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A Midsummer Night's Dream:

Social proof in HRI

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Abstract— The introduction of two types of unmanned aerial vehicles into a production of *A Midsummer Night's Dream* suggests that social proof informs untrained human groups. We describe the metaphors used in instructing actors, who were otherwise untrained and inexperienced with robots, in order to shape their expectations. Audience response to a robot crash depended on whether the audience had seen how the actors interacted with the robot “baby fairies.” If they had not seen the actors treating a robot gently, an audience member would likely throw the robot expecting it to fly or handle it roughly. If they had seen the actors with the robots, the audience appeared to adopt the same gentle style and mechanisms for re-launching the micro-helicopter. The difference in audience behavior suggests that the principle of social proof will govern how untrained humans will react to robots.

Keywords- *Human-robot interaction, robotic theater, UAV-human interaction, social proof, social interaction, performing arts*

I. INTRODUCTION

Two types of unmanned aerial robot “fairies” were incorporated in the Texas A&M production of William Shakespeare’s *A Midsummer Night's Dream*. A pizza-sized AirRobot AR-100 quad rotor helicopter served as the alter ego for the king fairy and six fist sized Blade mCX micro-helicopters accompanied six other fairies. The robots were envisioned as the alternative shapes of fairies and hovered near their human actor. The robots possessed no obvious surfaces for handling when costumed and had only limited means for showing intent.

The involvement of the robots was primarily to have roboticists work with theater professionals and learn how to create believable agents. Despite the observations made here, the production was not originally conceived to study direct human interactions. The production did not advertise the presence of robots, the robots did not assume any speaking role in the play, and the play was not altered except for the addition of a Prolog to bring all the actors, robots, and dancers together in a futuristic setting.

However, the production did lead to surprises about direct human-robot interaction, suggesting that untrained humans rely on *social proof* to guide their interactions. Social proof is the idea that people will be influenced by what others are doing, and will mimic those actions [1]. This effect was



Figure 1: Fairies re-launching the “baby fairies” after a crash.

repeatedly observed by the audience mimicking the actions of the actors towards the robots.

II. HUMAN-ROBOT INTERACTIONS

The incorporation of robots into the play led to two broad categories of direct human-robot interactions: *actor-robot* and *audience-robot*. The first category, actor-robot interactions involved actors—who were otherwise unfamiliar with robots—gesturing to, gesturing with, launching, catching, and carrying micro-UAVs. The robots had predefined entry and exit cues within the 6 scenes, but most interactions were partially improvised. However, the interactions were not limited to the script because the micro-helicopters did not land or maneuver in a precise, repeatable fashion and crashed an average of 8.75 times per night over 8 performances. Crashes also led to the direct *audience-robot* interaction, as the micro-helicopters sometimes fell into the audience or flew close enough that audience members tried to catch or swat them away. The quad rotor did not crash or have any deviations from the script.

III. FINDINGS

During the rehearsals, metaphors were employed to teach the untrained actors on how to interact with the robots. One of these metaphors, “micro-helicopters are like babies,” produced an interaction schema on stage that appeared to be adopted by the audience if the audience had seen that interaction, otherwise the audience treated a crash differently.

A. Use of Metaphors to Guide Actor-Robot Interactions

Actor-robot interactions in the early rehearsals uncovered unsafe forms of operation that risked damaging equipment and possible injury. These were corrected through the use of two metaphors.

First, significant damage resulted from the actors not understanding how the micro-helicopters operated, which was also accompanied by unrealistic expectations of ruggedness. In order to encourage interaction and increase comfort with the equipment, the actors were initially told that robots were safe to interact with and that they should not be concerned by falls. In the early rehearsals, the actors would toss the robots into the air even when their blades were fully stopped or at unfavorable angles (including upside down). The actors seemed to expect the robot to be adaptable.

This incorrect (and costly) model of how to interact with the robots was corrected by comparing the robots to “baby fairies” and discussing the needs of the robots to be able to fly. The “baby fairy” metaphor immediately produced gentle handling. As a side effect, the metaphor translated into improvised affect on stage. The actors became very possessive and protective of their baby fairy on stage. When the robots landed in the hands of the actors, the actors were exceedingly gentle. If a “baby fairy” crashed, an actor would rescue it, perhaps miming soothing or scolding the robot, as shown in Figure 2, or even scolding the audience. As noted by the audience in the talkbacks, the improvised reactions to the robots’ unpredictable crashes and inaccurate landings were a very positive contribution to the play.



Figure 2: Fairy scolding “baby fairy”.

The second unexpected interaction involved actors being generally unguarded and incautious near the AirRobot AR-100 despite its size and larger spinning blades. The robot’s stability in flight and actors’ comfort with the smaller micro-helicopters may have contributed to a reckless attitude. Telling the actors and dancers to keep a distance from the AirRobot did not change the behavior noticeably.

This dangerous situation was corrected with a more negative metaphor; the roboticists told the actors that the AirRobot is also known as the “flying weed wacker of death” because of the potential for injury from the rotors. In response, not only did the actors and dancers immediately keep a safe

distance from the robot, the actors propagated the metaphor and it even appeared in a college newspaper article [2] about the play.

B. Evidence of Social Proof in Audience-Robot Interactions

The audience reacted to the robot crashes differently if it occurred before a scripted actor-robot interaction or after an unscripted crash on stage with improvised actor-robot interaction.

The first crash was often during the Prolog. If the crash was on the stage, the dancers and actors ignored the disabled robot until the end of the sequence and then picked up the robot while exiting. If the crash was into the audience, the audience had not been aware of the robots and appeared startled. This happened 3 times, and they reacted by throwing the robot back into the air or onto the stage (duplicating the rough treatment initially applied by the actors during rehearsals), setting it onstage, or just keeping it.

However, in 9 cases, a crash into the audience occurred after the lullaby scene where the human fairies call the robot fairies and have them land in their hands, as seen in Figure 1. If a crash onstage during that scene occurred, an actor would cuddle or scold the robot and then gently hold it palms up to allow the robot operator to spin up and take off. If the robot rotor did not spin, the actor would then carry the robot, much like a pet through the duration of the scene. Thus, the audience had been indirectly shown how to treat the robot.

In the 9 cases where a robot crashed into the audience after that scene, the audience member duplicated the general gentle handling and launching procedure.

IV. DEFAULT AND DIRECT SOCIAL PROOF

One explanation for the difference in audience behavior described above is *social proof*. The untrained audience, and actors, may use films and interactions with consumer electronics as default social proof of how to interact with robots. Since films present over-idealized robots that adapt to humans and consumer electronics are usually robust and reliable, this may account for the initial rough treatment of the micro-helicopters and disregard for safety near the quad rotor. Witnessing a credible source, the actor, handling the robot, gave a direct and context-sensitive exemplar of how to treat these particular robots.

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