# Reports on various readings

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## Quick Explanation

This document is meant to contains all the readings and understandings I'll do during my HCI Internship. So basically, I'll be putting in here some articles and what I understood and thought about their topics and conclusions/results. The second goal of this is to start using Latex to write documents, so don't worry if you find some weird stuff, it either is the result of shameful mistakes of mine or simply dumb experiences I've done and didn't erase.

## Articles Summary



## Article Reports

### Evaluating the Extension of Wall Displays with AR for Collaborative Work

**by : R.James, A.Bezerianos, O.Chapuis [james2023evaluating]**

***Quick Summary :***

In this article, the researchers are trying to offer a proper way to extend the unused space of a LHRD room. In order to do that, and after reading related work about the already existings uses of AR with other physical Displays they came with an idea and prototype of wall-extension using AR. So as almost every good paper, this one contains a part about the user studies and results, which I won't comment as much as the rest for obvious reasons, even tho I'll comment it quickly because it's a part of the research.

***The Idea & Experiment:***

This article is about extending a LHRD in order to upgrade the vizualisation and manipulation of datas by two users collaboratively. For that the idea was to create a Virtual environment around the WallDisplay using AR technology. And uprising the following questions :
"Is the extension useful ?"
"How the AR space is used ?"
"Does the addition of AR affect collaboration strategy ?"
"What's the cost of adding AR ?" In order to answer these questions and produce clear and useable datas, an experiment was thought and made up by the searchers. The Idea of this experiment was to show both participant a bunch of dixit images with specific tasks to execute with em, in these tasks were a classification one using storytelling and loose collaboration (aim is to enforce coupled-collaboration), and a much simpler classification task (simply regroup cards by colors for example) which would involve participant self decisions and selections. Moreover, tasks have been done with various contexts, some realized only with the wall, and others with both Wall+AR, in order to compare properly the logs and collected datas.

***Results & Review :***

After the experiment, it apperared that the manipulations between the case with/without addition of AR were signlificantly different not especially from a performance sight at first, but on the used strategies. But even tho theses strategies were a kind of linked when it was about classification. In fact group were cutting the wall onto 3 different spaces or they created 2 additional spaces to obtain 3 separated ones. The main changes were on the tasks repartition, it appears that with the addition of AR, tasks were divided more significantly between participants. And it also became clear that adding AR was useful to overcome the lack of space on the wall.

And then for the Storytelling task, the collaboration between couples was (as excpected) way closer, and globally groups were working in pair thoughts (selecting all 10 cards together). The addition of AR helped the groups to create their story separatedly from the rest of the cards, but in contrast with the classification tasks, the strategy weren't modified at all by this extension of the wall.

An interesting log that appears in this research is the amount and quality of interactions measured, it shows that globally, the addition of a personnal space was appreciated by most of the groups, and furthermore, the addition of extension wasn't increasing that much the amount of interactions, perhaps it simply made their quality better ?

About all the other logs, we can mainly see differences between Wall & Wall+AR, participants were moving much more when virtual surface were allowed, and card would be manipulated a bit more for the classification in Wall+AR, and the task time was decreased by the addition of virtual stuff, even tho the distance between participant had increase, not significantly enough to status on the non-quality of a Wall+AR collaboration tho.

***Questionnaries :***

Shall I talk about these ??

***Discussion :***

It was globally observed that beside excpectations of a "secondary use" for the virtual surfaces, they were used as a main component whenever they were allowed. Another main feedback was that the wall alone restricted the possibilities by the lack of space to use. The question subasked by this is the following, are these observations the result of the AR technology, or people would feel the same with physical displays ? Well in fact with physical displays it wouldn't be possible to manipulate objects with such fluidity . And as the previous works were all focused on AR, we don't know (at least it's not proved yet) if there would be a true lack of freedom with physical surfaces. Another thing that is interestingly mentionned is that the resolution of LHRD are way superior to what we have in AR headsets yet, so there's a question "What if all the surfaces were displayed with AR ?" .

Also the AR space, that was meant to fulfill all the empty space of a single wall, was mainly created on both sides of the wall, which was one of the principal purpose of this research. Overall, the different surfaces were seen as "territories", which could be related to the personnal aspect of such AR surfaces. These reflected a feeling of ownership throughout the experiment when using the surface that was on a specific participant side.

The addition of AR has engendered changes only for the classification task, as for the story nothing really changed, in fact it has "normalized" the different strategies. In fact with only the Wall, there were most different strategies than with the Wall+AR, were all strategies were much more similar. The conclusion on this point is that a restricted area might favorize a tighter collaboration & coordination.

Furthermore there really is a trade-off when adding AR to a LHRD, because even tho the Wall+AR interface is more efficient, it demands more mental and physical efforts. But for this point, I personnaly don't think this is a real problem, in fact on one-hand we don't want people to do to much efforts but are these effort enoughly significant to consider them as a problem ? Another more defendable point for me would be that in the measured interactions, there are fewer actions when it cames to Wall+AR. But overcoming that, the Wall+AR setup has been enjoyed much more than the single Wall, is that because people prefer to work all by their own ? Well I don't know but for me there are more advantages than problems caused to the addition of AR.

***Conclusion :***

Globally, these results are a bit complicated to generalize to other configurations, in fact the one used throughout the research appeared to be really good one, and the conclusion of this paper is that the benefits & drawbacks of such combination aren't clear at all. Because it highlights that this addition is useful for sure, as when AR was added, the virtual surfaces were even more used than the Wall itself. Main questions are about what it would lead to in other extended practices.

But, this research mainly demonstrates that this addition is feasible and beneficial over any drawbacks it engenders.

## Effects of Display Size and Navigation Type on a Classification Task

**by : C.Liu, O.Chapuis, M.Beaudouin-Lafon, E.Lecolinet, W.Mackay [liu2017CoReach]**

***Quick Summary :***

This research papers offers a set of Gestures that would allow users of LHRD to interact more easily with the contents they wanna manipulate. As the general multi-touch displays are using pretty common ones, these doesn't scale well with a wall-sized display.

In this paper, the main worked points are about co-located collaborative navigations, which involves more complex dynamics when you're aware of problems like "gorilla-arm" or simply the loss of precision for precise manipulation gestures. Also the *CoReach* set of gestures had to be thought taking care of multiples human factors, such as collaborative strtategies, or even physical constraints.

Especially, this research focuses on Collaborative interactions, as most (if not every) of the previous works did focus on addressing precision and fatigue problems for single-users. To recap, *CoReach* focuses on Large Scale Interaction & MultiUser Cooperative Actions.

***Motivations :***

With the rise of dat-driven decision making, scenarios where people face communication barriers due to domain-specific terms are becomming common place. And as a solution to this problem comes the large interactive spaces, and especially as we're talking about datas visualization and manipulation, LHRDs !

***Gestures:***

Obviously, what would be a set of gestures without any gestures ? So here is a scheme showing and explaning the three different implemented gestures for the *CoReach* prototype :

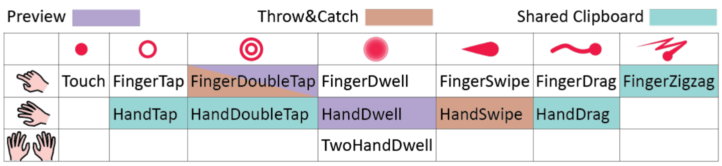


Figure 1: Figure 1. image taken from the source article (Fig2)

So these three recognized gestures were implemented in the prototype, and they're meant to facilitate data-centric collaborative tasks on large interactive surfaces. Plus these are especially the pattern gestures that can be applied & used by a couple of users in a tasks. Below are detailled these three different gestures and their uses.

- *Throw and Catch :* This gesture is meant to help people exchange informations by litteraly sending it to each other. It requires a medium level of synchronization between the users' actions.
- *Preview :* This one is motivated by the fact that users often decides to show their cards to each other, in order to discuss it with more ease. It requires a high level of synchronization between the users tho.
- *Shared Clipboard :* For this last one, it simply provides a way to group items and move them as a whole and not one by one. For some reasons this group is temporary (in order to allow the user to rest a bit and ease his use of this feature).

***Study 1 :***

This first Study is **standard vs. Co-Reach Gestures** and has it's titled, is meant to compare a co-located collaboration between two users using standard and co-reach gestures. One of the goals of this is to test the users' acceptance of CoReach gestures. Both contexts are using the same image arrangement, only some instructions were differing between contexts. Also the experiment used logged kinematic to save head movements, users' gestures activations & images movements on display.

And so for the gestures acceptance, results were quite good, as most of participants preferred using Co-Reach gestures instead of standard ones. Plus participants admitted that Co-Reach gestures were funnier to use than the standards. Furthermore the *Throw & Catch* gesture has proved itself as very useful for participant, in addition to be the easiest to learn.

Finally, as numbered results for this experiment, it made it clear that Co-Reach gestures allowed users to be further from one to another than with the standards. And most used gestures were *Throw & Catch* and *Preview* as they were far from each others.

***Study 2 :***

The second Study is **Direct vs. Remote Touch** that helped to assess the potential of shared interactions whenever they're at different distance. In other words, the searchers wanted to know in which cases such gestures were the most useful and prefered between direct and remote interactions with/on the wall. TO do that, tablets were included to the previous experiment, using adapted gestures from the Co-Reach ones detailled earlier.

So in this experiment, some of the gestures are replaced by others (not in their functionment truly, these replacements are more of adaptations than real modifications), plus the context of tasking are divided in three, *Wall Only* (WW), *Wall+Tablet* (WT), *Tablet+Tablet* (TT). Which are named explicitely tho. In contrast with the first study, there were less differences to notice between the different contexts. Even tho most participants told that gestures were easier to accept and use direclty on the wall, moreover some of them explained that they felt like working on the wall was making the collaboration more natural and logical.

Overall, *Throw & Catch* was still the most used gesture, also, the percentage of use for each gesture was very different from one context to another, in fact being allowed to use a tablet made participants increase their use of *Share Clipboard*, but made em boo the *Throw & Catch* one.

***Discussion :***

Both studies showed that Co-Reach gestures were nicely adapted to what they were meant for, and so on different aspects ;

- First of all it helped to minimize the gesture disruption, because its use was linear (no menu to select or any other mode to switch in between).
- Secondly, the different synchronization levels required by the gestures was very interesting. In fact having a gesture that forces user to be synchronized (at least a little bit) is nice, but here it was even better, because users weren't truly forced, as the only gesture which required that level of synchro was one that only requires a "semi-synchronization" between users.
- And last but not least, offering a choice between more that one type of gesture allows the users to adapt themselves to the set of gestures. And more precisely it allows people to choose which collaboration strategy they're gonna use throughout the experiment.

But *Co-Reach* is also an interesting proposition because it doesn't obstructs the users communications, furthermore it made users feel more as a part of a group than as lonely individuals. Which is kinda interesting when it comes to collaborative tasks, but if that so-called group is composed of more than 2 users, then there will be a scalability problem for sure.

As confirmed in the paper, if there were a third user in the group, the gestures wouldn't be able to suit the tasks as perfeclty as they did for only two users. But perhaps adding other gestures a bit more adapted to a larger group of user could solve this quite easily (as easy asdesigning and implementing such gestures can be tho...).

***Conclusion :***

As conclusion I've nothing to really add to what I discussed before, the only things to say is that theses gestures has proved to be better than standard ones, but also they seemed to been adapted to other uses, like remote uses. And globally, the future possible works would be increasing the possible ways of communication between participants.

## Effects of Display Size and Navigation Type on a Classification Task

**by : C.Liu, O.Chapuis, M.Beaudouin-Lafon, E.Lecolinet, W.Mackay [liu2014effects]**

***Quick Summary :***

As wall-sized displays are now becoming one of the most used technologies when it comes to data manipulations, knowing the benefits and drawbacks of using LHRD seems as interesting as important. And so this article does it by comparing these to their desktop monitors equivalents, for a task that involves explicit data manipulation. The purpose of the article is to conduct a controlled experiment to compare the performance of physical navigation in front of a wall-size display with virtual navigation using pan-and-zoom on a desktop monitor for this task. The authors aim to understand the interaction effect between display type and task difficulty and to develop guidelines for designing displays for interactive tasks that involve data manipulation. Overall, the article seeks to contribute to a deeper understanding of the advantages and drawbacks of wall-size displays compared to desktop monitors and to provide insights for the design of displays for complex tasks.

***Experiment Idea :***

The conducted experiment was an abstract classification task where users had to divide & sort items into classes depending on their properties. Searchers used a middle ground approach where there were more containers than classes, and then users would have to place those items into containers without letting the container overflow. The task required users to determine when two items were in the same class, which was represented by a different letter. Information density was operationalized by adjusting font size. The experimenters controlled the complexity of the task through several parameters, including the number of items, classes, containers, and label font size. This approach provides a rich yet easy-to-control design space for experimental tasks based on the abstract task. The experimenters compared the benefits and drawbacks of wall-sized displays and desktop displays in this classification task.

***First Experiment :***

This first experiment compared user's performance, subjective experiences, and preferences when distinctly using a desktop computer and a large wall display for a pick-and-place task. The experiment used three different label sizes and two levels of task difficulty. The results show that participants' performances were significantly better on the wall display than on the desktop, especially for the harder task and the medium label size. The wall display also resulted in lower subjective mental load and frustration. Almost all participants preferred the wall display, except for the large label size. The study found a strong interaction effect between the display type and the label size, where the desktop with large labels was fast but exploring small and medium labels was painful. Participants also reported different senses of engagement between the desktop and the wall display, where the desktop gave a sense of control while the wall display gave a sense of being part of the interaction.

***Second Experiment :***

This second experiment aims to test whether virtual navigation techniques on a desktop interface can beat physical navigation on a wall-size display for difficult classification tasks. In this one, researchers compared three different desktop techniques for difficult classification tasks: a baseline pan-and-zoom (PZ) technique, an overview+detail (PZ+OV) technique, and a focus+context (Fisheye) technique. They recruited 12 volunteers aged 22 to 38 with normal or corrected vision and used a within-subjects design. The results showed no significant difference in task completion time between the three techniques, and none of the techniques were as effective as physical navigation on a wall-size display for this task. Nine participants preferred the Fisheye technique, while three preferred PZ+OV.* But still, it showed that physical navigation on a wall-size display outperformed virtual navigation using desktop techniques for difficult classification tasks. Despite the fact that the focus+context and overview+detail desktop techniques performed similarly to the pan-and-zoom technique in terms of task completion time, none of them came close to the performance of physical navigation on the wall-size display. Additionally, while the fisheye lens technique was preferred by some participants, others found it difficult to control and focus on labels despite its high magnification factor. Overall, the experiment confirmed the superiority of physical navigation on a wall-size display for complex data manipulation tasks compared to desktop techniques.

***Discussion :***

In the *CONCLUSION AND FUTURE WORK* part, the statement is that a wall-size display can be more efficient than a desktop display for difficult data classification tasks that involve data manipulation, especially when there is a high information density. Moreover, thanks to the experiment that compared physical navigation in front of a wall-size display with virtual navigation on a desktop display. Authors found that the desktop display was more efficient for easy tasks, but the wall-size display was significantly more efficient (up to 35%) for difficult tasks. They suggest that this is just the first step in understanding the benefits of wall-size displays and that future research should investigate collaborative work and new techniques for improving user performance and reducing cognitive load in both wall and desktop environments.

***Conclusion :***

My personal conclusion would be that the choice of display size and navigation technique can significantly impact user performance for certain types of tasks. This may have implications for the design of user interfaces and visualizations, especially for complex data manipulation tasks. The study highlights the need for further research to understand the interaction environment provided by wall-size displays, particularly in collaborative work settings. Additionally, the study suggests that a deeper understanding of spatial memory and the respective advantages of physical and virtual navigation could inform the design of new techniques for both wall and desktop environments to improve user performance and reduce cognitive load.

## Shared Interaction on a Wall-Sized Display in a Data Manipulation Task

**by : C.Liu, O.Chapuis, M.Beaudouin-Lafon, E.Lecolinet, W.Mackay [liu2016shared]**

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As wall-sized displays are now becoming one of the most used technologies when it comes to data manipulations, knowing the benefits and drawbacks of using LHRD seems as interesting as important. And so this article does it by comparing these to their desktop monitors equivalents, for a task that involves explicit data manipulation. The purpose of the article is to conduct a controlled experiment to compare the performance of physical navigation in front of a wall-size display with virtual navigation using pan-and-zoom on a desktop monitor for this task. The authors aim to understand the interaction effect between display type and task difficulty and to develop guidelines for designing displays for interactive tasks that involve data manipulation. Overall, the article seeks to contribute to a deeper understanding of the advantages and drawbacks of wall-size displays compared to desktop monitors and to provide insights for the design of displays for complex tasks.

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