# The People-Prototype Problem: Understanding the Interaction Between Prototype Format and User Group

**Katherine M. Sellen, Michael A. Massimi, Danielle M. Lottridge, Khai N. Truong, Sean A. Bittle**
University of Toronto
10 King's College Road, Toronto, Ontario, Canada, M5S 3G4
{kate.sellen, micheal.massimi, danielle.lottridge, khai.truong, sean.bittle} @utoronto.ca

**ABSTRACT**
When gathering feedback about an envisioned system, prototypes communicate design ideas to user groups. However, it is unclear how user responses are affected by prototype format. We conducted a 2x2 quasi-experiment (video /storyboard format x older and younger user groups) to test for an interaction between prototype format and user group. We found a significant interaction between prototype format and responses across user groups. Our results indicate that differences in user responses can be misinterpreted as the result of user group characteristics. We advise using multiple prototype formats to counteract a 'media effect'. Alternatively, we advise using storyboards for a smaller 'media effect'.

**Author Keywords**
Prototyping, video, storyboard, scenario based design, eldercare.

**ACM Classification Keywords**
H5.2.m. Information interfaces and presentation (e.g., HCI): user interfaces – Theory and methods, Prototyping

## INTRODUCTION

Eldercare is a domain undergoing rapid growth for the CHI community [7, 9]. When designing systems such as remote monitoring of older adults it is important to ensure that varying viewpoints from both older adults and their younger caregivers are understood accurately and equally.

How do we create prototypes that enable user groups with different viewpoints to give high quality feedback about a system in the first stages of its development? Narrative, scenario-based protoyping techniques like storyboards and video may be a solution. For the purpose of this research we use a broad definition of 'prototype' that includes depictions of interactions between users and a system [3].


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Storyboards and videos are particularly valuable for portraying the situated, context-dependent nature of many system types. These scenario-based prototyping techniques help designers convey their ideas to multiple user groups early in system concept development [13]. Storyboards are suggested for use as part of scenario-based design [3] as a visual rather than textual description of a new user experience [6, 14] and for portraying "visionary" systems [12]. Storyboards can be effective summarizations of videos [2]. These properties combined make them successful in the design of novel, embedded or pervasive systems [14], and with populations who may have difficulty understanding complex verbal or textual descriptions (*e.g.,* children [8]).

Both videos and storyboards have their own properties that affect the type of feedback they elicit [13] as do other prototype formats [5]. A storyboard and video of the same scenario are likely to differ in a number of ways (detail, movement, angles, scaling, focus). Differences in user responses may result from these innate characteristics of prototype format [5].

The debate about prototype format choice has existed for some time [4,5,11] but little empirical work exists comparing prototype format and response for systems that involve multiple user groups, scenario-based prototyping techniques, or early stage feedback. Most studies concentrate on the identification of usability issues. This study aims to test for a relationship between scenario-based prototype format and response across user groups (Figure 1). To use an analogy, each prototype format is like a different lens for observing the same system concept; it's not clear that what each group sees through each lens is the same.

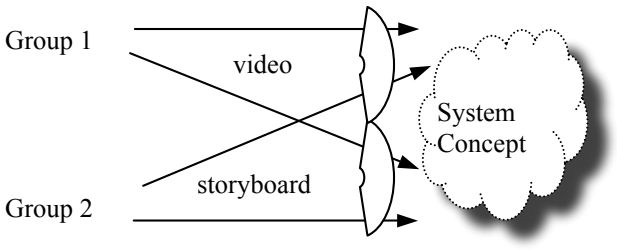


**Figure 1. Different user groups perceive the system concept differently, as mediated by prototype**

Our study provides support for the claim that responses will be dependant not only on the user group, but also the prototype format. This research can help designers choose appropriate prototype formats for eliciting responses from multiple groups of system users, and, provides evidence to researchers that knowledge claims based on user responses to system prototypes requires multiple prototype formats.

## STUDY

We conducted a 2x2 (prototype format vs. user group) quasi-experiment using in-home technology for eldercare as our target domain. This domain was chosen because the two target user groups in this domain are distinct – older individuals receiving social support and younger family members or individuals providing said support.

### Materials

We drew on the literature of in-home eldercare to draft a scenario wherein a woman uses her computer to check on the well being of her mother living across the country. The mother's home is equipped with video cameras for ensuring safe completion of activities of daily living. Video cameras were chosen as the depicted sensing technology due to their usage in some current eldercare applications [7] and as a familiar existing technology. While the scenario was inspired by the literature, we made it more general and comprehensible by replacing references to uncommon technologies such as embedded sensors and ambient displays with video cameras and computers.

We made two prototypes of this scenario – one a storyboard and one a video. We attempted to minimize differences between the two while remaining cognizant of the capabilities of each format (Figure 2).

### Participants

The eldercare scenario described above involves two distinctive characters: a senior being monitored, and a younger caregiver who checks in on the senior. We selected individuals representative of these two characters for our two user groups. From a senior center, we recruited 9 community-dwelling seniors aged between 65 and 84. To constitute the second user group of younger caregivers, we recruited 8 university students aged 18-35 from a wide range of disciplines, and 3 working individuals aged between 30 and 35. Our younger sample included individuals from a wide range of disciplinary backgrounds (education, anthropology, medical sciences, engineering, computer science). All had either current or past experience of issues of eldercare and contact with a relative or friend within the age range of the older group.

### Method

Participants either viewed the video in full-screen mode on a 14" LCD laptop screen or read the storyboard printed on a sheet of 8.5x11" paper. We randomly assigned each participant to either the video condition or the storyboard condition, yielding a between-subjects design with approximately 10 participants in each condition. After watching or reviewing the system, we asked participants a series of questions in a structured interview covering participant's conceptual model of the system, attitudes towards adopting the technology, and emotional response to the story. The materials were in front of the participant at all times, and participants were encouraged to freely review the material. Each session lasted for 30-40 minutes.

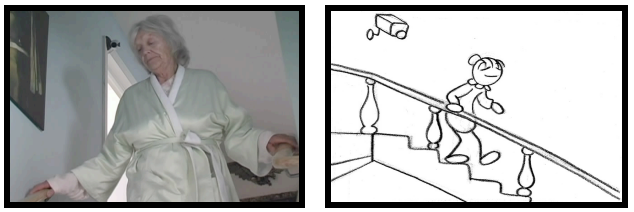

**Figure 2. Example of content similarity between the employed video and storyboard.**

### Analysis

Two researchers transcribed all 20 interviews and coded them for measures associated with hypotheses:

- *H1: Valence:* Number of positive, negative, or neutral comments regarding the prototype or the system (*e.g.*, "I wouldn't want that – there's no privacy!" would be coded negatively). We hypothesized that we would observe more positive/negative responses than neutral due to the richness of video.
- *H2: References to material:* Number of verbal references to the prototype to explain an idea, or number of times participant pointed at the prototype (*e.g.*, "The first panels are clear."). We hypothesized that the storyboard would promote more references to the material due to visual persistence.
- *H3: Self-reference:* Number of times the participant referred to his or her preferences or traits (*e.g.*, "I'm a private person") and mentions of the self when viewing the prototypes (e.g., "That's something I would do," or "I have a daughter who lives nearby.") We hypothesized that we would see more self-references with the storyboard, as the abstract nature of the storyboard would allow the user more freedom to identify with the character and story depicted.

Coders completed the first interview transcript together and simultaneously developed the coding schema. Subsequent transcripts were coded independently. Transcripts were further reviewed for insights related to the hypotheses. Observed inter-rater reliability was 0.77 (Pearson's correlation coefficient). All counts were divided by the total number of coded ideas, yielding percentages for analysis. Two univariate ANOVAs were completed with prototype format and user group as independent variables.

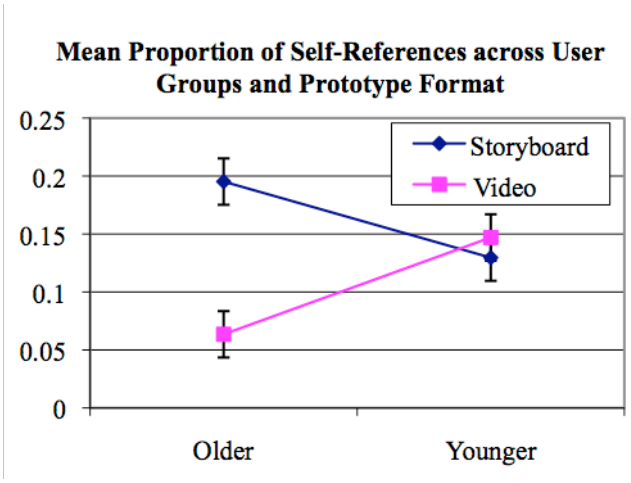


**Figure 3. A univariate ANOVA indicated that in the older user group, there was a significant difference in the number of self-references made between the storyboard and video.**

## RESULTS

A significant interaction was found between age group (younger, older) and format (storyboard, video) for proportion of self-references (H3), $F(1, 17) = 15.631$, $p = .001$ (Figure 3). The older group made most self-references in the storyboard condition, $M = 0.2$, $SD = 0.02$, and fewest in the video condition, $M = 0.064$, $SD = 0.038$. The younger group's proportion of self-references was relatively constant across media.

The main effect of media was also significant, $F(1, 17) = 9.194$, $p = .008$. Across user groups, storyboards elicited a larger proportion of self-references than video: $M_{storyboard} = 0.16$, $SD = 0.042$, $M_{video} = 0.11$, $SD = 0.068$. Measures of inter-rater reliability demonstrate that the definition of self-reference was applied consistently. Measures associated with valence (H1) and references to material (H2) yielded no significant differences.

### Qualitative Analysis

Qualitative analysis revealed a difference in understanding of the technology and the characters depicted. Older participants frequently made statements suggesting they misunderstood the storyboard (*e.g.,* "looks like a nun is looking at a screen"). While similar confusions occurred in the video condition, participants did not confuse the characters. There were no instances of comprehension problems with the technology (computer vs. television) in the video condition.

Storyboards enabled participants to make comparisons across frames during the interview. For example, A3 used early frames to explain later events: "This [points to frame 7] is a screen showing…[points to frame 4]… it looks like the same person." While all participants referenced the video or storyboard, video prevented participants from pointing to scenes and making directed comments.

Thematic analysis of the transcripts yielded a set of concerns relevant to the application domain. These included: tension between autonomy and privacy; inadequacies of cameras to prevent acute risks (e.g., strokes, falls); and differing expectations of familial or professional obligation to provide care. For sake of brevity, we omit these themes and focus our discussion on the significant interaction of prototype format and user group.

## DISCUSSION

We observed two types of differences when testing prototypes with user groups: "system effects" where groups responded to the system differently, and "media effects" where groups responded to the media differently. We first discuss the relevance of self-references; we then discuss characteristics of the user groups and prototype formats in order to suggest possible explanations for the observed differences. Finally, we discuss the implications for designers and researchers.

### Self-references

Designers/researchers frequently want to know whether end users identify with the system concept. More self-references may indicate psychological and emotional access to the material. This facilitates thought and discussion about how the system relates to personal experience. Both videos and storyboards have their own properties that affect the type of feedback they elicit [3, 15]. Storyboards require the viewer to fill in detail and interpret drawings. Video leaves little to the imagination. We suggest that the depiction of an individual and their specific setting in video makes it harder for a range of heterogeneous users to think freely about a depicted system and their own experience. Storyboards allowed participants to place themselves in the scene more easily, but at the risk of miscomprehension.

### Differences Arising due to User Group

There are many possible explanations for why one user group can react differently to the same system concept. The two user groups chosen in this study vary by age, sensory ability, cognitive ability [1], cultural upbringing, media preferences, and attitudes about technology. Demographic data indicated that the older group had less experience with new technology, while the younger group reported using the Internet everyday or every week. These differences combined with other factors such as place in the lifespan, personal experiences of falls or medication mistakes (self or other), and attitudes regarding recording may have framed the responses participants offered.

### Differences Arising due to Both User Group and Format

In our study, the older adults made significantly more references to themselves in the storyboard condition than they did in the video condition. The younger group showed little variation between formats. Other measures (number of positive or negative statements) did not appear to change. However, given the observed difference in references to self, we conclude that older adults respond differently to the same system concept depicted using different prototype

formats. The storyboard was in view at all times (unlike the sequential nature of the video). Physical persistence of the storyboard helped older adults (who may have age-related memory decline [1]) make reference to particular parts of the story. This, combined with differences in place in the lifespan and personal experiences of eldercare, might have served to exaggerate the variation in responses between prototype formats in the older group.

### Implications for Scenario-Based Design

When we discuss formative evaluation and prototyping in the context of scenario-based design, we are commonly interested in gathering insights regarding preliminary system concepts. The findings of this study illustrate the potential for obtaining misleading or incomplete feedback during the design of a system, or misattributing differences in responses to media to the actual system concept. For example, imagine a designer/researcher who shows a video prototype to younger and older user groups. She finds that the older group reacted differently than the younger group. She attributes the differences to age effects in response to the system. Our results caution that observations include both a 'system effect' confounded with a 'media effect,' and that further exploration is needed. The results of this study also suggest that when only one prototype is possible due to project constraints, that using storyboards would minimize group differences. However, qualitative results suggest that care must be taken to maximize comprehension when using storyboards. A blend of video and storyboard is also a possibility as described by other researchers [2].

## CONCLUSION

Our study demonstrated that when using scenario-based prototypes to elicit feedback about a system concept involving multiple user groups, participant responses vary based on the characteristics of the user group ("group effects"), the format of the prototype they are presented with ("media effects"), or both. Designers may continue to create single prototypes due to project constraints, in which case, based on this study, we recommend using storyboards to minimize group differences. Researchers who aim to draw stronger conclusions from their studies, however, should use multiple prototype formats to control for the 'media effect'. When a user group includes older individuals (as in many eldercare applications), choice of prototype format appears especially critical. In future work, it will become important to replicate this study and examine additional user groups, prototype formats, and domains.

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