Sharing the Load Online: Virtual Presentations with Virtual Co-Presenter Agents

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ABSTRACT

The pandemic has caused a significant increase in the use of videoconferencing for oral presentations. Prior work demonstrated that an embodied conversational agent that co-delivers an oral presentation could be used in face-to-face presentations to reduce public speaking anxiety and increase presentation quality. In this work, we evaluate the use of a co-presenter agent in the delivery of virtual presentations given over a videoconferencing system, comparing them to presentations given without the agent. We found that participants were satisfied with the co-presenter agent, and those who liked the agent (scoring above the mean on a composite self-report measure of satisfaction) rated the presentations they gave with the agent as having significantly higher quality compared to those given without the agent. There was evidence the agent helped participants feel less nervous about their talks. Interviews confirmed these findings, and identified additional advantages and disadvantages of using co-presenter agents in virtual presentations.

CCS CONCEPTS

• **Human-centered computing → User studies**.

KEYWORDS

Videoconferencing, Virtual Presentations, Co-presentation, Virtual Agent, Slideware, Embodied Conversational Agent

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1 INTRODUCTION

Despite a strong preference for face-to-face meetings [17], the COVID-19 pandemic has forced the vast majority of meetings online. The need to give polished and impactful virtual presentations has suddenly become imperative across all fields, including the sciences. However, there are several significant barriers to giving good virtual presentations, including public speaking anxiety and difficulty maintaining audience engagement.

Public speaking anxiety is very common, affecting up to 35% of the population [5], and is the number one fear experienced by the public in the United States [6, 16]. Public speaking anxiety alone can lead to avoidance of preparation and rehearsal for presentations [11], poor presentation quality [27], and increased speech disturbances [20]. There is some evidence that virtual presentations lead to lower levels of public speaking anxiety compared to in-person talks [22, 39], but anxiety is still an issue and can be made worse online due to lower audience responsiveness and the increased evaluatory nature of online presentations [28]. Social impact theory predicts that co-presenting should decrease public speaking anxiety [24], an effect confirmed in empirical studies [18], including a study with a virtual agent as a co-presenter for in-person presentations [45].

Most guides on virtual presentations indicate that presenters giving online talks must constantly work to maintain their audience's engagement [10, 15, 19, 23, 47] given the significant distractions available and the lack of accountability for attention afforded in the face-to-face setting. In a 2009 survey of 760 business people, 58% of respondents admitted that they frequently surf the web, check their email, read unrelated material and handle other ancillary work during digital meetings [17]. The challenge to maintain engagement has led to recommendations to keep presentations more interactive and fast-paced, and to frequently provide "pattern breaks" such as changing visuals or speakers [19]. Thus, involving a co-presenter could also improve audience engagement.

In this work we explore the use of an embodied conversational agent that plays the role of an automated co-presenter for virtual presentations. The agent appears as another meeting participant in a webinar or videoconference, and takes turns with a human presenter in the delivery of an oral presentation using slideware. The agent uses appropriate verbal and nonverbal behavior for content delivery and speaker transitions, and attentive listening when the

human presenter is speaking. In this work we report on the design of the co-presenter system and a comparative evaluation study comparing virtual presentations given with the agent to presentations given without the agent.

After reviewing related work, we describe the design of a co-presenter agent for virtual presentations. We then describe an evaluation study to assess presenter attitudes towards co-presenting with the agent, and the impact of the agent on presenter anxiety and confidence compared to presentations given without the agent.

2 RELATED WORK

2.1 Online Presentation and Meeting Support Technologies

In the case of online presentations, researchers have developed a variety of systems to support speakers in online presentations, in part by simulating the face-to-face experience of presenting. For instance, unlike face-to-face presentations, presenters in online settings have little to no access to audience feedback. To address this problem, researchers have developed systems that capture audience feedback both implicitly through use of polls [36] and annotations [12], and explicitly by tracking facial expressions [29] and emotional states [41] of audience members through computer vision techniques. In addition, to support eye contact between attendees in online meetings, prior work has looked into the development of systems to manipulate the real time rendering of faces in video conferencing systems [36, 46]. These systems rotate the head of a user when rendering their face, in order to establish eye contact and simulate a face to face experience.

2.2 Virtual Agents and Presentations

We look to the virtual agents literature to further position our work. Virtual agents have been relatively well explored in the context of face to face presentations in a number of roles such as presenters, audience, public speaking coaches, and to help with public speaking anxiety.

As presenters, virtual agents with different levels of automation, from a fully autonomous agent that presents on a particular topic by crawling information on the web [3] to presenting manually authored content [32] have been developed to deliver oral presentations. However, these systems offered no interaction with the humans and are more akin to human monologues, where the agent only replaced the human presenter. In order to overcome this problem, Nijolt et al., [31] developed a system that can interact with the users by tracking the audience and allowing for a more realistic simulation. However, this system was intended to replace the human presenter and not developed for collaborating and co-presenting with a human presenter. To address this problem, Trinh et al. [45] developed DynamicDuo, a life sized agent that serves the role of a co-presenter in human-agent oral presentations. The agent was found to be effective at reducing the public speaking anxiety of the human speaker, increasing audience engagement, and perceived presentation quality. Using this system as a test bed, researchers have also investigated a number of other prototypes with virtual agents as co-presenters such as: interaction through use of natural user interfaces through use of gestures [30], different roles the agent could play as a co-presenter [21], and as supporting media for scientific talks [4].

Researchers have also investigated the role of virtual agents as presentation coaches and audience members. For example, Pertaub et al. [35] studied the effect of virtual audience in provoking arousal in speakers and identified that a negative virtual audience invoked greater anxiety in speakers. Recent advancements in speech and motion tracking has led to a number of studies using virtual agents as coaches that evaluate the speaker behavior such as: pacing, pitch, use of filler words, and non-verbal behavior and include suggestions for improvements [9, 44].

3 ONLINE VIRTUAL CO-PRESENTER

We leveraged existing videoconferencing platforms and slideware in our system design. In particular, we chose the Zoom videoconferencing platform [48] due to its ubiquity, and Google Slides [13] as the slideware application, since it can be accessed through a web browser and does not need to be installed on the user's computer.

Agent Design. Our virtual co-presenter ("Angela") was created using the Adobe Fuse character creation software [1], and animated within the Unity 3D game engine [42]. The animated agent is capable of displaying a variety of nonverbal behaviors to simulate face-to-face dialog, including head nods, eyebrow raises, directional gazes for signaling turn-taking, a range of hand gestures (e.g., beat gestures for emphasis, contrastive gestures for comparisons), and posture shifts to mark topic boundaries, all generated using the BEAT text-to-embodied-speech system [7]. The agent dialogue was authored using a hierarchical transition network-based scripting language, augmented with template-based text generation. We designed the system so that Angela and the human presenter would take turns, each presenting one or more slides, with Angela's dialog pre-scripted for each slide. Angela's speech was synthesized in real-time using the CereProc Speech Synthesis engine [8]. Using viseme callbacks from the text-to-speech engine, Angela lip-synced the synthesized speech using blendshape animations.

System Setup. We designed the virtual agent to match the display of human participants within Zoom as closely as possible. To achieve this, we used the Open Broadcasting Software [33] to create a video stream of Angela's Unity application window, and enabled it as a virtual camera. This virtual camera was used as the video input within Zoom instead of the webcam on the wizard's computer, thus transmitting the agent's face and voice into the video conference call. A researcher acting as a Wizard-of-Oz ran the agent system on their computer, and signed into Zoom as the agent. The wizard controlled the flow of the presentation by clicking a button to trigger the agent's speech wherever applicable. At the beginning of the session, the wizard was also able to enter the name of the human presenter so that the agent could refer to her co-presenter by name while speaking.

Agent Appearance and Behavior. Within Zoom, Angela was visible waist-up similar to the human participants on the screen, looking directly into the "camera", as shown in Figure 1. The agent had a flat single-color background. The agent's background was set to be in green color when she was not speaking. When the agent was the active speaker, her background was programmed to turn yellow to bring attention to her speech.

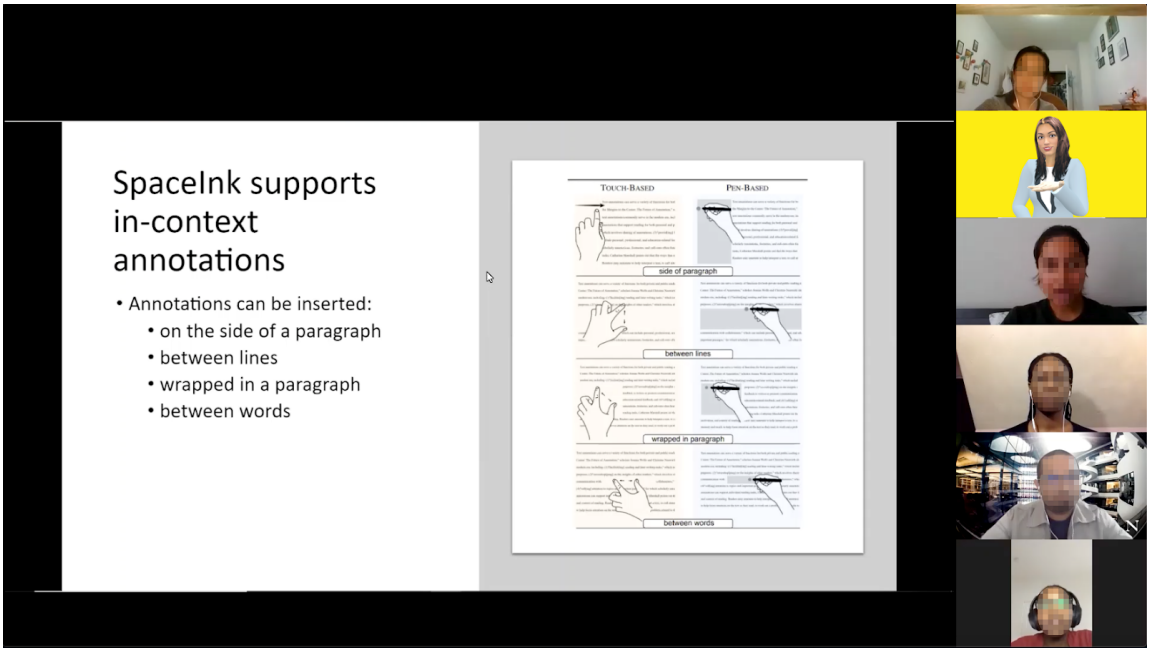

Figure 1: The system as seen on the Zoom video-conferencing platform. The presentation slides are on the left, while all the attendees of the meeting are shown on the right. The virtual co-presenter Angela appears similar to other attendees. The yellow background indicates Angels is currently speaking.

4 EVALUATION OF VIRTUAL CO-PRESENTER ONLINE

We conducted a user study to examine the effectiveness of our virtual co-presenter agent in improving the online presentation experience. We conducted a within-subjects study where participants delivered a pre-prepared PowerPoint presentation with our virtual co-presented in one presentation and by themselves in the presentation. The study was conducted online via Zoom.

4.1 Study Procedure

The two study sessions were 3-6 days apart, each 60-90 minutes long and followed the study procedure visualized in Figure 2. The ordering of the conditions (Human-agent and Human-only) was randomly assigned and counterbalanced. The study was conducted by two experimenters, one that ran the study and one that provided technical support and set up the virtual co-presenter system. In each session, we asked participants to review, rehearse, and deliver a 7-minute presentation on a pre-defined topic based on two recent HCI research papers. The first session presentation topic was on an annotation research-based tool called SpaceInk [37] and the second presentation was on a similar but different tool called texSketch [40]. Both presentations were presented in English using Google Slides with pre-prepared slides. Each presentation had 8 slides with presenter notes and each was recorded for later analysis of presentation quality from the audience's perspective.

A day before reporting for the study sessions, participants were emailed the research papers related to the prepared presentation they were to deliver. When participants reported for the first session, they were consented to participate and asked to complete baseline assessments (sociodemographics and the Self-Perceived Communication Competence Scale [26]). In both sessions, we asked participants to complete the STICSA[14] and PRCS[34] measures before we introduced the task of presenting and delivering the presentation using the pre-made slide decks.

In the human-agent session, one of the experimenters set up the virtual co-presenter (Angela) to join the Zoom as a Zoom participant. At the beginning of the study, Angela's video was turned off, and was turned on during the rehearsal and presentation phase. In this session, participants reviewed the presentation for 15 minutes (in a separate zoom break-out room in the absence of the experimenter) and rehearsed with the virtual co-presenter agent for another 15 minutes before delivering their video recorded presentation to an audience of three confederates, selected from a pool of 9 student volunteers that were trained to remain neutral in all presentations. Two experimenters were also present during the presentations. In the rehearsal and presentations, the participant and the agent took turns presenting each slide of the presentation. When it was the agent's turn to present a slide the experimenter ("Wizard") cued the agent to present based on a preloaded script. The participant always gave the first and final slide of the presentation.

In the human-only session, participants were given the same amount of time as the human-agent session to review, rehearse and present. In this session, however, they rehearsed and delivered the presentations without the virtual co-presenter. In both sessions, participants were asked to fill out an anxiety (STICSA) questionnaire before their presentation as the audience member joined the zoom session. After the presentation participants filled out the PRCS and the presentation quality questionnaire. In the human-agent session, they were also asked to rate the virtual co-presenter. After completing the questionnaires, they were interviewed by one of the

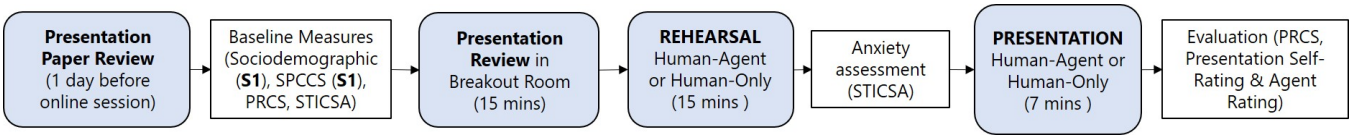

Figure 2: Evaluation study procedure for both study sessions.

experimenters using a semi-structured interview. They were then debriefed and compensated for their participation.

4.2 Measures

We assessed presenters' experience in the study using the following self-report measures and a semi-structured interview that was conducted at the end of each session. **Anxiety** was assessed at intake and before each presentation using the State-Trait Inventory for Cognitive and Somatic Anxiety (STICSA) questionnaire [14]. **Speaker confidence** was assessed at the beginning of each session and after each presentation using the Personal Report of Confidence as a Speaker (PRCS) questionnaire [34]. **Virtual co-presenter rating** was assessed after presentation with the virtual co-presenter using a 7-item, 7-point scale questionnaire as shown in Table 1. **Overall presentation self-rating** was assessed after each presentation using a 7-item, 7-point scale questionnaire as shown in Table 2.

4.3 Participants

We recruited 13 students and professionals with background in sales, engineering and teaching (5 Males, 8 Females, ages 22-42, mean 27) through online advertisement. Of the 13 participants 4 were categorized as high competence public speaker, 8 as moderate competence based on the Self-Perceived Communication Competence Scale [26]. However, one participant did not report their public speaking competence. Participants were compensated with a $25 amazon gift certificate for their participation in each session.

4.4 Quantitative Results

Twelve participants (5 males, 7 females) successfully completed both sessions of the study. This resulted in 24 interactions, 12 with the virtual co-presenter (Angela) and 12 without. Due to technical issues, one participant was unable to complete their session virtual co-presenter and had to be dropped from the study. The results presented here are for the 12 participants that completed both sessions of the study.

Virtual Co-presenter Ratings Analysis of virtual co-presenter ratings showed that presenters were satisfied with the coach (M = 5, SD = 1.87), found her to be helpful (M = 5.08, SD = 1.51) and trustworthy (M = 5.25, SD = 1.6). The rating with the lowest result was the ease of use (M = 4.16, SD = 2.80), possibly due to lack of control over the virtual co-presenter and delays during turn-taking. Given this study used a wizard-of-Oz setting, the presenter had no control over the virtual co-presenter. Table 1 shows the results of the virtual co-presenter's ratings.

Self-Rating of presentation Quality Table 2 shows presenters' self-rating of their presentation based on study conditions. Results of Friedman tests showed no significant differences between the Human-only and Human-agent condition in any of the single item quality measures. However, there was some evidence that the agent helped participants feel *less nervous* about their talks, compared to presentations without the agent (p=.07). Results of repeated measures ANOVA tests showed no significant effects of condition on state anxiety (F1,22=0.30, p=.59) as measured by STICSA or speaker confidence (F1,10=.31, p=.59) as measured by PRCS. However, the agent did have a significant effect on presenter self-ratings of their presentation quality (t(7)=3.30, p=.013, d=1.17), Figure 3, *among those presenters who were satisfied with the agent (n=8)* (i.e. rated greater than neutral (>4) on 1-7 virtual co-presenter composite scale, Table 1) and there was no session order effect on their ratings. There was no effect of condition on presentation self-rating for those who had lower ratings for the virtual co-presenter.

4.5 Qualitative Findings

We conducted semi structured interviews eliciting presenters' experience with online presentations, presenting with the virtual co-presenter agent and suggestions for improvement. The interviews were recorded and transcribed resulting in 3 hours and 11 minutes of audio files and 108 pages of transcripts. We performed a thematic analysis on the transcripts following the general inductive approach [43]. We inductively coded all the transcripts for emerging concepts, compared themes across transcripts and finally clustered themes into higher-level themes related to agents' role in reducing presentation workload and pressure, influencing presentation delivery, and their potential future roles in presentation.

Reducing Presentation Workload and Pressure. Participants felt that the virtual agent (Angela) greatly impacted their presentation by *"picking up, half the workload"* [P4], and *"help the anxiety and just the pressure"* [P6] of presentation delivery. Participants felt that in the presentation preparation phase the agent reduced the burden of having to *"memorize every single slide, that's kind of nice"* [P5]. In the presentation delivery phase, they felt that having the virtual co-presenter *"boosts your confidence a bit because it's like you're presenting as a unit as a team, rather than taking the whole thing on yourself"*[P9]. They expressed that delivering the presentation with the agent also gave them *"a time gap to prepare for your next slide. So, this like, eases off your mental tension"* [P10]. The time when the agent was presented also gave them an opportunity to *"look at the audience and see their reaction, see if they are concentrating or maybe they just, just floating"* [P7].

Reliable Co-presenter that can Influence Presentation Delivery. The virtual co-presenter was perceived as a reliable co-presenter that when compared to humans that *"have this tendency of forgetting words or replacing it with something else, the agent system can capture everything effectively"* [P2]. One participant explains that when co-presenting with a human one has to *"kind of have to follow what they're saying cause in case they like drop out or something happens, they blank out, I have to save them, and I know I don't have to save her [Agent]"* [P5]. Some participants felt that the agent influenced them to *" a small degree because it also made me slow down"* [P4]. They felt that *"how she's presenting is perfect, her speed there is perfect"* [P8]. P7 expressed that they also *"I love*

Table 1: Average rating of the virtual Co-presenter Agent.

Virtual Co-presenter's Ratings (Scale 1-7) 1-Not at All, 4-Neutral, 7-Very much	Mean(SD)
How **satisfied** are you with Angela?	5.00 (1.87)
How much do you feel you **trust** Angela?	5.25 (1.60)
How much do you feel Angela **helped** you?	5.08 (1.51)
How much would you like to present with Angela in **future presentations**?	4.75 (2.17)
How much do you **like** Angela?	4.67 (1.87)
How helpful was Angela in reducing your **public speaking anxiety**?	4.50 (2.27)
How **easy** was it to co-present with Angela?	4.16 (2.08)
Composite Score (α = .85)	4.72 (1.40)

Table 2: Self-perceived ratings of presentation quality for the two study condition (Mean(SD) and p-value of Friedman Tests).

Presentation Quality Ratings (Scale 1-7) 1-Not at All, 4-Neutral, 7-Very much	Human-Only	Human-agent	p-value
How **engaging** was your presentation?	4.91 (1.38)	4.83 (1.85)	.91
How **nervous** were you during your presentation?	4.25 (1.86)	3.33 (2.02)	.07
How **understandable** was your presentation?	4.91 (1.24)	5.25 (1.66)	.59
How **exciting** was your presentation?	4.00 (1.71)	4.55 (1.86)	.19
How **entertaining** was your presentation?	4.17 (1.64)	4.67 (1.87)	.10
How **competent** were you during your presentation?	4.42 (1.65)	5.17 (1.59)	.14
How would you rate the **overall quality** of your presentation?	4.75 (1.64)	5.17 (1.53)	.40
Composite Score (α = .90)	4.42 (1.05)	4.91 (1.38)	

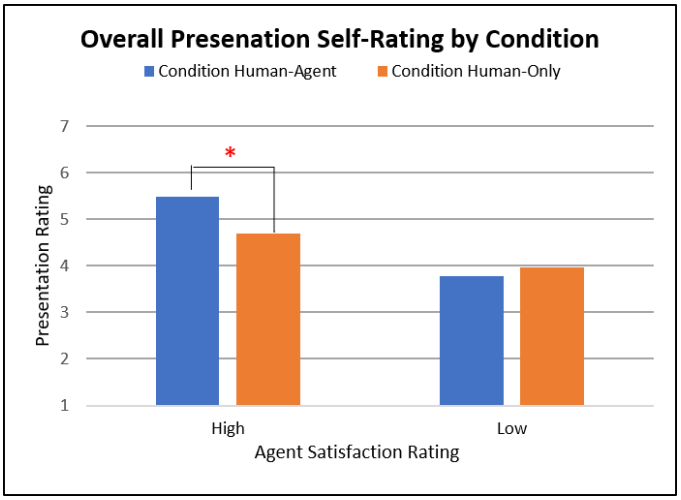

Figure 3: Self-ratings of presentations quality for Human-only and Human-Agent conditions based grouped by virtual co-presenter ratings.

her confidence" and this gave them *"that morale to, not be anxious or not feel alone. So, like, feel like we were having this conversation and not a presentation alone."*

Agent Roles in Online Presentations. We identified a few limitations of the current system and potential roles that a virtual agent could take in online presentation. Some participants said that *"I liked Angela but sometimes, like, she froze at certain parts"* [P6] and that during turn-taking *"she was taking a bit long to respond" [P8]. Others felt that "she could have been more, in the natural flow kind of thing, not as a robotic voice"* [P9]. Given that the agent was cued by the research study assistant, some participants expressed that they wanted *"more control over the presentation"* [P11]. Nevertheless, participants expressed interest in using the co-presenter agent in their future presentations and envisioned a few roles that the agent could take. Most participants reported that they would mainly use the co-presenter agent *"for static content"* [P12] *"to share the*

information and not much of an interaction with the audience" [P1]. Some felt confident in using the agent as their substitute presenter *"if like I was out sick"* [P13] or *"was out doing other stuff, like if I had some obligation, I could use her and it would be like use the same words that I would say"* [P5]. Others envisioned more dynamic roles for the virtual co-presenter that include responding to audience questions because, as P10 explains, *"she could have like, more precise answers to what the audience might ask"* and continuing the presentation when the presenter got *"stuck up somewhere or maybe I forgot my lines of presentation"* [P1].

5 CONCLUSION

Participants were satisfied with the co-presenter agent, felt that she was reliable, that they could trust her, and that she helped with their presentations (all scoring above Neutral on self-report ratings). There was some evidence that the agent helped participants feel less nervous about their talks, compared to presentations without the agent (p=.07). Participants who liked the agent (scoring above the mean on a composite self-report measure of satisfaction) rated the presentations they gave with the agent as having significantly higher quality compared to those given without the agent.

Interviews confirmed the quantitative findings. In addition, participants indicated that they felt the agent reduced their workload by giving part of the presentation for them, increased their confidence because they felt part of a team rather than having to give the presentation by themselves, and decreased their nervousness by giving them a mental break to prepare for the next part of their presentation. Some participants also felt the agent addressed another common problem in virtual presentations, that of not being able to assess audience feedback, by giving them occasional breaks during which they could focus on audience reactions rather than their presentation content. Some also saw the agent as a role model, helping them slow their speech down, which is important since nervousness can cause speaking too fast in virtual presentations [10].

This study has several limitations beyond the small convenience sample used. Our primary quantitative finding–that those who liked the agent rated their agent presentations significantly better compared to their non-agent presentations–is correlational rather than causal, since satisfaction with the agent was assessed at the end of the session with the agent. Most importantly, presentations were given in an artificial context to an audience of confederates; results for real-world presentations to potentially much larger and more critical audiences are unknown. We also did not assess audience acceptance of and reactions to a virtual co-presenter agent. Finally, we do not know how presenters or audiences will react to repeated exposure to co-presenter agents over time: will they increase in acceptance, or will the novelty and engagement quickly wear off?

There are many exciting directions for future work that could further improve the virtual presentation experience. We included the agent as an additional videoconference participant. However, if the agent were integrated into a videoconferencing system it could overlay and visually interact with the slideware (as in [25, 38]). We are also interested in exploring different roles the agent could take on in the presentation (as in [21]), and more advanced authoring tools to enable presenters to fine-tune the look and behavior of the agent (as in [2] for authoring speech prosody by demonstration). Finally, we would like to see the technology evaluated in a wide range of real settings to determine how well presenters and audiences accept co-presenter agents in their work.

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REFERENCES

[1] Adobe. 2021. Adobe: Creative, marketing and document management solutions. url=https://www.adobe.com/. Accessed: 2021-01-11.
[2] Google AI. 2018. Expressive Speech Synthesis with Tacotron. https://ai.googleblog.com/2018/03/expressive-speech-synthesis-with.html.
[3] Elisabeth André, Thomas Rist, and Jochen Müller. 1998. WebPersona: a lifelike presentation agent for the World-Wide Web. *Knowledge-Based Systems* 11, 1 (1998), 25–36.
[4] Timothy Bickmore, Everlyne Kimani, Ameneh Shamekhi, Prasanth Murali, Dhaval Parmar, and Ha Trinh. 2020. Virtual agents as supporting media for scientific presentations. *Journal on Multimodal User Interfaces* 14, 4 (Nov. 2020), 1–16.
[5] John B Bishop, Karen W Bauer, and Elizabeth Trezise Becker. 1998. A survey of counseling needs of male and female college students. *Journal of College Student Development* 39, 2 (1998), 205–210.
[6] Anke W Blöte, Marcia JW Kint, Anne C Miers, and P Michiel Westenberg. 2009. The relation between public speaking anxiety and social anxiety: A review. *Journal of Anxiety Disorders* 23, 3 (2009), 305–313.
[7] Justine Cassell, Hannes Högni Vilhjálmsson, and Timothy Bickmore. 2004. Beat: the behavior expression animation toolkit. In *Life-Like Characters*. Springer, Berlin, Heidelberg, 163–185. https://doi.org/10.1007/978-3-662-08373-4_8
[8] CereProc. 2021. The world's most advanced text to speech technology. https://www.cereproc.com/. Accessed: 2021-01-11.
[9] Mathieu Chollet, Pranav Ghate, Catherine Neubauer, and Stefan Scherer. 2018. Influence of Individual Differences When Training Public Speaking with Virtual Audiences. In *Proceedings of the 18th International Conference on Intelligent Virtual Agents*. Association for Computing Machinery, New York, NY, USA, 1–7. https://doi.org/10.1145/3267851.3267874
[10] Roger Courville. 2009. *The virtual presenter's handbook*. 1080 Group, Portland, OR, USA. https://www-users.cs.york.ac.uk/~alistair/presentations/TheVPsHB-2013-COLUK-GTM.pdf
[11] John A Daly, Anita L Vangelisti, and David J Weber. 1995. Speech anxiety affects how people prepare speeches: A protocol analysis of the preparation processes of speakers. *Communications Monographs* 62, 4 (1995), 383–397.
[12] Elena L Glassman, Juho Kim, Andrés Monroy-Hernández, and Meredith Ringel Morris. 2015. Mudslide: A spatially anchored census of student confusion for online lecture videos. In *Proceedings of the 33rd Annual ACM Conference on Human Factors in Computing Systems*. Association for Computing Machinery, New York, NY, USA, 1555–1564.
[13] Google. 2021. Google Slides: Free Online Presentations. https://www.google.com/slides/about. Accessed: 2021-01-11.
[14] Daniel F Grös, Martin M Antony, Leonard J Simms, and Randi E McCabe. 2007. Psychometric properties of the state-trait inventory for cognitive and somatic anxiety (STICSA): comparison to the state-trait anxiety inventory (STAI). *Psychological assessment* 19, 4 (2007), 369.
[15] K Virginia Hemby. 2019. *Delivering Effective Virtual Presentations*. Business Expert Press, New York, NY, USA.
[16] Debra A Hope, Richard G Heimberg, and Cynthia L Turk. 2010. *Managing social anxiety: A cognitive-behavioral therapy approach: Therapist guide*. Oxford University Press, USA, New York, NY, USA.
[17] Forbes Insights. 2009. Business meetings: The case for face-to-face. *New York. Retrieved from http://www. forbes. com/forbesinsights/Business_Meetings_FaceToFace/, and viewed on August* 20 (2009), 2014.
[18] Jeffrey M Jackson and Bibb Latané. 1981. All alone in front of all those people: Stage fright as a function of number and type of co-performers and audience. *Journal of personality and social psychology* 40, 1 (1981), 73.
[19] Colette Johnson. 2016. *Virtual Presentations Made Simple: Practical tips for effective web presentations* (1 ed.). 1, Vol. 1. CreateSpace Publishing, Scotts Valley, CA, USA.
[20] Stanislav V Kasl and George F Mahl. 1965. Relationship of disturbances and hesitations in spontaneous speech to anxiety. *Journal of personality and social psychology* 1, 5 (1965), 425.
[21] Everlyne Kimani, Ameneh Shamhekhi, Prasanth Murali, Dhaval Parmar, and Timothy Bickmore. 2019. Stagecraft for Scientists: Exploring Novel Interaction Formats for Virtual Co-Presenter Agents. In *Proceedings of the 19th ACM International Conference on Intelligent Virtual Agents*. Association for Computing Machinery, New York, NY, USA, 10–12.
[22] Kim T Kirkwood. 1998. *Validity of cognitive assessments via telecommunication links*. Ph.D. Dissertation. The University of Edinburgh.

[23] Timothy J Koegel. 2010. *The exceptional presenter goes virtual.* Greenleaf Book Group, Austin, Texas, USA.

[24] Bibb Latane, Steve Nida, et al. 1987. Social impact theory and group influence: A social engineering perspective. *Psychology of group influence* 1, 1 (1987), 3–34.

[25] Fabrice Matulic, Lars Engeln, Christoph Träger, and Raimund Dachselt. 2016. Embodied interactions for novel immersive presentational experiences. In *Proceedings of the 2016 CHI Conference Extended Abstracts on Human Factors in Computing Systems*. Association for Computing Machinery, New York, NY, USA, 1713–1720.

[26] James C. McCroskey and Linda L. McCroskey. 1988. Self-report as an approach to measuring communication competence. *Communication Research Reports* 5, 2 (1988), 108–113. https://doi.org/10.1080/08824098809359810

[27] Kent E Menzel and Lori J Carrell. 1994. The relationship between preparation and performance in public speaking. *Communication Education* 43, 1 (1994), 17–26.

[28] Michael T Motley. 1990. Public speaking anxiety qua performance anxiety: A revised model and an alternative therapy. *Journal of Social Behavior and Personality* 5, 2 (1990), 85.

[29] Prasanth Murali, Javier Hernandez, Daniel McDuff, Kael Rowan, Jina Suh, and Mary Czerwinski. 2021. AffectiveSpotlight: Facilitating the Communication of Affective Responses from Audience Members during Online Presentations. *arXiv preprint arXiv:2101.12284* 1, 1 (2021), 1–13.

[30] Prasanth Murali, Lazlo Ring, Ha Trinh, Reza Asadi, and Timothy Bickmore. 2018. Speaker Hand-Offs in Collaborative Human-Agent Oral Presentations. In *Proceedings of the 18th International Conference on Intelligent Virtual Agents*. Association for Computing Machinery, New York, NY, USA, 153–158.

[31] Anton Nijholt, Herwin van Welbergen, and Job Zwiers. 2005. Introducing an Embodied Virtual Presenter Agent in a Virtual Meeting Room. In *Artificial Intelligence and Applications*. ACTA Press, Canada, 579–584.

[32] Tsukasa Noma, Liwei Zhao, and Norman I Badler. 2000. Design of a virtual human presenter. *IEEE Computer Graphics and Applications* 20, 4 (2000), 79–85.

[33] OBS. 2021. OBS Studio. https://obsproject.com/. Accessed: 2021-01-11.

[34] Gordon L Paul. 1966. *Insight vs. desensitization in psychotherapy: An experiment in anxiety reduction.* Stanford University Press, Palo Alto, CA.

[35] David-Paul Pertaub, Mel Slater, and Chris Barker. 2002. An experiment on public speaking anxiety in response to three different types of virtual audience. *Presence: Teleoperators & Virtual Environments* 11, 1 (2002), 68–78.

[36] Verónica Rivera-Pelayo, Johannes Munk, Valentin Zacharias, and Simone Braun. 2013. Live interest meter: learning from quantified feedback in mass lectures. In *Proceedings of the Third International Conference on Learning Analytics and Knowledge*. Association for Computing Machinery, New York, NY, USA, 23–27.

[37] Hugo Romat, Emmanuel Pietriga, Nathalie Henry-Riche, Ken Hinckley, and Caroline Appert. 2019. SpaceInk: Making Space for In-Context Annotations. In *Proceedings of the 32nd Annual ACM Symposium on User Interface Software and Technology*. Association for Computing Machinery, New York, NY, USA, 871–882.

[38] Nazmus Saquib, Rubaiat Habib Kazi, Li-Yi Wei, and Wilmot Li. 2019. Interactive body-driven graphics for augmented video performance. In *Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems*. Association for Computing Machinery, New York, NY, USA, 1–12.

[39] Susan Simpson. 2009. Psychotherapy via videoconferencing: A review. *British Journal of Guidance & Counselling* 37, 3 (2009), 271–286.

[40] Hariharan Subramonyam, Colleen Seifert, Priti Shah, and Eytan Adar. 2020. texSketch: Active Diagramming through Pen-and-Ink Annotations. In *Proceedings of the 2020 CHI Conference on Human Factors in Computing Systems*. Association for Computing Machinery, New York, NY, USA, 1–13.

[41] Wei Sun, Yunzhi Li, Feng Tian, Xiangmin Fan, and Hongan Wang. 2019. How Presenters Perceive and React to Audience Flow Prediction In-situ: An Explorative Study of Live Online Lectures. *Proceedings of the ACM on Human-Computer Interaction* 3, CSCW (2019), 1–19.

[42] Unity Technologies. 2021. https://unity.com/. Accessed: 2021-01-11.

[43] David R Thomas. 2006. A general inductive approach for analyzing qualitative evaluation data. *American journal of evaluation* 27, 2 (2006), 237–246.

[44] Ha Trinh, Reza Asadi, Darren Edge, and T Bickmore. 2017. Robocop: A robotic coach for oral presentations. *Proceedings of the ACM on Interactive, Mobile, Wearable and Ubiquitous Technologies* 1, 2 (2017), 1–24.

[45] Ha Trinh, Lazlo Ring, and Timothy Bickmore. 2015. Dynamicduo: co-presenting with virtual agents. In *Proceedings of the 33rd Annual ACM Conference on Human Factors in Computing Systems*. Association for Computing Machinery, New York, NY, USA, 1739–1748.

[46] James Vincent. 2020. Nvidia says its AI can fix some of the biggest problems in video calls. https://www.theverge.com/2020/10/5/21502003/nvidia-ai-videoconferencing-maxine-platform-face-gaze-alignment-gans-compression-resolution

[47] Tim Ward and Teresa Erickson. 2020. *Resilience: Virtually Speaking: Communicating at a Distance.* Hunt Publishing Limited, John, United Kingdom.

[48] Zoom. 2021. Video Conferencing, Web Conferencing, Webinars, Screen Sharing. https://zoom.us/. Accessed: 2021-01-11.