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Abstract—**This paper describes the Survivor Buddy human-robot interaction project and how it was used by four middle-school girls to illustrate the scientific process for an episode of "SciGirls", a Public Broadcast System science reality show. Survivor Buddy is a four degree of freedom robot head, with the face being a MIMO 740 multi-media touch screen monitor. It is being used to explore consistency and trust in the use of robots as social mediums, where robots serve as intermediaries between dependents (e.g., trapped survivors) and the outside world (doctors, rescuers, family members). While the SciGirl experimentation was neither statistically significant nor rigorously controlled, the experience makes three contributions. It introduces the Survivor Buddy project and social medium role, it illustrates that human-robot interaction is an appealing way to make robotics more accessible to the general public, and raises interesting questions about the existence of a minimum set of degrees of freedom for sufficient expressiveness, the relative importance of voice versus non-verbal affect, and the range and intensity of robot motions.**

*Keywords- **assistive robots, human-robot interaction, gaze and gestures, interaction styles, robots, user interfaces***

I. INTRODUCTION

Robots are being considered for applications where they serve as proxies for humans interacting with another human (point of injury care). Consider that two trapped Australian miners requested MP3 players with a Foo Fighters Album while waiting for rescue [1]. In these domains, the human ("dependent") is connected to multiple other humans ("controllers") via the robot proxy for long periods of time. The literature already shows that the dependent in search and rescue scenarios will respond to the robot socially [2], [3], raising the possibility that people become distrustful as well as cognitively confused by a robot that presents a different affect for different controllers rather than a consistent communication strategy.

The Survivor Buddy project, which is investigating a formal, comprehensive communication strategy for HRI combining verbal and non-verbal affect, was recently used for an episode of the Public Broadcasting System (PBS) "science reality" TV show called SciGirls to be aired in February 2010. In each SciGirls episode, a set of 3 or 4 middle school girls are paired with mentors to design, implement, conduct and analyse a scientific experiment. In this episode, four girls worked with the Survivor Buddy multi-media, social robot "head." The Survivor Buddy head has a LCD screen to permit the survivor to videoconference with responders (or family), watch live TV or listen to music. The first version of the head has four degrees of freedom emulating the range and speed of human head movements.

The SciGirls programmed affective behaviours and voices for the Survivor Buddy then tested them with their friends.

II. RELATED WORK

Survivor Buddy is intended to be a *social medium*, serving as a multi-media link to the outside world and a form of expression for surrogate operation by remote humans communicating with the victim. Work by Nass shows that even when technologies lack explicit social cues, people respond to them as social entities [4]. The Computers as Social Actors paradigm suggests that individuals automatically apply a wide range of social responses to technologies [5], [4]. Research performed under this paradigm has shown that even computer experts are polite to computers [6], apply gender stereotypes to computers [7], and are motivated by feelings of moral obligation toward computers [8]. Computer users identify a computer's "personality" as submissive or dominant and as in human-human interaction, respond more favourably to one with a personality similar to their own [9], [10]. Even unintentional cues of social identity elicit powerful attitudinal and behavioural responses from humans.

III. QUASI-EXPERIMENTAL DESIGN, IMPLEMENTATION AND ANALYSIS

Four different independent variables were considered with the focus eventually landing on *personality*. The final study design featured a single factor (extroversion) with two levels (extrovert vs. introvert).In discussions with the four girls, it was decided that the study task needed to feature the robot's voice and affective behaviours designed by the girls earlier in filming as part of their introduction to robotics. The girls also learned the need for participant's experiences to be identical for both conditions, except for the personality manipulation. Tic-tac-toe was selected because it was game that could be rigged, so that any differences in attitudes toward the robot were attributable to the manipulation, not participant performance in the game.

The prototype version of Survivor Buddy was teleoperated with an affective behavioural interface and a verbal interface

Fig.1- View from SB Webcam

Fig.2-View of experimental layout

The affective behavioural interface consisted of a button menu of the behaviours (YES, NO, SURPRISE, SAD) and two variations (extra- and introverted) created by the SciGirls. The behaviours were developed by the girls using the Microsoft Robotics Developer Studio (MRDS).The voice interface was implemented using the Center for Spoken Language (CSLU) Toolkit [11]. The extraversion team modified the voice to be higher, speak faster, and have more variation while the introversion team made the voice a bit higher and faster than the default but less than the extravert voice and somewhat slower.

Two of the featured girls remained in the room taking notes on the participant's behaviour, while the final featured girl used a laptop to select and play the robots utterances. After the game one of the girls escorted the participants to a separate room where they completed the questionnaire. The questionnaire featured a total of six items. Instructions at the top of the questionnaire told participants to indicate how well each of the words described the robot they interacted with. Each item featured a five-point unipolar scale ranging from Not at all to extremely. To determine if there were any personality-attraction effects, the four girls also rated their friends extroversion, indicating how reserved and outgoing each of their friends was on a five point scale. These scores were used to group each of the participants into one of three categories corresponding to low, medium, and high extroversion. Since the girls were not yet familiar with statistical methods, the girls calculated condition averages for each of the six questionnaire items. The greatest difference between group averages was for the reserved and outgoing measures. The girl's analysis also suggested that participants preferred the extroverted robot, regardless of participant personality, but that participants with middling extroversion scores liked the robot the most.

IV. OBSERVATIONS

While the experimentation was not statistically significant, the design process combined with the reaction of the SciGirls and their friend suggest three research questions. First, the SciGirl affective designs favoured some degrees of freedom over others (as seen from table 1), posing the question of *is a minimal set or a preference ordering of degrees of freedom for an affective robot head?* Identification of such a set could allow the mechanical design to be more cost-effective and allow HRI researchers to focus on creating a satisfactory set of behaviours around this minimal set. Second, an examination of the sessions

captured by the Survivor Buddy's webcam showed that the SciGirls' friends fixated on the stationary robot head rather than the external speakers, with the exception of the first group which could see the SciGirls. This raises the question of *is voice more important than non-verbal cues for certain situations?* If voice is more important than nonverbal cues, it may be a more cost-effective way to make existing non-anthropomorphic robots socially consistent or to reduce costs in new robots. Fig. 2 shows one group clearly looking at robot but as can be seen from Fig. 1, this is almost $90°$ from the actual source of the voice. But the relative contribution of voice versus nonverbal cues remains unclear. Third, the SciGirls experimentation with introverted and extroverted characteristics highlight that there is no understanding of *what is the right range and velocity of motion?* Is duplicating human motion sufficient or even desirable? This is important because it informs mechanical design.

TABLE I
JOINT RANGE ASSOCIATED WITH EACH BEHAVIOR

	Pan	Tilt	Roll	Translate
Yes$_e$		± 50°		
Yes$_i$				± 7 Cm
No$_e$	± 90°			
No$_i$	± 60°			
Surprise$_e$		- 60°		
Surprise$_i$		- 30°		
Sad$_e$		+20°	-45°	- 7 Cm
Sad$_e$	+60°	+20°		- 7 Cm
Sad$_i$		+15°		- 4.6 Cm

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