
Collaboration in the Living Room or How Couples Design Together

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Abstract

Although many decisions in the home are made together, between partners and within families, most digital applications for interior design are geared towards single user operation. In this paper, we present the results of a first look into how couples design together and how that is different from how professional designers collaborate in teams. Based on prior art in collaborative design, we developed a shelf design application that runs on multiple and synchronized tablets and includes a projector that projects the design real-time and real-scale in the living room. We asked pairs of participants to design with the application using two tablets in a single shared design space and using two tablets with both private and shared design spaces. The initial results with three couples in their homes reveal how they design together which might help future design applications for at home.

Author Keywords

Design interface; collaborative design; couples; intimacy.

ACM Classification Keywords

H.5.2 [Information Interfaces and Presentation (e.g. HCI)]: Graphical user interfaces.

Introduction

Shopping is a social activity, often done with friends or family. In families, a majority of everyday decisions are made together between husband and wife, or parent and child, compared to decisions made by a single person [9]. Family members take various roles in a design process that leads up to a purchase, roles include information gatherers, influencers, decision makers and purchasers [8].

The online configurators that assist in purchasing and configuring products are aimed at single users and take place on a small screen, on a phone or tablet. In contrast, design teams collaborate using large shared workspaces such as whiteboards and tables. Currently, there is limited understanding and technologies supporting design collaborations involving intimate users, such as couples and families. Therefore, in this study we look into how family members design together and try to frame it as a collaborative design process. The overarching goal is to develop guidelines to inform non-professional design application aimed at use at home. We focused on co-located, synchronous collaboration [7]: couples configuring a modular shelf system on a wall in their home. We analyzed the interactions and behaviors of couples and compared them to co-workers when designing together on two tablets in their living room.

Related Work

The related work in computer-supported cooperative work regarding professional design teams is a starting point for developing support for non-professional design teams, aka couples. Maher et al. [6] have identified three categories of design collaborations, namely *Mutual collaboration*, in which participants “are busy

working with the other”; *Exclusive collaboration*, in which participants “work on separate parts of the problem, negotiating occasionally by asking advice from the other”; and *Dictator collaboration*, in which collaborators decide a leader who is “in charge” of leading the process. We expect to find differences in behavior because of the intimacy of the stakeholders.



Figure 1: We studied how couples collaborate when designing in their living room. Our application consists of multiple synchronized tablets to manipulate objects, and a projector that projects the design real-time and real-scale on the wall.

Several professional collaborative tools have a shared and often large workspace such as a whiteboard [1, 2, 3, 6]. These workspaces support designers to layout ideas spatially, point at things, draw and annotate together, and unifies communication and task space [4, 5]. Team Storm [3] for instance, allows designers to sketch in either private spaces or public spaces, with tools to provide feedback on others' sketches. We provide such a shared space with a projector, using tablet PCs as input devices.

Designers fluently switch between synchronous and asynchronous work, between working together on a single aspect of the design [1] and breaking away to explore ideas by themselves [2]. When returning from independent work, designers must synchronize their mental models of the design by explaining their work to others [1]. The group may need to integrate separate ideas into a new unified design. This process involves combining parts of several sketches or generating a new design that borrows conceptual aspects. We support multiple design spaces to let family members explore ideas on their own, before combining ideas into a shared design.

Design

The related work on how professionals collaborate suggests having a large shared workspace as well as having both shared and private workspaces. Based on these guidelines we developed a design application called TwoShelves. TwoShelves let couples design a virtual shelf system together on a wall in their home. We selected a 2D configuration task as the domain for this study because it is straightforward with a common interface on a multi-touch tablet. In this way, we expect participants to focus on the design task and collaboration.

The application includes functionality commonly found in online configurators: a library of objects, adding and deleting objects, positioning objects and changing colors and materials. In addition to shelves and cabinets, we also included a variety of everyday objects such as plants, televisions, and books, as shown in Figure 2. Objects and groups of objects can be freely copied between design spaces to support copying a shared design in the private space, or copying a partial

solution from the private to the shared space. TwoShelves real-time synchronizes all design spaces between the tablets.

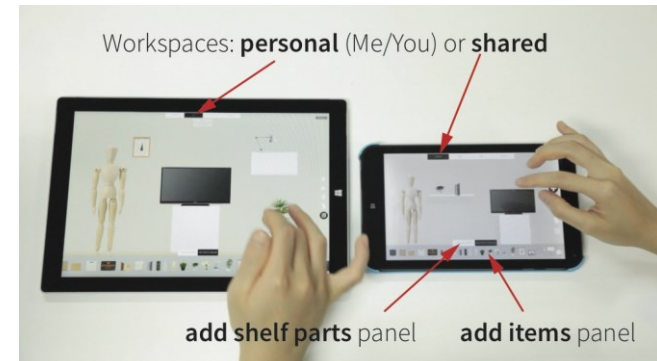


Figure 2: The tablet application supports multiple workspaces for shared and private design. Two panels located on the bottom contain collections of furniture items and accessories.

Also, the application includes an ultra-short-throw projector to visualize the design real-time and real-scale on a wall in the living room. This projection has two goals, a shared visualization to support collaboration, and to situate the design task. Basic Spatial Augmented Reality blends the projected virtual objects with the existing furniture and interior.

Together the setup is thought to allow for a variety of collaboration styles. Both partners have a tablet as an input device, can directly discuss together using the large projected visualization, physically point at projected objects, or can work separately in private workspaces.



Figure 3: The study was performed in the homes of the couples.

Exploratory User Study

With the prototype, we conducted an initial explorative study where we had pairs of participants design a shelf configuration on a wall. A pilot study was intended to identify usability problems and performed with three pairs (M-M, F-F, and F-M) of co-workers: graduate design students in a lab environment. All pairs had been working together in an office for at least nine months. The second study was conducted “in the wild”, to explore how couples collaborate while customizing shelves together in their home. We recruited three couples, two younger couples (ages 24,25 and 30,31) and an older couple (age 51,57) who are married for 15 years.

Both studies started with brief instructions of the system. Then, we asked them to (re)design two wall shelf configurations together with two conditions: in a single shared design space and making individual designs in private design spaces before making a shared design. This second condition was designed to observe how participants explain designs to each-other and merge their designs. Both conditions took place on a different wall in the home, and the order was counterbalanced.

We videotaped the couples during the study, and also recorded the tablet screens. Upon completion of the two design tasks, we performed a semi-structured interview to understand their design process. The shared condition took between 7 and 12 minutes, whereas the condition with integration took between 10 and 20 minutes. The co-workers in the pilot showed similar durations. The results were analyzed using bottom-up affinity diagramming.

Results

The results with three couples in their house show differences in collaboration to that of co-workers in the pilot studies. We observed all styles of collaboration [6], but the dictator collaboration was only seen by a two male co-worker team.

Whereas the co-workers maintained physical distance, the couples were intimate, leaning over each other to make remarks or to discuss ideas. The older couple manipulated in equal amounts and concurrently as they seem to know each other well. In contrast, the females of the younger couples took control and did nearly all manipulation in the shared design space. The males provided feedback and suggestions, occasionally performing minimal manipulations such as rearranging positions of shelves. If the males did partake in manipulation, the partners naturally took turns. After a while, the young couples slowly switched to working on a single tablet, where the male supported the tablet while the female did the interaction.

When designing together in the shared design space, both couples and co-workers had difficulties conveying ideas to their partners. All of the pairs, except the older couple, expressed in the interviews that they prefer having a separate design space to communicate ideas by showing individual designs to each other. That allowed them to provide constructive feedback to each other’s designs and pinpoint on design elements during negotiations, allowing them to make compromises.

The couples discussed on design elements and consulted with each other actively as they designed. When they worked in their private design spaces, they had fewer discussions as they concentrated on

designing in their personal design. They occasionally looked at their spouse's tablet and commented on the design, or asked for advice or confirmation. For example, when referring to the shelves they designed, a participant asked her partner, "Is that too plain" while another participant asked, "Should I choose the same color?" indicating that they needed support and reassurance from their partners on their decisions. Their decisions were influenced by each other, and they focused on making shared decisions together.

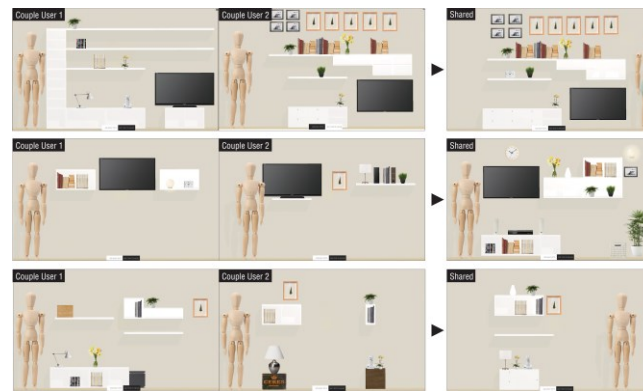


Figure 4: Each row shows the individual designs of the couples made in their private workspaces (left, center) and how they combined their design (right).

In contrast, the co-workers manipulated concurrently. They implicitly created territories and avoided intervening in each-other's design. Combining individual designs in the shared space, resulted in a crude integration. When the couples integrated their designs, they modified each other's individual designs in a discussion. As a result, the shared designs made by the couples were completely modified designs; meeting the requirements from both users as shown in Figure 4.

Discussion

In this study, we looked into a synchronous design task in which we forced couples to design together and make decisions at the spot. Nonetheless, the results indicate that couples differ from co-workers when designing with a customization application. Results show the need for a longitudinal study to understand how couples make decisions over time and to provide insights into the multiple roles and stages of information gathering and planning. A longitudinal study could also look into non co-located collaboration and include the transition from design to realization.

We observed that couples take different roles when designing that might be gender specific. Primarily the female participants did the layout task whereas their partner provided feedback and comments. In contrast, the co-workers displayed simultaneous manipulation and separated the design task in territories. The difference in behavior could also be explained by the level of intimacy. We suggest that future design application for couples provide support for multiple roles during the design activities and consider intimate collaborators working together on a single device rather than on separate devices.

However, both couples and co-workers indicated the necessity of a personal workspace and argued that making individual designs allow visualizations of ideas for effective communication. Couples and co-workers utilized different methods to integrate individual designs made in their personal workspaces. Couples modified each other's work to integrate them harmoniously while co-workers integrated their territories crudely with minimal modification out of respect for each other's designs. The results indicate

the benefits of multiple workspaces and the ability to copy and paste between workspaces. However, workspaces might be arranged in a more flexible way, not only to support communication, but also asynchronous exploration over time.

Apart from differences between collaboration styles of couples and co-workers, we observed all participants using the wall projection as a spatial reference during their design activities. Participants pointed at the wall projection during discussions and continuously referred to it to check the sizes of the shelves, making sure that they fit into the allocated space; and also to rearrange positions of the shelves, making sure that the shelves line up with existing furniture. Two participants overlaid existing furniture with matching virtual items, to obtain a better sense of scale when working on the tablet. Therefore, we suggest incorporating the real environment into the workspaces of furniture design applications to support spatial referencing.

Whereas this study was performed with simple Spatial Augmented Reality, Head Mounted Displays both for Virtual Reality as well as for Augmented Reality are becoming readily available for design researchers. In the future, we aim to extend the application to run on these types of devices to understand the unique interaction qualities for design tasks, and to study how couples collaborate when they layout a 3D space.

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