ABSTRACT
We aim to make sense of a perplexing human experience (fun) as it occurs in a recently discovered place for socio-technical study (the home). Our toolkit includes technology probes, associated fieldwork and models from software engineering. We describe how we interleave the probes and models. As the work will please neither modeling nor fieldwork purists, we enunciate the benefits of our ambidextrous approach.

Author Keywords
Quality goals, agent-oriented modelling, fieldwork, domestic domain, probes.

ACM Classification Keywords
H5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

INTRODUCTION
This paper investigates the relationship between cultural probes and models appropriated from agent-oriented software engineering (AOSE). Our focus is on potential synergies between fieldwork and software engineering to design social technologies for the domestic domain.

In previous work, we used AOSE models to represent goals and qualities of social interactions (Boettcher, 2006). These models were used as intermediary artefacts between stakeholders and were able to bridge data collection and development processes (Paay et al., 2009).

In this paper we take this relationship a step further. In addition to using the models as valuable shared or boundary artefacts (Star, 1989) during design and development, we explore how they can be used for the collection and analysis of data. We aim to investigate novel ways of collecting field data such that the methods are informed by and contribute to AOSE models. We aim to understand how AOSE models can be used to guide data collection with technology probes thereby reducing the gap between fieldwork and technology development.

HAVING FUN AT HOME
Though relevant to many design contexts, here we are concerned with a particular type and rather perplexing type of user goal – fun! Fun comes in many ways and there are endless possibilities of how fun can be realised between people. Fun and enjoyment are as important in the home and leisure context as productivity and efficiency in the work context (Blythe et al., 2004). Therefore, research about positive emotions around technology use is becoming increasingly important (Hassenzahl, 2003). We are particularly interested in the shared experiences and emotions such as having fun and joy mediated between grandparents and their grandchildren via domestic technologies. In order to achieve fun oriented technologies in the light of domestic life and inform development we need methods that pass on to development the complex, abstract and often ambiguous insights of field data collections.

Socially-Oriented Requirements
The domestic domain is challenging for would-be technology designers. Needs are often unspoken, relationships not straightforwardly hierarchical, lived life idiosyncratic, even exotic (Howard et al., 2006). The grandparent-grandchild relationship is an example of a set of complex social interactions, even more so when the relationship must be maintained over distance. Technologies for strengthening bonds within separated families have to fulfil specific goals such as “being playful”, “engaging over distance” and “having fun”. Such social goals are difficult to describe and account for in technology design and development: Social goals are ambiguous, non-instrumental, subtle and long term (Paay et al., 2009). Catering for specific needs of the young as well as for the old is a challenge. We aim to provide new insights into the design of communication technologies for the home that combine rich data collection in the domestic domain with the modelling of complex social concepts. This approach is used to extend our understanding of social requirements and to design innovative technologies in support of these requirements.

Socially-oriented requirements need a different treatment and recording within the development process. The functionality of a socially oriented system is often unclear. We need a higher-level view for representing, further exploring, and discussing overall goals and this view is represented by the AOSE goal models.

AGENT-ORIENTED MODELLING
AOSE Goal Models
We use AOSE models to record high-level goals for social technologies. Goal models are useful at early
stages of requirements analysis to arrive at a shared understanding (Jureta and Faulkner, 2007); and the agent metaphor is useful as it is able to represent human behaviour. Agents can take on roles associated with goals such as “playing” or “gifting”. These goals include quality attributes such as “having fun” that we represent in a high level pictorial view used to inform a technology probe. We include such quality goals as part of the design discussion and maintain them as social concepts while eliciting the requirements for a system. For this purpose the AOSE goal models have to be simple yet meaningful enough to represent the goals of social interactions.

**Quality Goals**
Technology can facilitate interpersonal contact in social situations, but that technology is only valuable if it addresses and fulfils the felt needs of people acting in their social environments. The needs typically include many that are high-level, cognitive, emotional, and hard to measure, such as playfulness, the act of engaging in an activity or expressing feelings. Quality attributes are often forgotten about during software development, but are a major factor in determining system success (e.g. Sterling & Taveter, 2009). These quality attributes can be represented in goal model diagrams as a quality goal. Quality goals represent quality attributes of the sort that are found in social environments, and more commonly in domestic environments. Quality goals, such as fun and play, are less amenable to decomposition than hierarchical functional goals. Quality goals are often subjective, context-specific, and imprecise. Importantly, AOSE goal models provide an account for the often ambiguous nature of social concepts.

**Role of goal models in the process**
The value of matching socially oriented studies of human interaction with user requirements elicitation methods to abstract activity and intelligently embed technology into social contexts has been widely acknowledged (e.g. Viller and Sommerville, 2000). Other researches describe bridging the gap between the output of field studies and the required input to system designs through meta-modelling (Iqbal et al., 2005). This mapping is based on plans and procedures that need to be clearly specified. However this is not straightforward for quality goals.

**INTERLEAVING MODELS AND PROBES**

**AOSE goal models for intergenerational fun**
In a previous study we used cultural probes (Gaver, 1999) to elicit high level goals AOSE notations were used to model these goals (Sterling and Taveter, 2009). These models proved useful as shared artefacts in driving discussions between interaction designers and software engineers, and helped to maintain quality goals derived from field data to design specifications (Paay et al., 2009).

The AOSE goal model in Figure 1 represents the current knowledge we have about intergenerational fun from previous study (Davis et al., 2008). This model is used now to inform and influence the data collection of the study.

**Figure 1: AOSE goal model for intergenerational fun. Goals are represented as parallelograms. Quality attributes are represented as clouds.**

**Technology probes for intergenerational fun**
A technology probe (Hutchinson et al., 2003) that has emerged from previous research is “Collage”; a shared domestic display using mobile camera-phones as an input device and a touch screen for synchronous interaction between family members. Collage enables a sharing of interactions and serendipitous interaction without being intrusive acting as a technology probe (Vetere et al., 2009).

**Benefits of integration**
There are several reasons for interleaving technology probes and AOSE models.

1) **Expressing field data**
First, we see AOSE models as a suitable way to express field data. A process of combining technology probe data collection and AOSE models allows us to talk about intangible outcomes. Fieldwork can seek out the unfamiliar, surprising, complex, and ambiguous aspects of life. In qualitative data collection often there is no specific language available to talk about these aspects. As a consequence the resulting representation of field studies ends up with abstract terms explained by concrete instances. These kinds of data are difficult to represent and put forward in the design process. There is a need for a shared location for technology probe information to go, so that it can be discussed and passed on. Therefore, we are interested in expressing the intangible aspects of social life. Our aim is to provide a language for the “intangibles” that can be put forward and be shared throughout the design process. What the AOSE models provide is a place where technology probes can abstract their collected information. Having a shared artefact early on in the process will support discussions and facilitate clarification about results. This produces models closer to the needs and goals of the user, as the models are discussed with the collected data.

2) **Reflecting on the context of goals**
Another important reason for having a goal model is that it can be used separately and in addition to the requirements specification document. Requirements
documents should be domain independent (e.g. Fabbrini et al., 2001). But early quality requirements tend to be imprecise, subjective, idealistic and context-specific (Jureta et al., 2006). AOSE models are part of a development methodology and can be combined with motivational scenarios, roles and domain models (Sterling and Taveter, 2009), all of them describing and providing context of the domain. This makes them an ideal artefact to capture the context in which the social goals are embedded. Technology probes deliver context that often gets lost after the data analysis. Context should not be formalised too early because we see a need to understand context better and a technology probe study can provide this context. Formalising context ahead of time is often difficult.

(3) Tracing of design decisions
The goal models help trace design decisions. Consequently there is less “fishing” for design rationale leading to more consistency in the process through the use of one high level artefact for orientation and discussion. The models act as a guide for conversations without being too directive. Knowledge can be fed into an artefact that is structured. That structure can be used without causing immediate constraints. Further, the designed system can be compared and explained against the model. The system might not meet all of the initially captured user motivations, but all the motivations are still available and visible. That helps designers not only to know what and why they have made certain design decisions, but also where and when they compromise.

(4) Start documenting early on with design in mind
With a language or representation one can start to document early on. The proposed process forces us to articulate some preliminary AOSE models and express the social goals we know about. In doing so we start to become clearer about what we have and we use that clarity to inform the technology probe and refine the models during data collection. The AOSE models are further used for design. We start documenting in a lightweight fashion early on and keep adjusting the models as new insights emerge.

INTEGRATED METHODOLOGY
In this paper we propose an approach that helps to clearly understand (a) how the AOSE models influence the technology probe; and (b) how the data is mapped back into the models. In this regard two processes are interleaved and complemented - the data collection process and the agent-oriented process. As we are interested in the influence one has on the other, we need a process that allows us to investigate this mutual influence. Some questions that we have in mind regarding the use of AOSE models for representing technology probe data are: What are the right abstraction levels? What is the right number of concepts included in the model? How could we formulate guidelines for creating models? We plan to iterate our research design with these questions in mind.

An iterative process
We iterate the procedure of revising the models and the technology probe. As the AOSE models and the technology probe might need major adjustments, we plan several iterations of adaptation of the AOSE models and the technology probe. We review and refine the used models and the system used as a technology probe in an iterative process. The technology probe should fulfil the following roles:

- a tool that allows investigation of the goals of grandparent-grandchild communication over a distance. Consequently we become clearer about the goals represented in the goal model;
- a focus of attention in that its data collection capabilities regarding the goals are investigated;
- refined over time in order to improve its data collection capabilities;
- concretising some of the modelling thinking that is taking place; and
- elaborating the context in which the goals are situated when using technology.

The AOSE models are used to influence two main aspects of design: the way the technology probe looks to the end user and the way it looks to the researcher or the way the technology probe collects interesting data. Both are seen as opportunities to model the technology probe in two different ways: the system as a photo display, and the system as a research tool.

The participants meet the probes
The goals represent the activities that the technology needs to facilitate. The collage system is able to fulfil these desired goals expected to lead to intergenerational fun: Playing, gifting, showing & telling, and creating memories. Interviews with researchers familiar with the system confirmed that the collage system is able to cater for all these goals. Over time we will be able to change the system as it appears to the user by adding visual stimuli to the system according to goals contributing to intergenerational fun or by including new functionality supporting as we see fit. This stimulus material can be traced and learned from in regard to the different goals.

The probes meet the participants
The logging of the data is the second aspect that is influenced by the AOSE goal model. For example, the goal “gifting” suggests exchanges between grandparents and grandchildren. Therefore, we decided on logging exchanges of pictures and messages in order to learn more about the social concept of gifting in the intergenerational relationship. Via the time stamp we can see a course of actions and reactions as it unfolds and gives us more insight into different games and therefore intergenerational “play”. Another example is “show and tell”. Logging the number of photos taken and the number of commentaries accompanying the photos will give us some indication of the degree to which show and tell was supported. With the models we have a notion for collecting data for a specific purpose that will help us
later on. As we are interested in social activity we will analyse our logs according to the patterns in sending and responding regarding certain goals. This will generate questions and answers as to what was happening over time and trace goals that might require several interactions or exchanges.

CONCLUSIONS
AOSE models are a tool for representing and discussing user motivations for different communities. As such, they serve as a shared artefact for communication between fieldworkers and software engineers. We expect synergies and new insights by combining concepts from Software Engineering and Human-Computer Interaction. For qualitative researchers AOSE models are a place to abstract to and record complex social goals. For software engineers, AOSE models are a starting point to discuss the meaning of requirements for social interactions for developing novel technologies for the domestic domain.

In order to better explore the mutual influence, an iterative method is proposed. An approach has been outlined to start with the models that influence the design of a technology probe. In this regard the goals are not only an outcome but a leading element for data collection.

In introducing the models early into the process and influencing data collection, knowledge can be gained about (1) the notation of AOSE models; (2) the use of technology probe; and (3) the domain before detailed design decisions are made. The expected outcomes of the research are methodological insights: how the use of AOSE models can influence and drive data collections in the field, and how software engineering tools and Human-Computer Interaction tools can complement each other.

New insights we have gained already are:
• field data can be integrated into software engineering methodology;
• meaningful conversations about abstract concepts such as fun are possible, and goals are the catalyst;
• high level quality goals help to discuss socially-oriented requirements; and
• model-based methodology can be applied flexibly.

The role of the goal models is not simply the typical formal process of modelling to lead to the development of a system as in the traditional domain of software engineering, but they become a way to inform field studies, think through problems, and to reach agreements. The initial process of formulating a model supported the whole team to collaborate across traditional borders and consider the complexity of everyday intergenerational fun in design discussions.

ACKNOWLEDGMENTS
We thank the Australian Research Council (grant #DP0880810) and participants in earlier empirical work.

REFERENCES