# *Collaborative modeling for robot design*

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In this poster, we describe a method for using grounded theory and modeling to support collaborative design of social robots for the elderly. Robotic technologies are being designed to assist people in their everyday lives in various ways: as companions (Wada and Shibata 2009), domestic helpers (Gates 2007), receptionists (Kirby et al. 2005), and educational aids (Ruvolvo et al. 2008). In response to the steadily rising average age of the population in the US, Europe, and Japan, the elderly are commonly designated as an appropriate audience for assistive robotic technologies. Designing robots for the elderly poses a variety of challenges—understanding the specific needs and desires of the elderly, supporting independence and human dignity, and making sure that technologies can be successfully incorporated into existing social and physical environments, or "elder ecologies" (Forlizzi 2004). These challenges suggest that designing robots for the elderly calls for attention to individual attitudes towards technologies as well as community norms and practices of social interaction and technology use.

## *Designing with the elderly*

In designing robots that can participate in the daily lives of the elderly, we propose working _*with*_ rather than just _*for*_ the elderly. The elderly are a vulnerable population whose worldviews and expectations can be very different from those of robot designers. Furthermore, technology designs assuming the elderly need to be assisted by machines, rather than use machines to help themselves, reproduce a situation in which the elders' agency is diminished. We suggest a grounded approach to research that would support technology design, accompanied by an iterative practice of collaborative modeling that will include the presentation of research results in the form of ethnographic findings and computational models to elders for reflection and critique.

We would like to increase participation of elderly in design for two reasons:

- To improve the designs of technology
- To give elderly more agency in constructing their interactions and environments.

The resulting technology designs would include the viewpoints, needs, and desires of the end users; they would be built according to their understandings of space, interaction, needed and appropriate assistance. Furthermore, we want to build a system that will enable and encourage discussions among the elderly about issues of design, how technologies fit into their communities and everyday lives, as well as how the values and practices that they want to develop in their communities. Finally, we hope that the resulting models and robotic technologies will contribute to the community's ability to self-organize and be reflexive about its change and development.

***Modeling a community***

We imagine the community as an "information ecology" (Nardi & O'Day), which is a space in which technologies function and one in which people act and make sense of technologies. The metaphor of the ecology encourages a focus on the diversity of niches, relevant actors and their roles, and the dynamic changes that a habitat and its denizens go through. Designing for an information ecology also calls for the incorporation of the values and perceptions of community members, as well as the potential differential impacts that the technology may have on various groups.

We build computational models to observe and think about change in the community. We use agent-based modeling because it allows for us to model interactions and local processes of the community (Gilbert 2008). ABMs such as these can be used not just for design of policies and technologies but also to have a framework for evaluating how the introduction of technologies affects the ecology. Another benefit is that agent-based models produce generative data that gives the ability to not only match real data for validation (Grimm and Railsback 2006), but also provides easier to understand explanations for why pattern emerge across populations (Epstein 2006).

In our models we consider interactions between community members, staff, spaces, and technologies. Interactions could range from conversations to uses of particular technologies. It is possible to generate many kinds of interactions with agent-based modeling software, which is formalized as a type of edge, or link, in a network of interactions. The majority of our selections of technologies, actors, and processes to model will come from interviews and activities with the community. However, we will have to formalize some spaces from top down. In order to do these we consider what objects are most important in supporting community self-organization and self-evaluation. A house, a space that one occupies for much of their time, could be one such object. Common spaces, where members of the community gather and interact, are another relevant space.

The model will be itself designed using grounded methods. We follow carefully what aspects of the ecology are significant to the various actors in it and use those in the model building process. If organizing social events and who participates in events is one of the most important concerns we will focus our model on that. We also document the model building process with interactions with the community to trace where design themes originate from.

For this poster we will display some prototype models of the retirement home and its community areas and describe the different technical choices we made to code and define each space. We also describe a card game we will use to gather data that we play as an activity with the members of the community. The activities are focused broadly on the questions of what makes community and on the problems the community faces and therefore we also present a game that we will play with some initial ways of coding and interpreting the data from the game. The game is used to help us structure our models and populate our models with data. The games will evolve as the models evolve and, hopefully, bring the objects found to be relevant in models into the action of play.

**Figure 1: An office at AIST in Tsukuba, Japan, where Paro, a seal robot for the elderly, is designed.**

**Figure 2: A nursing home in Japan, the information ecology in which Paro is put to use.**

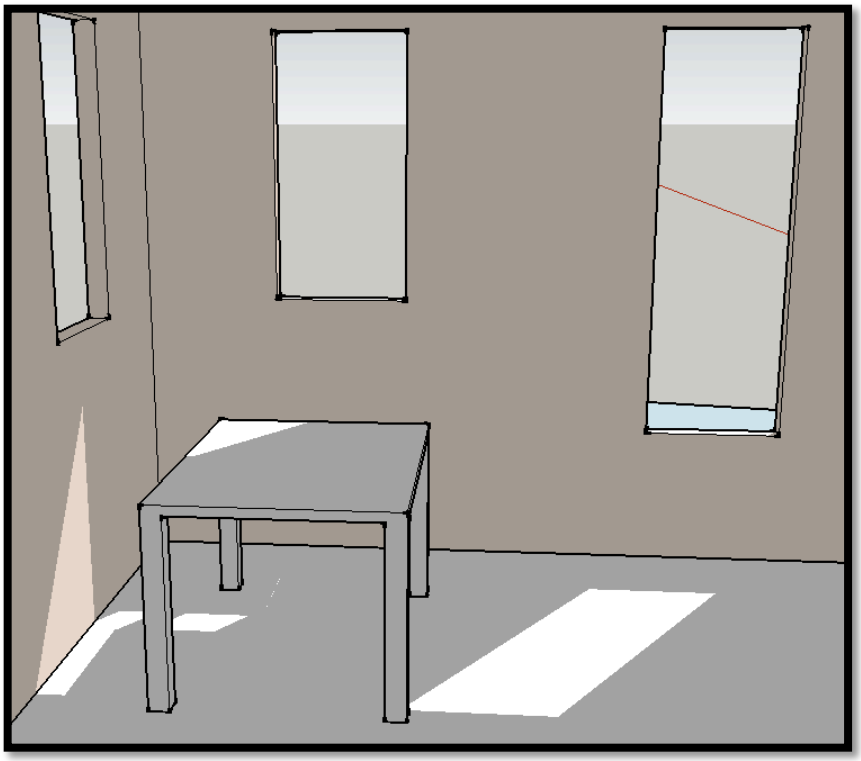

**Figure 3: A 3d Google Sketchup model of a shared dining area. Such models can facilitate discussion about space, time, and use.**

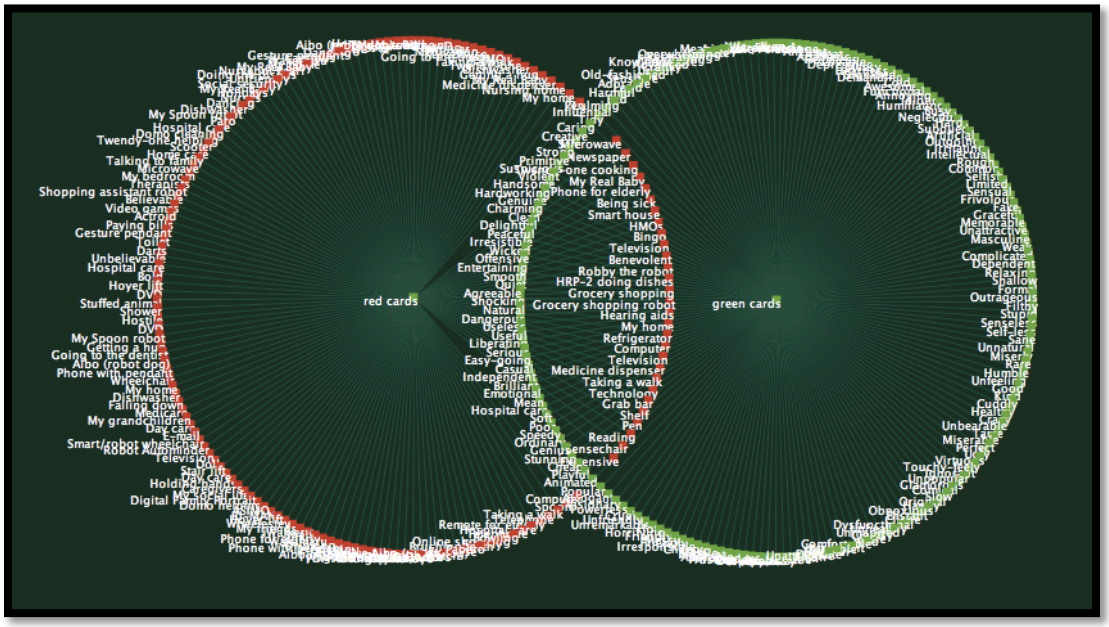


**Figure 4: A Netlogo interface for a card game, which was derived from a popular card game Apples to Apples. The game is used to facilitate discussion around specific categories and technologies within of an ecology of care.**

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