interview

Here summarised the feedback towards Notie from semi-structured interview.

- About Notie's facilitation, participants from group 1 and group 2 who gave lower ratings thinks she should be more active:

  "Notie should give more feedbacks." "Notie is not as talkative as I thought." "To solve the pause problem during a discussion, it might be helpful if Notie says some theme-related key words to continue inspiring the participants, or do time control to remind the next speaker."

- While participants from group 3 thinks she is too dependent on her instructions:

  "I don't know where this kind of feeling comes from but I feel like I'm waiting Notie's instruction. It's might just my personality."

  "Is it possible for her to not occupy a video window, but just be on the sidelines?"

- About what kind of information Notie should supply:

  "Hopefully, the imformation showed on the background will make the topics to be discussed more clear and will be very useful for students who are

distracted or hard of hearing in class." "At the end, there will be a summary note." "Provide more informative responses or well directed transitional statements." "For meeting process, it would be great for Notie to catch keywords during the discussion and display on the screen."

"Remind the group members to allocate time for speaking among themselves." "Add timer function if it is in the rotating round speaking system."

"The reason why werewolf game won't be freeze may also be because the process, stage, time, identity each is very clear, everyone is very clear complete belong to their own time, but also have a certain psychological preparation to do what they should do in the designated time."

- About Notie's voice and appearance:

  "The voice can be more realistic, more like a real person, and the background can be adapted to her." "Her funny voice relieved my stress." "I thought you were using a voice changer to speak."

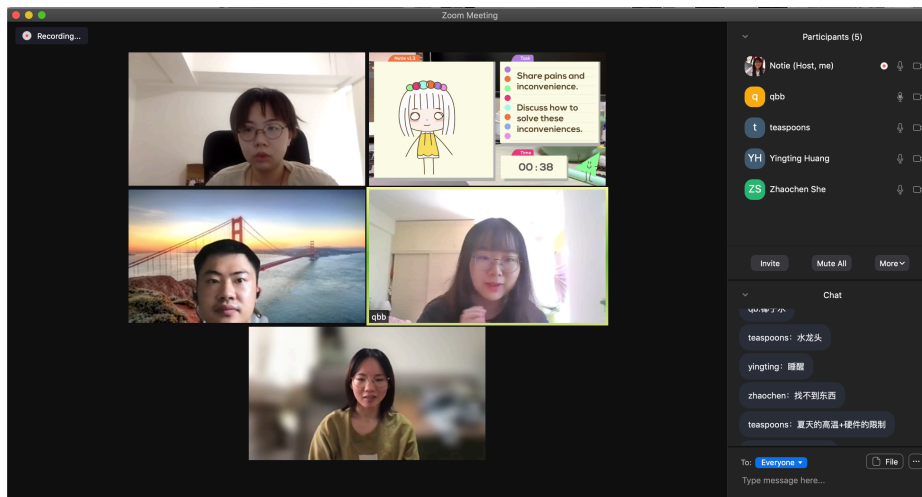- For the note taking function which only apply to group 3:

Figure 4.2   According to the keyword record given by notie in the chat box at the bottom right, the third group is discussing possible solutions to the previous problem

"I think the function of taking notes is very good and saves labor. Often the students in the group who are responsible for taking notes are not able to participate in the discussion at the same time. Nor can they record everything. This is the kind of thing that should have been left to the machine."

Figure 4.3 The speech to text result generated when third group having discussion

4.3. Discussion

Basically Notie works quite well for prevent the participants entering freezing state from the beginning. Below I want to discuss how the functions works and whether those key elements are being triggered during the test.

4.3.1 Social presence

The pre-recorded video is mainly designed for social presence. When Notie mention other participants' name, I hope participants can begin thinking about meeting others. To make sure participants can easily remember the information, I only show the names of people who joined the room before that participant. So everyone is receiving a unique video depends on their sequence.

Here is a question only asked in interview: After watching the video, do you have any impressions of the members of the group? Most participants replied: *I*

27

have a rough impression. (8 of 11)

No participants can remember the names, but I got a interesting question directly from messaging app before one session start: *"Is C the person I know?"* This question appear because I have written the names of the participants using the pinyin alphabet rather than the exact Chinese characters. Many Chinese names may have the same pronunciation, and it just so happens that this participant's name is pronounced the same as another participant's friend. I consider this question as a good sign that participants are thinking about others and the actions they suppose to take when they watching the video. Viewing the names listed by Notie will trigger the feeling that they will meet each other later and this could be mental preparation.

This is another good answer that proves that my videos are effective in mental preparation that the participants experience a sense of social presence: *"When I watched the video, I'm already in a social mood."*

It's also worth to mention that, because I am sending videos right before the determined testing time in order to make sure they won't watch them too early, it's caused one participant didn't watch it before join the meeting.

4.3.2 Casual communication

I want the participants greeting to each other while they join the meeting. To achieve this I let Notie say "Hello" to everyone when they joined. But this isn't work as only 3 participants replied Notie's greeting.

Even I observed many participants smiled after Notie said hi to them, they didn't tend to reply. I do hope that all participants will join notie to say hello to the newcomers, but it's seems that it's hard enough to just reply to Notie.

For this question, I got some answer that it's stupid to reply to an bot: *"The bot is talking to me, but I'm lost in the confusion of whether I should respond to an AI or not···"* This brings me to a new question that what kind of communication is normal between robots and human? And when you have no knowledge about a robot, what would you do to interact with it? I think all the participants felt novelty when they first see Notie, but when Notie's facilitation become normal, what kind of conversation we should have here is a question.

Figure 4.4 Third group replying to the first question

4.3.3 Simple and easy

Here comes the key moment, after everyone is in the room, we should begin discussion. Right after Notie asked them about the task, the three groups participants replied in 4.2s/5.1s/5.7s. This is the first question about the topic and I want to make it as simple as possible.

Here is the interview with two participants who replied to this question from group 2 and group 3.

"*I felt I should say something then I did so.*" "*I answered Notie's question on the topic of this discussion, and it was just a bit awkward to answer it.*"

According to the time record and interview, I think all the groups replied to it without any pressure. Even there are awkward feelings, I think if we had greetings or other conversation beforehand, it could be much better. The first question is still simple and easy, participants can reply to it without long time consideration.

4.3.4 Psychological safety

Psychological safety is about whether participants trust others enough that they dare to take actions that carry some risk and are less afraid of making mistakes. In order to achieve this in a newly formed group, I would like to let Notie do crazy things.

I asked two questions that seems not relevant:

Is Notie behaving normally? Agree: 6 of 11

and I like Notie: Agree: 10 of 11

I also got some comments about Notie's behaviour: *"Notie's cute and funny voice erase my tension." "Sometime she's not quite normal, but I find it interesting."*

In summary, I think notie does a pretty good job of being cute and laughable. As a observer behind Notie, I am happy to see participants laughed.

4.3.5 Timer and Call for speak

Figure 4.5 The interface with timer

Because only the third group call all participants to speak, so this questions only got answers from group 3.

For the question: Did you often look at Notie during the discussion? The top answer is *"I look at her naturally when she speaks."*

And for the question: Does Notie's call make you feel nervous or stressed? The top answer is *"I' m used to it"*

As what we discussed in literature review, robot can control the time very well. This also works on Notie because she has a clear voice, that when she speaks everyone just stopped talking and wait for the end. When applying a timer in the background, other participants are looking at it frequently when Notie speaks.

The call for speak functions needs further discussion. In group 3 it's seems OK, but compared with other groups, the third group seems more passive. Once nobody talk in the middle of the discussion, the participants are waiting for Notie to call their names.

4.3.6 Equality

For the average contribution, group 2 shows bad results compare with other group.
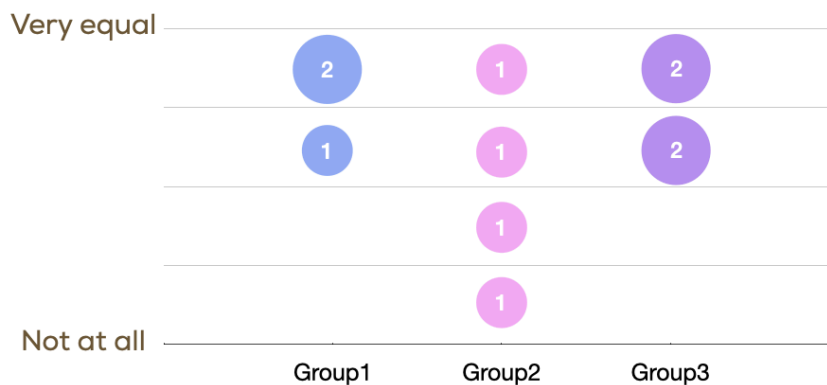
Figure 4.6 Answers to Q.12

This might cause by there is one participant only speak once during the discussion time. And I had a interview with her afterwards, she thinks it's could be better if Notie gives her a cue that it's her tern to talk. She said: *"I felt a little awkward when she called me by my first name directly. With so few people here, all knew whose turn it should be next." "I have to wait until a long enough gap*

to be sure it's the next one's turn, otherwise I'm afraid of interrupting someone else. I need a clear signal."

Compare those three groups, group 1 had equal participation because the three participants are quite talkative, even without Notie's instruction they are pushing the discussion forward by themselves. While Notie gives a lot facilitation in group 3, they tend to show a dependency.

Figure 4.7 Second group

Chapter 5
Conclusion

5.1. Findings

First, having a bot asking simple question at the beginning is an efficient way to get the students start talking. Second, the cute appearance and funny voice of assistant bot can erase the tension, help the small group members feel psychological safety. Third, mentioning the names of group members can trigger a sense of social presence. Fourth, the bot and reminder or timer function are well matched.

There are also some benefits of online assistant bot being confirmed: The bot can facilitate many groups at the same time; Bot won't give judgements; Students feel less regulated; A very objective record can be made; Taking notes is very helpful.

5.2. Limitations

Due to the limitations of the implementation, some of Notie's features were not tested well. First of all, I couldn't implement pop-up window in Zoom, which caused a long gap between reading Notie's introduction and joining the room. Because the video was sent online, there was no guarantee that all participants would watch the video at the same time, and the way they join the meeting varied, resulting in a large variation in the time to join zoom. I needed to wait for everyone to be present, and then the participants who arrived first often waited longer. It also took a very long time to connect the audio as I manually acknowledged each participant entering the room.

The two-minute class video did not give a good picture of the class. When participants were invited to the test we would talk about the test content, all the participants knew early on that there was going to be a discussion. The real

classroom situation may have a much longer listening time and the students are already a bit tired before starting the group discussion. There is usually no notice before the group discussion, and the time given to students to prepare mentally can be very short. It should be mention that there is information asymmetry between participants, some participants already know Notie before the test while some doesn't know there will be a robot facilitator.

There was some bias among the participants. Some participants had prior knowledge of the existence and function of notie because they had more frequent contact with me. Some participants had no relevant knowledge at all. At the same time, the participants' familiarity with me varied from friends from many years ago, to recent classmates, to those who had never met me before. After being invited to my test, their acceptance of opening the video call was not quite the same. Participants who were unfamiliar with me, or who had not seen me for a long time, might be more nervous when preparing in advance.

Notie is not automated yet. I need to control it talking and moving manually. This caused two negative effects, first she is not giving timely response. In a conversation, very short pauses can also be easily detected. Second, she acted a little too much like a real person for participants to confirm whether she was a robot. To reduce the stress of being monitored, she is required to exist as an emotionless machine. More programmed action might be better in this case.

5.3. Future work

I'm very excited to find out that there are many possibilities based on Notie's current structure and we can develop more features for her:

- Regarding time control, the robot needs to control not only the length of the entire discussion, but also the length of each member's speech. To achieve this, it is necessary to apply technology that recognizes the identity of the speaker.

- In order for the group to have a fairer grading, the robot can analyze and send the student discussion participation data to the instructor. This will also reduce teachers' workload and help them plan their classrooms better.

- The Notie's note taking function. How to extract key words from the sentences? How can machine take notes for people effectively? Summarize the speech is also a problem that can be studied.

- Notie can have other kind of responses besides sound and text, such as sending zoom emoticons. Sending image signals can be used in the process of discussion without interrupting the speaker's thoughts and giving timely feedback.

- Different groups and classrooms require different styles of mentoring, for example some groups will tend to rely on mentoring, then we need more talkative robots. In addition to Notie, there can be assistant bot with different appearance designs, they can have different functional preferences and provide services with different focus.

This research start with the most representative freezing state which occurs before the discussion, but there is also the possibility of freezing during the discussion process. In the future, as long as we pay attention to the first freeze, it may be possible to continue to study why the freeze occurs on other timing and how to solve it.

It's also would be interesting to study the best timing to interrupt speakers. This would be a realistic problem when we want to coding for Notie. Human would be afraid to interrupt speakers for the sake of others' feelings, but the difficulty for the robot is the criteria for judging when to interrupt. Solving this problem ensure that Notie control speech time without bringing too much negative effects to the group.

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Appendices

A. Code File

Speech to text

```
import azure.cognitiveservices.speech as speechsdk
import time

done = False
def from_mic():
    speech_config = speechsdk.SpeechConfig(subscription="",
    region="japaneast")
    speech_recognizer =
    speechsdk.SpeechRecognizer(speech_config=speech_config)

     # setting up callbacks for the speech recognizer function
    speech_recognizer.recognizing.connect(lambda evt:
    print('RECOGNIZING: {}'.format(evt.result.text)))
    speech_recognizer.recognized.connect(lambda evt: print('RE-
    COGNIZED: {}'.format(evt.result.text)))
    speech_recognizer.session_started.connect(lambda evt: pr-
    int('SESSION STARTED: {}'.format(evt)))
    speech_recognizer.session_stopped.connect(lambda evt: pr-
    int('SESSION STOPPED {}'.format(evt)))
    speech_recognizer.canceled.connect(lambda evt: print('CAN-
    CELED {}'.format(evt)))

    speech_recognizer.start_continuous_recognition()
    while not done:
        time.sleep(.5)
```

```
    speech_recognizer.stop_continuous_recognition()
    print("stopped the continuous recognition service")

from_mic()
```

Text to speech

```
from azure.cognitiveservices.speech import AudioDataStream,
SpeechConfig, SpeechSynthesizer, SpeechSynthesisOutputFormat
from azure.cognitiveservices.speech.audio import AudioOutputConfig

speech_config = SpeechConfig(subscription="", region="japaneast")
audio_config = AudioOutputConfig(use_default_speaker=True)

synthesizer = SpeechSynthesizer(speech_config=speech_config,
audio_config=audio_config)

ssml_string = open("ssml.xml", "r").read()
result = synthesizer.speak_ssml_async(ssml_string).get()

stream = AudioDataStream(result)
stream.save_to_wav_file("/Users//Documents/.wav")
```

Use SSML to customize speech characteristics

```
<speak version="1.0" xmlns="https://www.w3.org/2001/10/synthesis"
xml:lang="zh-CN">
  <voice name="zh-CN-XiaoyouNeural">
    content here
  </voice>
</speak>
```

B. Questionnaire

Notie test feedback questionnaire

This questionnaire has 2 subsections and is expected to take 3 minutes.
*必填

1. Feedback on Notie (the Assistant bot)

1。 I can understand what Notie said. *

请仅选择一个答案。

◯ Agree

◯ Neutral

◯ Disagree

2。 I trusted the information given by Notie. *

请仅选择一个答案。

◯ Agree

◯ Neutral

◯ Disagree

3。 I felt comfortable with her and she was behave properly. *

请仅选择一个答案。

◯ Agree

◯ Neutral

◯ Disagree

Figure B.1 Questionnaire page1

4。 Notie was very helpful and gave quality assistance. *

请仅选择一个答案。

○ Agree

○ Neutral

○ Disagree

5。 I like Notie! *

请仅选择一个答案。

○ Agree

○ Neutral

○ Disagree

6。 Any comments on Notie?

_____

_____

_____

_____

_____

2. Feedback on the group discussion

Figure B.2 Questionnaire page2

7。 How often did you participate in today's discussion? *

请仅选择一个答案。

	1	2	3	4	5	
Not at all	◯	◯	◯	◯	◯	More than 5 times

8。 How well did the discussion environment allow you to express your thoughts? *

请仅选择一个答案。

	1	2	3	4	5	
Not at all	◯	◯	◯	◯	◯	Very well

9。 To what extent did the discussion encourage you to rethink your own values or ideas? *

请仅选择一个答案。

	1	2	3	4	5	
Not at all	◯	◯	◯	◯	◯	To a large extent

10。 Did you ever feel like you have nothing to say during the discussion? If so, how long did this state last? *

请仅选择一个答案。

	1	2	3	4	5	
I didn't feel at all	◯	◯	◯	◯	◯	I feel it all the time

Figure B.3 Questionnaire page3

11。 Did you feel embarrassed, uncomfortable or depressed? *

请仅选择一个答案。

	1	2	3	4	5	
Not at all	○	○	○	○	○	I felt all of them

12。 Did all group members equally contributed to the discussion? *

请仅选择一个答案。

	1	2	3	4	5	
Not at all	○	○	○	○	○	Very equal

13。 How much do you think group activities like this contribute to meaningful learning? *

请仅选择一个答案。

	1	2	3	4	5	
Not at all	○	○	○	○	○	Contribute a lot

14。 Overall, how satisfied are you with today's discussion? *

请仅选择一个答案。

	1	2	3	4	5	
Not at all	○	○	○	○	○	Very satisfied

Figure B.4 Questionnaire page4