
Shoji: Communicating privacy

Caroline Laroche

M.A. Multimedia design
Université Laval
295, boulevard Charest Est
Québec, QC G1K 3G8 Canada
caroline.laroche-lortie.1@ulaval.ca

Benoît Rochon

M.A. Multimedia design
Université Laval
295, boulevard Charest Est
Québec, QC G1K 3G8 Canada
benoit.rochon.1@ulaval.ca

Serge Pelletier

M.A. Multimedia design
Université Laval
295, boulevard Charest Est
Québec, QC G1K 3G8 Canada
serge.pelletier.1@ulaval.ca

Joëlle Sasseville

M.A. Multimedia design
Université Laval
295, boulevard Charest Est
Québec, QC G1K 3G8 Canada
joelle.sasseville.1@ulaval.ca

Abstract

People sharing a living space in Québec City chose to do so to take advantage of various practical advantages. However, this way of life is far from perfect. Indeed, the lodger's need for privacy is an aspect of shared accommodation that can be very hard to reconcile with the needs of the other roommates. Based on our user research, we were able to determine that this aspect of the domestic experience is an important issue with regard to sharing accommodation. Roommates can be encouraged to communicate delicate emotions differently through *Shoji*, an interactive door that acts as an ice-breaker and helps to avoid awkward situations, thus improving the quality of life and the domestic experience for everyone.

Keywords

Domestic experience, Sharing accommodation, Privacy, Intimacy, Communication, Sexuality, Spontaneity, Door, Tactile, Color, Aesthetics.

ACM Classification Keywords

H.5.2 [User Interfaces]: User-centered design, H.1.2 Human factors, Input and Interaction Technologies, Emotion and Affective User Interface, Ubiquitous Computing / Smart Environments

Introduction

Sharing accommodation is an increasingly popular way of life in the province of Québec, Canada [10]. Whether it is for financial, social, or conventional reasons, sharing living space has its advantages and disadvantages. This lifestyle greatly influences the way people live their lives, since each roommate impacts

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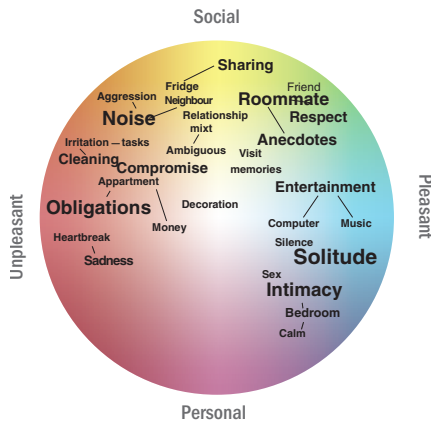


Figure 1. Two-dimensional map illustrating the relationships between emotional and interpersonal aspects of a shared living space.

WHY SHOJI

The name of our project is inspired by Japanese philosophy and by the spirit of traditional Shoji doors. The Japanese are well known for their search for harmony and serenity in their social relations. In the Japanese culture, every individual must work towards consensus and compromise [1]. This is a mindset that should be favored in the context of a shared living space.

The choice of a foreign name echoes Québec's multiculturalism. The appropriation of such an international theme was meant as a reflection of our local society, as well as suggesting respect and sharing in the domestic experience.

on the daily life of the other. However, in a setting where proximity between roommates is often limited to sharing space and bills, it can be awkward for them to talk about the moments of uneasiness that can occur occasionally.

Our user research soon made it apparent that the domestic experience encompasses much more than the daily use of common objects. Sharing a living space entails the need for a great deal of tolerance, especially when one's life cycle is greatly influenced by the cycles of other household members. Consequently, communication is the key to a successful shared living environment [5]. It is with a spontaneous and immersive communication tool that we believe it possible to find interesting solutions to the general issue of preserving privacy in a shared living space.

Privacy is defined as a state in which one is not observed or disturbed by other people [9], this quickly becoming a central and precious element of the domestic experience, especially when it is shared with other members of a household. Intimacy on the other hand is defined by a familiar, often affectionate, loving, or sexual relationship with another person. Uninterpretable since they are rarely preserved in a shared environment

However, even though our research has highlighted issues regarding intimacy, we consider our proposed solution to be applicable to much broader privacy issues.

Our solution is *Shoji*, an interactive door meant to serve as a vector for spontaneous communication between roommates. In no way is it meant to act as a substitute for communication. Breaking a first (and sometimes awkward) communication barrier allows for subsequent exchanges to be conducted more and more easily, preventing the accumulation of unsettled issues between roommates.

User-centered Design Process

In order to establish a relevant design opportunity, we have relied on design ethnography to focus on user needs. We have selected participants to compare the different life cycles of each roommate. To do so, we have selected three pairs of roommates, each pair sharing

an apartment. All participants had been living together for at least one year and were not necessarily friends before sharing the apartment. All of them were between the age of 18 and 26 years old and living in Québec City. Other participants have also been selected during later evaluation steps of the process.

Data collection The guided tour observation method [7] allowed us to understand the thoughts of our participants as well as their sense of belonging to their domestic space. During this observation period, numerous anecdotes gleaned from the interviews we conducted, clearly indicated the importance of the aesthetics of the living space to the participants.

Secondly, a sociological interview allowed us to learn more about our participants, helping to determine if their past experiences sharing accommodations or their sociological characteristics could influence their present domestic experience. Furthermore, over a period of one week, participants kept a log of their daily activities. This tool allowed us to understand their daily routine by allowing us to observe the impact of their individual and collective life cycles, their mood, and the disturbance caused by other roommates in their everyday lives. We observed that the roommates did not have identical routines and that their activities interfered with other roommates' life cycles.

Lastly, we assembled a post-diary interview called the word association chart [7]. This allowed us to extract the core of the participants' shared domestic experience by encouraging them to determine the bounds of their present as well as ideal living space experience. Participants spontaneously shared anecdotes and private comments during this exercise, revealing the true nature of our users. The word association chart (Figure 1) was specifically evocative and clearly illustrated the links within the collected data. Our data collection lead us to develop the concept of the interactive door requiring an iterative validation process that ranged from cross-reference idea diagrams to menu affordance tests with live participants.

Validation The validation steps confirmed the relevance of our design solution. It not only tested the acceptance of the general idea on more than 10 participants, but also the usability of certain components of the

interface itself. Secondly, testing the usability of our first prototypes led us to develop our design further. A second usability test where participants were asked to complete a specific task on a paper model allowed us to validate the ergonomic value of our menus, presenting scenarios of the different usage possibilities of the modified interface. This iterative evaluation process took place at every stage of our design development, up until the very end, at which point the final concept was presented and discussed with a group of potential users.

We also tested the communication codes of the interface, simulating these in an interactive video. Twelve participants took this test, which validated the expressive power of these codes. This other step of the iterative validation process allowed us to fine-tune our concept and build a solid base for our project.

Envisioned Solution

Following our ethnographic research, we underlined problems that were often a catalyst for conflict, out of which many communication complications occurred. It can be uncomfortable to express one's need for privacy, whether directly or indirectly. The malaise caused by involuntarily sharing many intimate aspects of our lives is omnipresent before, during, and after the conflictual situation. Moreover, sexual intimacy often is the source of difficult discussions and can cause many ambiguous situations between roommates. A sexual relationship is a sacred moment and many will do anything to protect such an important level of intimacy, some even pretending to have sexual intercourse in order not to be bothered in their room. [16]. Many participants admitted that many of their conflictual communications often took place over text messages because it was easier to engage conversation in an indirect manner, avoiding direct confrontation.

Moreover, we have identified a need for roommates to communicate spontaneously in order to facilitate conversations and therefore avoid the degeneration of their relationships (communicating right on the spot to defuse an awkward situation).

Our design idea came from realizing that the bedroom door, in the context of a shared living space, sets out the spatial and physical boundaries of one's privacy. The data we have collected revealed that

this sacred zone is a limit that is universally respected by the other roommates and guests. We have thus suggested that in addition to being a physical limit, the bedroom door could also become a tool to express more general privacy needs to the other roommates sharing the same living space. In particular, we observed that participants were not comfortable entering another roommate's bedroom during the guided tour. Some even refused to open the bedroom door.

Communication tool Our concept is based on the idea of the “sock on the doorknob” or the “do not disturb” signs on hotel room doors. According to social conventions, a sock on the door indicates that people inside the room are engaging in sexual intercourse [13]. However, as mentioned earlier, we have not limited the scope of this project to sexual intimacy, but have considered general issues related to privacy in a shared living environment. From this idea, we have established two main communication objectives applicable to different situations:

1. *Communicate to the other roommates one's need for privacy.*
2. *Warn other roommates when they disturb one's need for privacy.*

The idea of considering the door in its entirety (the exterior and the interior surfaces) as an interactive interface seemed therefore quite natural. We therefore wanted to transform this limit into an efficient way for roommates to communicate, the door then becoming a double-sided oversized tactile interface.

Inspiration The visual inspiration for the project came from the works of abstract-expressionist painter Mark Rothko [15]. His very large paintings feature square masses of color vertically placed one over the other. The immersive aspect of this artist's work set the tone for our concept. Moreover, the idea of “ambient information visualizations” or “ambient Information displays” [12] corresponds well to our idea of interactive communication. “Unlike virtual reality, ubiquitous computing endeavours to integrate information displays into the everyday physical world.” [14]. Based on this idea, we wanted to establish a communication system that operates on the bedroom door of each roommate. Both the interior and the exterior sides of the door are part of the interface system, each surface meeting one of the communicative objectives mentioned earlier.



Figure 2. Exterior view of the prototype door.



Figure 3. Interior view of the prototype door.

Aesthetics The validation processes we have used indicated that *Shoji* has much wider application than as a mere communication tool between roommates. These doors successfully reinforce, by their refined aesthetics, the positive state of mind and the relationship between roommates. Although the utilitary functions of an apartment are most important, personalization of the living space plays a central role in the sense of belonging to one's domestic space.

This is also consistent with Don Norman's theory, under which view aesthetics have a real influence on the perception that people have of an everyday object [8]. A nicer apartment then suggests a more harmonious acceptance, and therefore better relationships between roommates. Norman also claims that aesthetics play a major role in the learnability and appropriation of a tool or device [8].

Interaction Design

The device is a double-sided interactive door, each side of which plays a specific role and therefore interacts differently with the user. The exterior surface displays an informative scrolling timeline illustrating upcoming privacy periods requested by a roommate, while the interior allows the user to view a map of the apartment, to monitor the current status of other rooms and to send a warning to a specific room that happens to be disturbing the peace in the apartment.

Exterior surface The exterior surface of the door represents a timeline of the occupant's privacy needs (Figure 2), the time passing by being illustrated by the slow ascending vertical scrolling movement of the square color masses. Each color mass represents a time-slot chosen by the occupant wanting to express a period of time during which he does not wish to be disturbed. The present time is represented by a line located on the upper quarter of the door, at approximately eye level. Moreover, this structure allows the user to visualize the time-slots of future privacy moments requested by the occupant.

To notify his roommates of an upcoming requested privacy period, e.g. when he wishes to be left undisturbed to prepare for an exam, the occupant programs the desired time period and privacy level into the tactile interface. The level of privacy is reflected by the color of

the square featured on the door. For example, a red mass of color could indicate that the time period requested is very important and that the occupant can not be disturbed during the illustrated time period. The length of the time period is reflected by the height of the color mass.

Interior surface The interior surface of the door, on the other hand, displays a map of the apartment (Figure 3). This map is illustrated in a stylized way, where each room is featured as a colored square, echoing the aesthetics of the outside door for consistency with the global environment of the interface. The interior of the door thus allows the occupant to visualize the status of the other rooms as well as to communicate to another roommate who is disturbing the peace in the apartment.

For example, to warn a roommate that his loud music is disrupting the peace and quiet, the user can simply select the room in question and then make a swipe gesture on this room icon to send a signal to the person in that room. The signal is displayed as a momentary change in brightness of the other roommate's interior door. The more signals this roommate receives, the brighter the interior surface of the door lights up. Consequently, this allows roommates to communicate in a respectful, spontaneous, and non intrusive manner, avoiding conflictual confrontations with the disrupting members of the household. The malaise of communicating an awkward disturbance is thereby avoided.

Interface interaction To program his privacy need, the occupant must enter the information through an interface of the door as a schedule where the date, time and privacy level are entered in the system (Figure 4). The interface menu appears on the door, on the point of contact. The date is set with a slider, the time on a circular menu referring to the universal clock system, while the privacy level is set by a vertical gauge. We wanted to reflect the nature of the data entered with graphic metaphors, facilitating the use of the interface by making it as intuitive as possible. These concepts were well understood by the users in our subsequent testing phases.

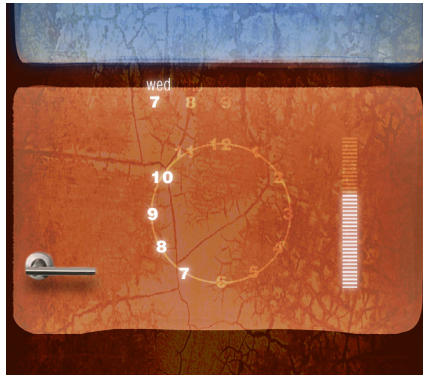


Figure 4. Main menu interface

Communication codes The communication codes we chose were tested by different participants in order to compare and validate the comprehension level of the different codes. A video presenting our door simulating the different possible signals was used to offer an accurate mental representation of the context of use. By doing so, we established three codes that vary according to the message needed to be conveyed: movement, color, and brightness.

As explained above, movement appears on the exterior surface of the door. The upward movement of the color masses represents time passing by and allows users to be aware of the current privacy status of a room, as well as projected privacy periods. This aspect was clearly perceived by participants, especially regarding the passage of time which was considered well defined.

In regard to color, we have validated that transitions between the different hues efficiently signified changes in privacy levels. These codes would also be customizable to the preferences and personal references of the different users. “Each of us has access to both personal and collective color associations. Personal color symbolism, influenced by age, gender, mood, and personal experience, can often be deduced by taking note of our regular choices of non-functional colors, such as those of favorite and frequently worn clothes.” [2].

Lastly, changes in brightness notify roommates of the level of disturbance. This signal is the result of another roommate’s desire to object to a disturbance during his need for privacy. During the validation phase, this signal was well understood as a warning because it attracts attention effectively.

Technological relevance Even though *Shoji* might seem slightly futuristic at first, the technological advances that are developed nowadays lead us to believe that interfaces like *Shoji* are already feasible. Indeed, many everyday devices tend to use information transmitted through integrated interfaces. Tactile technologies are emerging and such a type of interaction is slowly creating a technological revolution.

Nowadays, one no longer speaks of merely accepting technology. Our relationship with technology is instead defined as symbiotic,

as proposed by Brangier [3]. Certain ambitious projects found during our preliminary research even lead us to believe that this type of product could be marketable on a very short time-scale. Consider, for example, the vending machines currently popular in Japan that operate with interactive glass windows [11]. In comparison, it would also not be too surprising to see in our homes some of the elements presented by Hettich for their *Kitchen 2015* [6] or by Corning in their production *A day made of glass* [4].

Conclusion

The door symbolizes roommates’ privacy boundaries. This metaphor is illustrated through the implementation of an original means of communication that transforms this physical and psychological barrier into a vector for a pleasant domestic experience. Of course, sharing a living space requires its dose of compromise, careful listening, and empathy. However, no roommate wishes to compromise privacy boundaries at the expense of their relationships. Our interactive system, once fully integrated into daily life, is intended to improve spontaneous communication, therefore breaking a first barrier and facilitating social interactions to allow every member of a shared space to enjoy a quality domestic experience with moments of privacy. By allowing roommates to understand better the needs and expectations of others, we believe that relationships between them will no longer be tainted by the malaise and other tensions caused by unresolved issues, but will instead flourish through tolerance, agreement, and respect.

Project Evolution and Future Work

Our project will naturally need future validation with regard to real-life feasibility as well as future technological and commercial applications. An iterative development will help identify the different needs of different types of potential users.

For this project, we focused on creating an interface system only for bedroom doors, illustrating the explicit physical limits of the privacy zone of each roommate. Nevertheless, we also believe that this type of interactive technology meant to improve communication between several parties could also have very interesting potential in other

areas. If broadened beyond personal privacy, other uses for *Shoji* could include the family unit, professional offices, or even hotels, replacing the simple cardboard sign placed on the doorknob, for example. In the case of rooms with no door, the same functionalities could be made available through a system of framed artwork hooked on the wall or simply integrated into a piece of furniture.

However, we are aware that other aspects of our design, e.g., gestural interaction, will benefit from additional validation testing phases. *Shoji* is designed to act as an ice-breaker that facilitates communication; in no way is it meant to replace it. Therefore, issues related to communication could also benefit from further validation tests allowing us to understand better how people relate when they share living space.

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