Overview

- Dialogue systems become part of our daily lives.
- Previous systems have only followed user’s commands, not been able to create a new value by collaborating with users.
- It is essential that systems and users can work together on creative collaborative work.

Methods

- Devised the Collaborative Garden Task in which two workers work together to create a garden in Minecraft.
- Discovered two essential skills for dialogue in creative collaborative work:
  1. To be able to perform more processes to ask for and agree on suggestions between workers.
  2. To be able to agree on a particular image of the final product, then discussing changes and details.

Collaborative Garden Task Corpus

- Two workers work together to create an original and beautiful garden.
  - Workers interacted via text chat (in Japanese) with their partner and manipulated blocks.
  - Time limit for work was 20 min.
  - After work, workers answered a questionnaire about their satisfaction with the dialogue and the garden.
  - Workers were paid approx. five dollars for one dialogue.

Dialogue Example

1. Do you want to make something? (translated to English by authors)
2. I want to make a roof like a wisteria trellis.
3. Sounds good!
4. I'll try making it in the middle!
5. I will make a path down the middle.
6. I also want to make something on both sides.
7. This side, is this okay?
8. It's good!
9. Can I try to put a chair at the two trees?
10. So bored! If it's in the way, please remove it!
11. Thank you.
12. Do you know how to make a nice chair and desk?
13. I cannot think of any… I wish I had a half block or something…
14. Yeah…
15. It's going to be big!
16. I wonder if it is too much to ask for a table with just one of these…
17. No… That’s okay!
18. Great!

Analysis of Dialogue in Collaboration

- Identified characteristic 4-grams in high-quality dialogues.
- Two main types of expressions were characteristics of high-quality dialogues:
  1. Asking for a partner’s agreement
  2. Showing positive appreciation toward the partner

Mining Frequent Word 4-grams

- Methods
  - Classified 500 dialogues into the top 20% and the bottom 80% on evaluations scores.
  - Focused on word 4-grams that contain at least one content word.
  - Conducted Fisher’s exact test on a 2 × 2 cross table to identify characteristic 4-grams in high-quality dialogues.

- Results
  - One axis indicating whether a dialogue included a specific word 4-gram.
  - Other indicating whether a dialogue was among the high-quality dialogues.

Future Work

- Train an encoder-decoder model that can output user utterances on the basis of the garden’s state and the dialogue history.
- Work on developing a system that can creatively collaborate with users.

Analysis of Patterns of Collaboration Process

- Methods
  - Plotted the time-series data of the completion rate at the time of an utterance.
  - Conducted a cluster analysis using k-Shape.

- Results
  - Obtained six clusters.
  - Workers worked in silence after deciding what to make in the early phase.
  - Workers created the garden to some degree and then discussed the details while looking at created objects.
  - Workers discussed and agreed on the garden step by step.

Further Analysis

- Conducted Fisher’s exact test on a 2 × 2 cross table to identify which cluster was associated with high-quality dialogues.
- One axis indicating whether a dialogue was in a specific cluster.
- Other indicating whether a dialogue was among the high-quality dialogues.

Results

- High-quality dialogues appeared significantly (p < 0.05) more frequently in C3 and C5.
- It is essential to agree on a particular image of the final product in the early phase and then discussing the details to complete the garden.