

# Stagecraft for Scientists: Exploring Novel Interaction Formats for Virtual Co-Presenter Agents

Everlyne Kimani, Ameneh Shamhekhi, Prasanth Murali, Dhaval Palmar and Timothy Bickmore

Khoury College of Computer Sciences

Northeastern University

Boston, MA, USA

kimani15, murali.pr, ameneh, dhavalpalmar, bickmore@ccs.neu.edu

## ABSTRACT

Our research explores the development of new interaction formats for oral presentations that leverage a life-sized virtual agent that co-delivers a scientific talk with a human presenter. We developed a taxonomy of 36 novel interaction formats as well as 37 roles the agent can take on in co-presentations. We evaluated the impact of these formats and roles by selecting 10 from the taxonomy and recording brief presentations on the same topic using the different formats. Judges ranked dynamic agent roles higher on engagement and rated non-standard interaction formats no lower on appropriateness, compared to standard turn-taking co-presentations.

## CCS CONCEPTS

• **Human-Centered Computing** → Human Computer Interaction (HCI)

## KEYWORDS

Virtual agents, Co-presentation, Turn-taking, Agent role

## ACM Reference format:

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## 1 Introduction

Oral presentations are central to science, yet most scientists use talk formats that follow a standard format that mirrors the structure of their research papers. Although scientists occasionally co-present with collaborators, the most common co-presentation interaction format involves the speakers simply taking turns briefing their slides[1]. This routine, boring interaction format contributes to presentations that are perceived to have low quality[2].

Co-presentation, with multiple speakers on stage, affords a wide range of interaction formats that could engage an audience in novel ways. Speakers can participate in a variety of interaction formats, such as dialogue among themselves (with the audience as overhearers), or an interview led by one of them, asking questions of the other(s). Speakers can also take on roles that

are relevant to their topic, such as a study participant (for human subject studies), a competing scientist, or a sponsor. Each of these interaction formats provides potentially unique affordances for interaction that may result in talks that are more engaging and memorable than simple turn-taking, if done well. One barrier to using innovative co-presentation interaction formats is that they require a second presenter. This problem may be addressed using a virtual agent that plays the role of a co-presenter on stage. In our work, we are building upon previous work on a life-sized virtual agent that coordinates delivery of a talk with a human presenter via a PowerPoint extension and a control device [1].

## 2. Interaction Formats and Agent Roles

To identify the range of possible interaction formats that a human presenter could engage in with a co-presenter (human or virtual), we conducted several design sessions with a group of faculty, graduate students, and researchers. In the design sessions, 73 individual ideas on interaction formats, mechanics of how the human and agent work together at the turn-taking level, and agent roles and personas, were generated and defined. Following this, we performed an affinity diagramming activity to cluster similar ideas into a taxonomy (Figure 1). Our taxonomy specifies two main high-level concepts: how the agent and the presenter interact during a presentation (“interaction formats”), and who the agent represents in the presentation (“agent roles/personas”). These correspond to the first level of the taxonomy.

**Interaction Formats:** The 36 concepts clustered into the interaction formats were further sub-categorized into 3 non-verbal interactions, such as advancing the slides, and 40 verbal interactions where the agent presents parts of the talk. Among the verbal interaction formats, the concepts related to a specific section of the presentation (e.g. co-presenter presenting the study results) were categorized under the “presentation structure” class. Other formats were independent of the structure of the presentation and were only focused on the interaction between the agent and the human presenter (e.g. agent interviewing the presenter, agent encouraging the presenter).

**Agent Roles:** Another cluster of 37 concepts was focused on the virtual co-presenter’s roles/personas. Some of the agent roles were dependent on the topic of the presentation such as a doctor explaining medical aspects of a project (expert roles), or a study

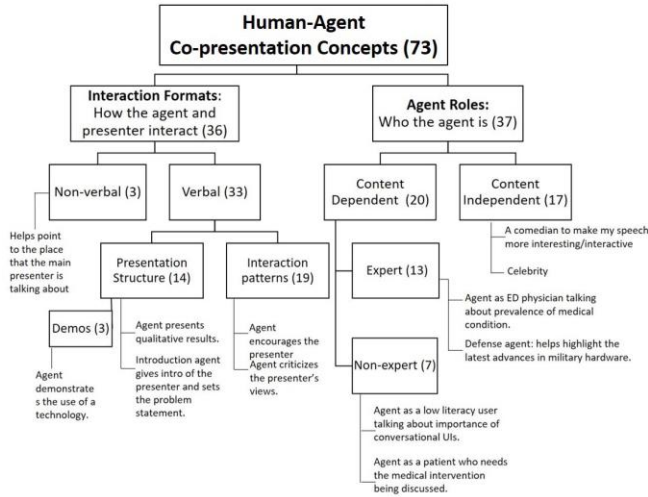


Figure 1. A taxonomy of human-agent co-presentations

participant describing her experience using a system (non-expert roles). The other category of roles was independent of the content of the presentation (e.g. a celebrity, a comedian, or a cute animal).

We down-selected from 36 interaction formats and 37 roles to 7 interaction formats and 3 agent roles for further evaluation, based on a subjective assessment of how engaging and appropriate they were.

2.1 Selected Interaction Formats:

- 1) *Debating*: The agent presents her point of view, to refute or disprove the presenter’s arguments by offering contrary evidence.
- 2) *Encouraging*: The agent provides encouraging statements after each topic to motivate the presenter.
- 3) *Providing Facts*: The agent presents only scientific information such as facts and numerical results, and the human presents the problem statement, hypothesis and other non-factual information.
- 4) *Interviewing*: The agent asks planned questions to the presenter at key moments of the presentation to help with the flow of the talk.
- 5) *Joking*: The agent tells jokes in between sections of the presentation to lighten up the mood of the talk.
- 6) *Navigating*: The agent outlines the presentation and summarizes each topic to orient the audience.
- 7) *Simple turn taking*: The agent and the human presenter alternate the delivery of the presentation after each slide.

2.2 Selected Agent Roles (Personas):

- 1) *Experienced role*: The agent is an individual with practical experience on the topic of the presentation without necessarily understanding the science behind it.
- 2) *Expert role*: The agent represents an individual with scientific knowledge of the topic.
- 3) *Novice role*: The agent represents an individual without prior knowledge of the topic but is interested in learning.

3. Evaluation

The DynamicDuo co-presenter system, described in [1], was used to evaluate the co-presentation concepts. We conducted a study in which judges rated pre-recorded human-agent co-presentations using each of the 7 interaction formats and 3 agent roles, comparing the novel formats and roles to the standard turn-taking co-presentation interaction format.

3.1 Presentation Stimuli Used in Study

We recruited an actor to deliver a series of brief oral PowerPoint presentations on the same topic (the science of fermentation) using the virtual co-presenter system (Figure 2e) and the agent shown in (Figure 2.d). The actor rehearsed and delivered 7 co-presentations each using one of interaction formats described in section 2.1. We then asked the actor to deliver 3 more presentations with 3 agents playing different roles with varied appearances and backstories (a cheese connoisseur with knowledge on the cheese making process, Figure 2.a), an expert food scientist with in-depth knowledge on the topic of fermentation (Figure 2.b), and an agent who is a novice student of biology interested in the fermentation process (Figure 2.c) to explore the impact of agent roles and personas. Each presentation contained 9-10 slides covering 16 key points in addition to introduction and conclusion. We shared the scripted presentations with the actor two days in advance and projected the scripts on a screen during the presentation for the actor to read from. These presentations were videotaped for judges to review.

3.2 Judge Participants

Judge participants were recruited via an electronic advertisement at our institution, were required to be 18 years old or older, speak and read English, and have some presentation experience.

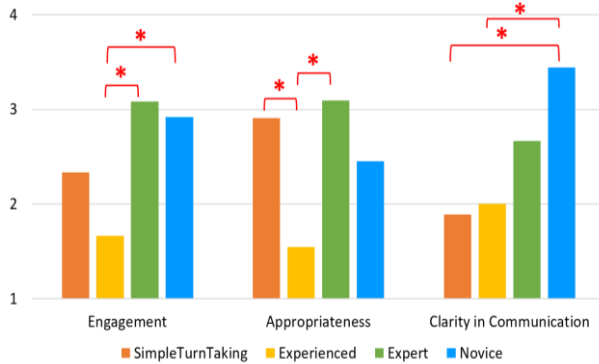
3.3 Presentation Evaluation Measures

Presentation and Virtual Co-presenter Rating was assessed after



Figure 2. The four agents used in agent roles evaluation: a) Experienced consumer, b) Expert, c) Novice, d) Neutral, e) Co-presentation setting: Agent displayed on the left and human presenter is on the right

**Figure 3. Relative Agent Role Rankings (\* indicates statistical significance using Wilcoxon). Ratings are on a scale of 1-4 (4 being the most engaging, appropriate or clear presentation and 1 being the least)**



watching each recorded presentation using a 9-question, 7-point scale measure. *Presentation Ranking* was assessed by asking judges to create rank-orderings of all presentations on engagement, appropriateness and clarity in communication of the presentations.

### 3.4 Judge Study Procedure

Judges were shown a series of the videotaped presentations. Judges either reviewed the 7 interaction formats or the 3 agent roles in a single session. Judges were then asked to describe the interaction pattern between the human and the agent (i.e. interaction formats) or the role of the agent in the presentations, to determine whether they clearly perceived the interaction formats and agent roles in the presentation. Judges then evaluated each presentation using the rating scales. After watching the entire series of videotaped presentations, judges were asked to conduct three different rank orderings of the presentations.

### 3.5 Results

We recruited 12 judge participants (7 females, 5 males, ages 22-31, mean 24) to evaluate the interaction formats, and 12 participants (6 females, 6 males, ages 22-26, mean 23) to evaluate the presentations portraying the agent playing different roles.

#### 3.5.1 Quantitative Interaction Format Results

Average ratings for all interaction formats were well above neutral. On average, presentations with the interviewer agent (Mean=5.83, SD=0.94) and simple-turn taking agent (Mean=5.83, SD=1.19) had the highest absolute ratings on *overall quality of the presentation* and ones with the encourager agent (Mean=5.67, SD=0.89) and factual agent (Mean=5.67, SD=0.89) had the lowest average absolute rating. On average, presentations with the debating agent (Mean=6.18, SD=0.40) had the highest absolute rating on *presentation engagement* and presentations with the encourager agent (Mean=5.42, SD=0.90) and the interviewer agent (Mean=5.42 SD=1.51) had the lowest

average absolute rating. There were no significant differences in absolute ratings or rankings of the interaction formats.

#### 3.5.2 Quantitative Agent Roles Results

On average, presentations with the expert, novice and neutral turn-taking agents were rated high on most measures. Friedman tests demonstrated that there was significant differences in appropriateness,  $\chi^2(2)=14.524$ ,  $p<0.01$ , credibility,  $\chi^2(2)=9.926$ ,  $p<0.01$ , satisfaction with the agent,  $\chi^2(2)=17.204$ ,  $p<0.01$ , agent's competence  $\chi^2(2)=18.313$ ,  $p<0.01$ , agent's engagement,  $\chi^2(2)=14.644$ ,  $p<0.01$ , and awkwardness,  $\chi^2(2)=12.907$ ,  $p<0.01$ , depending on the type of agent role. Post hoc analysis with Wilcoxon signed-rank tests showed that expert, novice and neutral turn-taking agent roles were rated significantly higher than the experienced consumer role. For the rank-orderings of presentations, Friedman tests demonstrated that there were significant differences in engagement  $\chi^2(2)=8.900$ ,  $p<0.05$ , appropriateness,  $\chi^2(2)=9.436$ ,  $p<0.05$ , and clarity in communication,  $\chi^2(2)=8.333$ ,  $p<0.05$  (Figure 3).

## 5. Discussion and Conclusion

Judges clearly perceived differences in co-presenter interaction formats and roles, with most (60.7%) able to clearly describe the differences among the interaction formats they reviewed. They also found all novel co-presenter interaction formats and roles acceptable for professional presentations, rating all well above neutral on the question regarding acceptability.

Overall, judges responded more positively to agent roles than interaction formats, as evidenced by significant differences in the role-based formats and qualitative responses. None of the interaction formats were rated higher than simple turn-taking on most measures, and there were no significant differences among them. Roles seem to be more recognizable and effective at setting audience expectations compared to the more abstract structure of the interaction formats. Having a co-presenter agent take on different roles may thus result not only in more engaging presentations, but more memorable ones as well.

Judges seemed to use turn-taking as their assumed "standard" reference point in rating presentations and applied a notion of fairness in their evaluations. Their expectation was that all co-presenters should share equally in the presentation workload—even when one of the presenters was a virtual agent—and they disapproved of interaction formats that violated this expectation. They felt that the co-presenter agent needed to add value to a presentation to receive a positive evaluation.

## ACKNOWLEDGMENTS

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