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Interactive Vignettes: Enabling Large-Scale Interactive HRI Research

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***Abstract*— We propose the use of *interactive vignettes* as an alternative to traditional text- and video-based vignettes for conducting large-scale Human-Robot Interaction (HRI) studies. Interactive vignettes maintain the advantages of traditional vignettes while offering additional affordances for participant interaction and data collection through interactive elements. We discuss the core affordances of interactive vignettes, including *explorability*, *responsiveness*, and *non-linearity*, and look into how these affordances can enable HRI research with more complex scenarios. To demonstrate the strength of the approach, we present a case study of our own research project with N=87 participants and show the data we collect through interactive vignettes. We suggest that the use of interactive vignettes can benefit HRI researchers in learning how participants interact with, respond to, and perceive a robot's behavior in pre-defined scenarios.**

I. Introduction

Vignettes, systematically elaborated descriptions of concrete situations, are a mainstay in HRI research [1]. Vignettes are used to elicit reactions and reveal perceptions, impressions, cognition, or even social norms. For example, Malle et al. used text-based vignettes to learn about peoples' moral reasoning with robots [2]. Text-based vignettes with pictures are also commonly used to study processes such as anthropomorphism (e.g. [3]) or impression formation (e.g. [4]). Video-based vignettes are often used in HRI as they provide a richer account of a robot's behavior. For instance, Torrey and colleagues [5] used video vignettes to compare peoples' reactions to a robot's various advice-giving strategies. One of the key reasons video-based vignettes are frequently used is that they are easier to create and stage compared to in-person laboratory studies [6]. When building a video-based vignette, researchers can strategically manipulate a robot, its environment, and the behaviors of human confederate(s) to create the precise scenario they aim for participants to respond to. In addition, a vignette can be made available online easily, allowing fully remote studies on platforms such as Amazon Mechanical Turk (MTurk) and Prolific, which reduces the resources required to conduct a study.

A key disadvantage of traditional vignettes is that participants often function as passive observers, viewing an interaction from a third-person point of view without being able to experience and engage in interactions with the robot presented in the vignettes. Also, participants have been

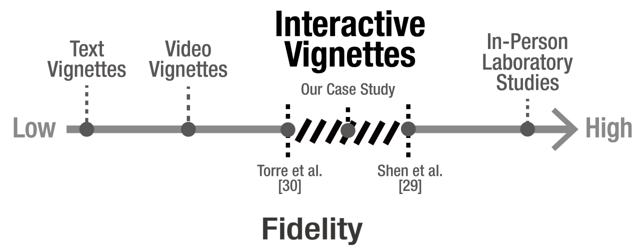

Fig. 1. The concept space of interactive vignettes in regard to fidelity.

notoriously known to not pay attention to contents in online studies [7], resulting in the concern of collecting inaccurate or unusable data and the need of additional attention and manipulation checks [8]. Moreover, researchers are typically not able to observe how participants actually interact with the robot, and instead must rely on self-reported responses collected through surveys of how they think they would respond to a given situation. With these limitations, the application of vignettes is usually constrained to certain types of HRI research that do not request back-and-forth interactions between participants and robots.

We propose the use of interactive vignettes, which maintain the advantages of video vignettes while increasing the presence and engagement levels. Similar to the concept of interactive theater vs. traditional theater, interactive vignettes enable respondents to immerse and actively participate in the given scenes from a first-person point of view and experience the influence brought by their own actions. The concept space of interactive vignettes in regard to fidelity thus lays between traditional vignettes and full-scale in-person studies, shown in Fig. 1. As several studies have demonstrated the capabilities of vignettes, bringing in the interactivity that is often missing in traditional vignettes can help expand and adapt the usage to more complex HRI research scenarios to learn how participants interact with, respond to, and perceive a robot's behavior in pre-defined scenarios.

In this paper, we outline the key affordances of an interactive vignette, including *explorability*, *responsiveness*, and *non-linearity*. We discuss how having each of the interactive affordances can further expand the usage of vignettes to HRI research with more complex scenarios. To better demonstrate the application, we offer an example of the use of interactive vignettes with our own work on the development of a novel robotic collaborative system. For the project, we have created and applied interactive vignettes by setting up a simulated design studio environment under Unity and implemented dynamic features to achieve realistic scenarios that enable rapid iterations and evaluations. Using an online study as

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a case, we demonstrate the implementation of interactive affordances and discuss the immersive experiences and data collection that interactive vignettes can facilitate to enable large-scale interactive HRI research.

II. Related Work

The term, vignette, is usually defined as an elaborated description of a social situation, person, or object that contains precise references to a certain scenario to elicit and investigate respondents' beliefs, attitudes, or judgments [9]. The use of vignettes has thrived in the social sciences to manipulate and study important factors in judgment- or decision-making processes [1]. Depending on the number and the level of factors, vignettes can be implemented with different experimental setups (e.g. within-subjects [10], between-subjects [11], and mixed [12]) with varied implications for the analysis and interpretation of collected data. Recently, several scholars have also started to promote the use of vignettes for not only quantitative research, but also for qualitative research to prompt responses from participants [13], [14].

A. Vignette-Based Research in HRI

Today, HRI researchers have applied different forms of vignettes to collect perceptions, attitudes, and behaviors toward robots under desired scenarios. Blaming et al. [15], for example, adopted text-based vignettes and gave participants hypothetical textual descriptions to study the general perception toward robots in the trolley moral dilemma. Malle et al. [16], on the other hand, applied image-based vignettes to examine the effect of various types of agents under similar moral dilemmas. In addition, image-based vignettes have often been applied in studies related to robots' appearance, such as anthropomorphism [17] and gender features [18]. Besides using static texts and images, audio-based vignettes are another variety that has been implemented to explore the effect of sound from robots [19].

With the capability to present concrete and detailed stimuli, video-based vignettes have been commonly seen in HRI research to manipulate dynamic modalities and study robots under complicated scenarios. For instance, several studies have focused on exploring robots' motions with generated videos for participants to evaluate under given situations [12], [20], [21]. Additionally, research on verbal conversation with social robots often incorporates the use of video-based vignettes to understand people's perceptions toward the situated actions and responses from robots [5], [22], [23].

While some of the video-based vignette studies offer a first-person point of view for participants to immerse themselves in the scenarios [6], [24], most of them remain in a third-person point of view [25]–[27]. The key disadvantage of this is that participants can only act as passive observers, viewing and reflecting on the situations without being able to experience and engage in the interaction with robots. Moreover, researchers are not able to get first-hand reactions but solely rely on self-reported responses. Another downside of online vignette studies is the concern that participants are not paying attention to the vignettes, which affects the quality of the collected data [28]. Attention and manipulation checks can be included in a survey to ensure that participants watched the vignettes, but there is not a good way to keep participants engaged nor to measure their engagement level [7].

As interaction is of central concern to research in HRI, traditional vignettes are constrained by a lack of interactive components to certain types of studies that do not require direct back-and-forth interaction with robots. To expand the usage of vignettes, we propose the use of *interactive vignettes*, which maintain the key advantages of traditional vignettes while adding interactive elements.

B. Interactive Vignettes

Previous work in HRI has explored ways to add interactivity to vignette-based research to some degree. Shen et al., for example, enabled participants to control the movement (video time-frame) of a telepresence robot to study the cross-cultural difference in preferred social distance [29]. This feature allowed the participants to see the result of their own input in real-time, creating an interactive experience when controlling a telepresence robot. A recent study from Torre et al. also incorporated the feature of real-time interaction with a simulation, having the participants play a swerving game to study the impact of anthropomorphism of robots in swerving behavior and future design of navigation algorithms [30]. The study setup allowed the researchers to directly observe participants' reactions and responses with insightful information under a given scenario.

Inspired by the work of Jenkins et al. [14], we decided to explore the potential of interactive vignette studies in a HRI context, including how interactive elements are crucial and beneficial to certain types of HRI studies. Further, we have not yet seen work details a comprehensive list of elements and features needed for constructing an interactive vignette study. As previous scholars have demonstrated the strength of vignettes to adapt to different types of research [13], bringing back the interactivity that is often missing in traditional vignettes will further expand the apllication and benefit the related research fields. In this light, we aim to promote the use of *interactive vignettes* in HRI. In the following section, we will discuss the key affordances of interactive vignettes.

III. Interactive Vignettes

We define an *interactive vignette* as a vignette which takes participants' input into account and changes the content and/or presentation of the vignette. Similar to the concept of interactive theater vs. traditional theater, participants can immerse and actively participate in an interactive vignette under a given scene from a first-person point of view. By enabling participants to engage in a dynamic scene, we can increase the presence and engagement levels of the participants. We discuss three core affordances interactive vignettes offer for HRI research: *explorability*, *responsiveness*, and *non-linearity*.

A. Explorability

Explorability refers to the affordance that offers participants flexibility in exploring the situation presented by a vignette. For example, standard video vignettes do not allow participants to adjust their point of view or change their position in order to make certain aspects of the vignette visible. Allowing participants to change their view point and/or change their position can provide participants with more situational awareness than video vignettes and provide researchers with additional insights about participants' behavior. Both the studies from Shen et al. and Torre et al. show how explorability can be the feature to achieve research purposes and for researchers to acquire first-hand data of participants' behavior under the desired scenarios [29], [30]. The ability to move within a vignette can also be used in HRI studies related to proxemics, how space is managed during interactions with robots.

B. Responsiveness

Responsiveness refers to the degree to which a vignette can adapt or respond to participant behavior. Adding responsiveness to vignettes allows participants to experience the influence brought by their own actions. For example, the study by Shen et al. [29] allowed participants to "control" how closely a telepresence robot should approach a person based on their own perception of appropriated distance. The responsiveness of interactive vignettes also affords participants to interact directly with a robot which can increase engagement and allow the collection of interaction data. For example, the chicken game from Torre et al. [30] put participants in the situation of directly interacting with a robot. The same concept can be applied to the earlier work from Takayama et al. [12], instead of viewing the scenarios as bystanders, participants can encounter the actions from robots themselves.

C. Non-linearity

Non-linearity refers to the flexibility for participants to decide the order in which they will engage and explore in the scenario, which is similar to the concept of interactive theater where audiences can pick the sequences of scenes during a play. Traditional vignettes expose participants to a static and linear narrative of a fixed sequence of events that does not take participants' feedback into consideration. This constraint limits the types of HRI research that can adapt the use of vignettes as a smooth flow of changing events is sometimes required during an interaction. Non-linearity affords more flexibility as participants can determine the sequencing of events to some degree to experience more realistic scenarios. An example of the application of non-linearity can be found in the work of Jenkins et al. [14], they setup the interactive vignettes by using the changing sequence of PowerPoint slides based on participants' choices. Coughlan et al. also incorporated the idea of "tailored scenarios" to developed vignettes based on each participant's input [31].

It is important to note that not all three affordances listed here have to be utilized when creating an interactive vignette. Based on the purpose of the study and type of data researchers aim to collect, different utilization of affordances can be considered when creating and setting up an interactive vignette. In the following section, we offer an example of the use of interactive vignettes with the implementation of the three core affordances on our own work on the development of a novel robotic collaborative system. We will look into the overall conceptual elements and system architecture we have constructed for creating and conducting an interactive vignette study.

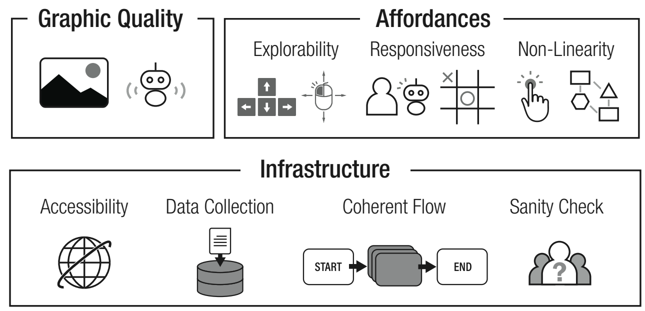


Fig. 2. The conceptual elements of the interactive vignette study for our project.

IV. Case Study

To demonstrate the usefulness of the interactive vignette approach, we present a case study we conducted as a part of the project to develop a novel remote collaboration robotic system. The goal is for the robot to serve as a physical instantiation of a remote user in a local space to engage in a collaborative sketching task.

A key challenge in developing a robotic collaboration system that will closely interact with people is that the enormous complexity of hardware and software makes it difficult to apply standard design approaches that involve rapid iterations and evaluation cycles. Exploring multiple options across a wide design space is time-consuming and labor-intensive as each design configuration requires a relatively complex infrastructure. The project serves as a perfect use case for our interactive vignette approach as it allows for a fast and low cost evaluation of important design parameters while also allowing for data that is richer than what would be possible with standard vignette approaches. While standard text-based or video-based vignettes allow researchers to gather data about a user's perceptions of a robot, they do not allow data collection about actual users' behaviors or reactions to a robot.

A. Interactive Vignettes Setup

For the project, we have created and applied interactive vignettes by setting up a simulated design studio environment under Unity. Fig. 2 lists the conceptual elements for our interactive vignette study. The choice of using a simulation instead of filming videos of an actual robot is because we are developing a system that has no yet existed. The application of interactive vignettes has enable us to perform rapid iterations and explore many different possible design within a short amount of time without actually building all the hardware.

Graphic Quality - We designed our system to allow for detailed 3D rendered environments and with capabilities to render realistic and complex robot motions. Unity offers high-quality graphics and lighting that can add more realism and provide participants an appropriate context in an interactive vignette. In addition, we applied an IK solver and the animation function to generate, fine-tune, and execute smooth and reasonable movements of a robot with multiple degrees-of-freedom. The set up of our interactive vignettes with Unity are shown in Fig. 3.

Interactive Affordances - A virtual camera was set up in Unity scenes to support the explorability affordance. Users can control the virtual camera through keyboard and mouse to have the ability of moving and changing perspective within the simulated environment. This interaction provides users with situational awareness within the demo and allows them to freely choose the position in relation to the robot. Further, to create the collaborative scenarios that are suitable to our project with back-and-forth actions and reactions, we incorporated the tic-tac-toe game for participants to engage in during the vignettes as this game include the feature of turning-taking that is essential to collaboration. The setup of this shared activity can enable participants to make actions and observe how the robot react to them in the simulated scenario. Based on different moves from participants and game results, the robot can respond differently, which supports both the responsiveness and non-linearity affordances of interactive vignettes and for us to study and evaluate our system. We made sure to include the information that participants need to get familiar with the interactive vignettes, for example, the instruction of the control and the activity, shown in Fig. 3.

Infrastructure - Accessibility, referred here as the access to the vignettes, is an important aspect when running online studies. To lower the requirement, we built our interactive vignettes as a WebGL application and uploaded a web page with an embedded app on a web server. Participants can easily use their own laptop or computer to access the interactive vignettes without the need to locally download or install any new programs. Moreover, with the web server setup, participants' actions to interactive elements can be collected and measured for further analysis which enables the data collection. Our interactive vignettes have several interactive elements that can be recorded and used to derive more insights about participants' behaviors or engagement than conventional video studies in addition to subjective questionnaires. Take the setup of camera view for example, we can record virtual camera movements with a timestamp to reproduce what participants see and how they move around in the virtual space during the vignettes. Observing these movements can lead us to useful indications, for instance, where their attention is paid to and how they place themselves in relation to a robot. The setup can also record other information such as their participant ID, completion time, and game results, which can be used for further analysis if needed. We made sure the interactive vignettes offer a coherent flow for participants to easily get familiar with and go through without confusions. With the implementation of shared activity for participants to experience in the vignettes, we can directly check their participation in the tasks by looking at recordings of activity results, text/mouse inputs, or camera movements. We intentionally set up the starting camera viewing point toward the opposite direction of the robot that participants will need to actually engage in the scenes to complete the tasks. The mechanism can help researchers to eliminate these invalid or less valuable data points.

Fig. 3. The setup of interactive vignettes with Unity for our project: the implementation of playing tic-tac-toe game with a robot.

B. Conditions

The presented case study explores a remote collaborative sketching scenario in which a remote operator collaborates with a local user via a teleoperated robot. More specifically, the study examines the impact of varying degrees of non-verbal cues (no cues as control, turn taking cues only, and non-verbal cues) of a tele-operated robot on user perceptions and behavior. Using the system described in the previous section, we conducted a 3-condition within-subjects interactive vignette study to compare the perceptions toward robots with different levels of expressivity. The sequence of the 3 conditions was randomized to avoid carry-on effects.

- *Control condition (**CC**)*: the telepresence robot remained at a fixed location to draw on board during the game.
- *Turn-taking condition (**TC**)*: the telepresence robot would move closer/farther (0.5 m) from the board to indicate turn-taking during the game.
- *Non-verbal cues condition (**NC**)*: on top of **TC**, the telepresence robot would follow the location of the participants and react to the result of the game.

C. Participants

We recruited N=100 participants from Mturk and paid $6.00 each for their participation as the study takes around 25 minutes to finish. Participants were recruited if they were

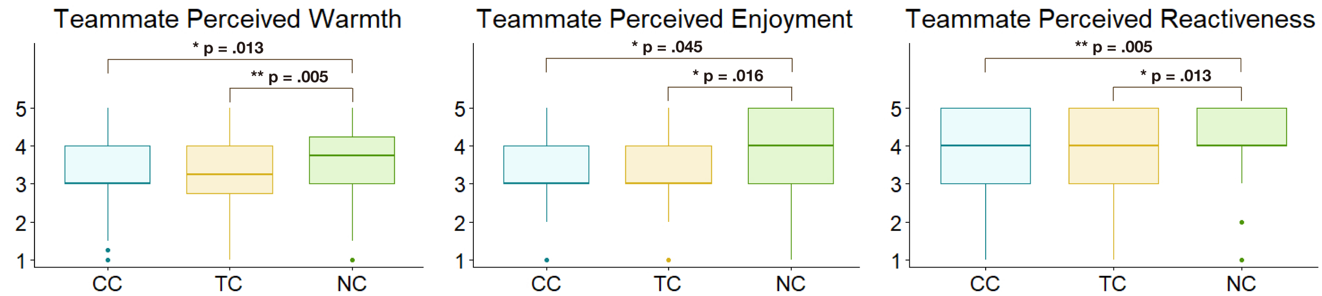


Fig. 4. Results of the subjective measures of teammate perceived *warmth*, *enjoyment*, and *reactiveness* with Bonferroni adjusted p-values.

from the United States and had previous task-approval ratings of 95% or higher. 13 data points were removed since the interactive vignettes indicated incompletion. The final dataset contained N = 87 participants (29-female, 58-male) with the average age of 38 years old (SD = 9.3). 4 of them indicated having experiences of using telepresence robots in the past.

D. Procedures & Task

The study happened on two sites: Qualtrics and the web apps for the vignettes we built. Participants were guided from Mturk to our Qualtircs survey, where they were given the task scenarios and informed that they would be remotely playing tic-tac-toe games with 3 teammates respectively. We chose to implement tic-tac-toe in this particular study because it emphasizes the aspect of turn-taking, which is a key component of collaborative tasks. We asked participants to imagine that the robot they would see in the games (vignettes) was controlled by their remote teammate located in a different city. Each of the interactive vignettes contained a simulated robotic arm with different levels of expressivity, shown in Fig. 3. Following the completion of each vignette, there was a post-vignette questionnaire. After the completion of all 3 vignettes, participants were asked to fill out a post-study questionnaire.

E. Measures

Subjective: We adopted perceived *warmth* (4 items) and *competence* (5 items) measures from the work of Mieczkowski et al. [17] and Fiske et al. [32]. We additionally asked participants to rate teammate's *perceived enjoyment* and *reactiveness*, participants' *enjoyment*, and their *willingness* to work with the teammate again. All the ratings are based on a 5-point Likert Scale.

Objective: With the application of interactive vignettes, we were able to collect information regarding an individual's moves, performance, change of viewing point, and navigation in the environment throughout the tic-tac-toe game.

F. Results

Subjective: A one-way repeated measures ANOVA was performed for each of the 6 factors we measured across all 3 conditions. Analysis indicates a significant effect on teammate's perceived *warmth*, *enjoyment*, and *reactiveness*. A post-hoc analysis was then conducted on each of the items with adjusted p-values using the Bonferroni multiple testing correction method, showing significant differences between **CC - NC** and **TC - NC** conditions. The results are shown in Fig. 4. The results show that the adding of non-verbal cues does improve the perceived warmth, enjoyment, and reactiveness toward the teammate and will potentially be the design option to apply to increase the collaboration experience.

Objective: With the collected data of individual's moves, performance, change of viewing point, and navigation from the interactive vignettes, we were able to recreate the scenes participants experienced and extract higher-level information. Looking through the data, we noticed that participants tended to not move again after they started the activity. We graphed out all the participants' ending positions in **NC** (see Fig. 5(b)), which shows the distribution of how the participants placed themselves in relation to the robot and the shared activity space. Fig. 5(c) is an example of another information we extracted: we were able to graph out each participant's trajectory in each interactive vignette and observe how they explored the environment.

G. Limitations

For interactive vignettes built under a virtual environment, we need to consider how missing physicality of the robot could affect participant's perceptions of the system. Recent work has argued that virtually embodied robots elicit a fundamentally different frame of mind from physically embodied robots [33]. However, previous studies have also demonstrated the strength of virtual vignettes in prototyping and testing robot behaviors [12]. In our case, we chose to apply a simulation based on the nature of our project: we are developing a robotic collaboration system that has not yet existed and we aim to perform rapid iterations with the fastest way and the lowest cost. We do understand that the results of our case study might need to be further examine when implementing the system in the future, we want to keep the focus on our main purpose here as promoting the use of interactive vignettes as an alternative to conduct large-scale interactive HRI research.

V. Discussion

We introduced interactive vignettes as an approach to expand on the affordances for data collection offered by traditional text- and video-based vignettes. We presented a case study of our own project as a demonstration of the usage if interactive vignettes to look into what this approach can offer to HRI research.

We argued that interactive vignettes offer three main affordances that distinguish them from traditional vignettes: *explorability*, *responsiveness*, and *non-linearity*. These affordances allow researchers to collect richer data while maintaining some of the simplicity of designing and deploying traditional vignettes. As such, interactive vignettes occupy the space between traditional vignettes and full-scale in-person studies when comparing approaches in terms of overall fidelity. Below, we highlight several key advantages that interactive vignettes offer as a research approach.

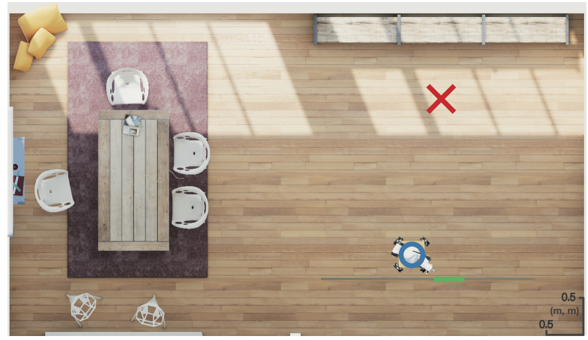
A. Enabling Rich Human-Robot Interaction Experiences

Most of the HRI studies with video-based vignettes have participants function as passive observers, viewing an interaction from a third-person point of view. Under these circumstances, participants are not directly experiencing nor engaging in the interaction with the robot presented in the vignettes and can only reflect and rate their perceptions as a bystander. The downside of this setup is that we cannot be sure whether the self-reported perceptions can be generalized to situations where participants are actually interacting with the robot(s). Further, participants are only exposed to one single scenario without more complex back-and-forth interactions. This limits the validity of vignettes that study how humans directly and continuously interact with or around robots.

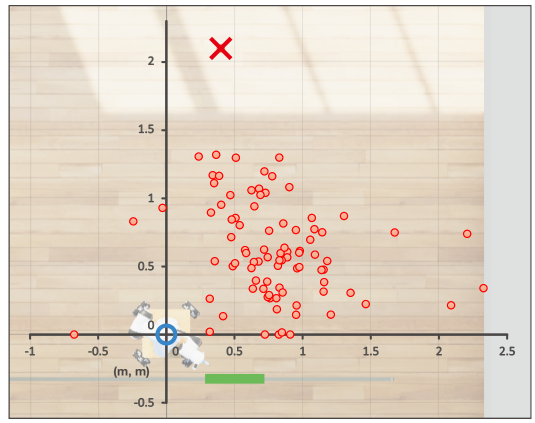
Our case study shows that with the adoption of interactive vignettes, participants can actively interact with a robot. For instance, we were able to include more ego-centric questions to understand the first-hand experiences from participants. We asked participants "*How much do you enjoy playing tic-tac-toe game with your remote teammate?*" and "*How likely would you be willing to work with your remote teammate again?*", both of which would not have been reasonable if they were only asked to watch a video showing someone playing the game with a robot.

In addition, our studies also shows the capability of interactive vignettes, when having the *explorability* affordance, to address peoples' preferred social distances. It is unlikely that a pre-set position will work for everyone that some people might feel unsafe if the distance is too close and feel unrealistic if it is too far. Thus, instead of constraining participants at a fixed position with a fixed viewing angle, the adding of explorability in interactive vignettes enables them to freely place themselves in the environment. This feature allows them to not only experience the interaction in a more comfortable way, but also reflect on a more realistic scenario based on individual preference.

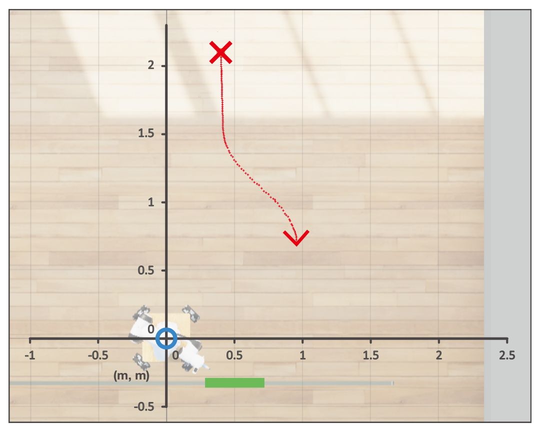
Finally, our study demonstrates that the adding of *responsiveness* and *non-linearity* affordances has enriched the interaction experiences and add onto the fidelity as participants were able to make moves by themselves and observe the reactions from the robots based on their moves and the final games results. The same effect would not be achieved with only video vignettes showing a person playing the game with the robot because participants might feel conflicted when viewing an action that is different from what they would have done when being in the situation.



(a) The top-view of the studio design setup in the interactive vignettes.



(b) Participants' ending positions (*red* dots) in the **NC** vignette



(c) P78's moving trajectory (*red* path) throughout the **TC** vignette.

Fig. 5. Top-view of the interactive vignettes (a) with the overlaid information from collected data (b) (c): *blue* circle is the robot's position, the *green* block is the game board's position, and the *red* cross is the starting position of all participants. The figures are scaled with the unit of meter.

B. Enabling Dynamic Data Collection

One of the constraints of traditional vignettes is that researchers do not have much information about what is happening when participants watch the vignettes. Often, questions in regard to the contents need to be added to make sure they understood the contents of the videos as attention check. Moreover, researchers are not able to observe how participants react to a particular moment in the videos, and instead, must rely on the self-reported responses collected through surveys.

In our case, we have demonstrated that the application of interactive vignettes that requires inputs from participants can bypass this limitation. We were able to continuously collect dynamic data throughout each of the vignettes, including an individual's moves, performance, change of viewing point, and navigation in the simulated environment. The collected information has allowed us to re-created the scene of each participant under each vignette. We here show some additional insights on participants' movements that can be extracted from the collected data, such as how participants placed themselves in relation to the robot and how participants move around in the space, shown in Fig. 5(b) and Fig. 5(c). The extracted information could signify participants' perceptions toward the robot, whether they feel safe to get closer to the robot and what is their sense of shared space when working beside a robot. For example, in our case, we found out that most people did tend to stay on the left side of the board as robot was set to stay on the right side (Fig. 5(b)).

Dynamic data collection through interactive vignettes can be adopted and used to facilitate HRI studies that involve more complex scenarios. For instance, the information about how people move around in relation to a robot can be useful for research on proxemics by enabling researchers to observe how space is managed by people during interactions with a robot. Researchers can easily generate the graph showing how the distance between a participant and a robot changes along the time. Further, recordings of participants' actions throughout the vignettes can help explore how a robot's behavior influences people's decision-making.

C. Interactive Vignettes vs. Simulations

While interactive vignettes share characteristics with simulation approaches in HRI (e.g. [34], [35]), interactive vignettes are different in two key aspects. First, vignettes are elaborated descriptions serving as stimuli to study people's judgement, decision-making, and reactions to a given scenario. While interactive vignettes can be created and provided through a simulation experience, such as what we did in our work and the study by Torre et al. [30], simulations are not a necessary component to simulate the realistic behaviors of a robot, as demonstrated by Shen et al. [29]. In the work of Shen et al., they recreated the actual scenario of controlling a telepresence robot in the vignettes by videotaping an approaching scene toward confederates. Second, simulation is also not a sufficient condition for an experience to be considered as an interactive vignette as the range of experiences is more constrained around a specific narrative and serve other purposes than studying behaviors.

A clear boundary between simulations and interactive vignettes is difficult to set as they have been overlapping in several HRI studies. However, we argue that simulations and interactive vignettes are grounded on different standing points that simulations are a tool that can be applied in varies HRI research, as discussed by Lemaignan et al. [34], whereas interactive vignettes stand as an approach with the purpose to study respondents' beliefs, attitudes, or judgments. For example, the work of Breazeal et al. on the Mars Escape game will not be seen as an interactive vignette study, even though it does have similar setup as our case study, because the main purpose is to collect and build a database for later implementation [36]. On the other hand, according to our definition, we would describe Torre and colleagues' design of the chicken game to study swerving behavior [30] as an interactive vignette approach. Our work here further explored this approach and highlights its unique affordances for conducting HRI research.

VI. Conclusion

In this paper, we proposed the use of *interactive vignettes* in the field of HRI to enable large-scale development and evaluation of interactive robotic systems. Interactive vignettes maintain the advantages of traditional vignettes while increasing the presence and engagement levels of the participants by including interactive elements. We outlined the core affordances of interactive vignettes, *explorability*, *responsiveness*, and *non-linearity*, and discussed the potential HRI research that can be benefited from them. We then demonstrated the application of interactive vignettes with our own work on developing a novel robotic collaboration system. We showed the dynamic data collection achieved with interactive vignettes that is usually not supported by traditional vignettes and needs to be gathered from in-person studies. To conclude, we suggest that the use of interactive vignettes can benefit HRI researchers in learning how participants interact with, respond to, and perceive a robot's behavior in pre-defined scenarios.

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