Human-Information Interaction in 3D Virtual Environments (HII3D)

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Most Important Outcomes:

1. Research results linked to collaborative information retrieval activities in virtual spaces, two publications accepted, one under review, one under development
2. The development and strengthening of a multidisciplinary research group (faculty and students) and collaboration between BUTE and HAS CARI which resulted in a successfully funded new research grant (Funding institution: Hungarian National Development Agency, Duration: 2 years, BUTE funds: 61,420,000.00 HUF) building on the work completed in the Fellowship
3. Building relationships between international institutions and researchers and their Hungarian counterparts via three visits by international researchers to Hungary and seven research trips to conferences funded from the Fellowship by BUTE students, faculty, and the Fellow
4. Mentoring undergraduate and graduate students to become familiar with and interested in technology research careers, encouraging students' participation in international conferences and publishing their work in international outlets

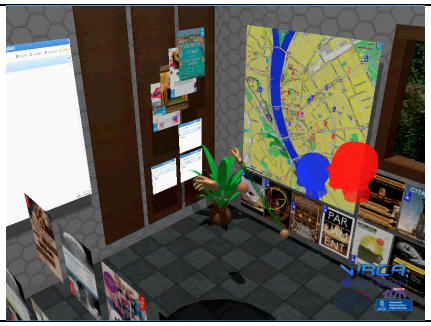
Work Completed to Meet Project Objectives

The main goal of the project was to study collaborative information interpretation and information use (sense-making) behavior by users in 3D virtual environments. In the first phase of research we designed and developed this environment in the Virtual Collaboration Arena (VirCA, www.virca.hu) collaborative space. The VirCA platform was developed by a research team at the Computer and Automation Research Institute of the Hungarian Academy of Sciences to allow users to build, share and manipulate 3D content. As the name suggests, VirCA allows collaboration between multiple actors located at geographically dispersed locations. As the VirCA website (www.virca.hu) states, "participating hardware and software devices can be spatially and/or logically distributed and connected together via IP network."

We conducted an extensive collaborative user study [3] to explore users' collaborative information interpretation and information use (sense-making) behavior. The participants had to plan a schedule of tours for a foreign student group spending a weekend in Budapest, Hungary. This task was similar to the problem discussed by Crabtree et al. [2] in the user task related to the preparation for visiting places. In order to create the plan, participants had to use information (tourist attractions, restaurants, opening hours and location) displayed on posters that were scattered all over the walls of the virtual environment. The plan itself had to be written in a shared editable document in the immersive space. This task was natural and familiar for students, as they confirmed in their post-interaction interviews. It also required the participants to jointly read, interpret, and use the information presented in the space thus allowing us to address our research objectives.

Twenty pairs of participants (n=40) completed the task. In each pair, one participant completed the task in an immersive environment, while their partner at a desktop computer. The two participants could see each other as an avatar in the space and had audio communication, which we recorded. In Figure 1 you can see the view of the space from the immersive environment and on a desktop computer. The participants filled out a demographic questionnaire and a test measuring spatial-visual ability before completing the collaborative task. After completing the task they were interviewed about their experience and they filled out tow questionnaires, one about the information interaction and the other about the collaboration experience. Their interactions were video recorded both in the immersive space and in the digital virtual space. Their verbal communication was also captured. Both the audio and the video data was transcribed and made available for analysis. We have made significant progress with the analysis of the data. Two publications have been presented and published [5, 6], and one publication [3] is currently being submitted.

Immersive space



Desktop view

Figure 1. View of the space from the two participants' point of view.

Main Results Achieved

The data analysis completed thus far focused on the design of the space [5] and the collaboration [3] among participants. Our design used a user-centered, iterative process including two rounds of usability testing. The resulting space was easy to learn and use for our participants. [5]

We analyzed the collaboration patterns of our participants in the space. All recordings of the sessions were transcribed and coded by multiple coders to identify various collaboration actions. [3] We coded the transcript to identify three categories of utterances: 1. Coordination, 2. Information sharing, 3. Usability questions. We conducted a Cochran's Q tests to compare the occurrences of the interaction types coded between the three phases of task completion. We have found significant differences between the sections for Coordination ($Q(2)=82.55$; $p<0.001$) (Figure 2), Information sharing for the task ($Q(2)=90.35$; $p<0.001$) (Figure 3), and Usability ($Q(2)=18.23$; $p<0.001$) (Figure 4). Coordination utterances were frequent in the beginning and end sections of the collaboration (Figure 2). Information sharing utterances appeared in a higher ratio in the middle section (Figure 3). The amount of usability-related comments goes down after the first section (Figure 4). The same Cochran's Q comparison of temporal sections were conducted for all the datasets of the pairs separately. This analysis revealed similar patterns. In the case of coordination the 63.16% of the participant pairs showed significant differences between the temporal sections. In the case of information sharing for the task 68.42% of the analyses conducted for participant pairs separately showed significant differences between the temporal sections. Finally for the utterances containing usability related issues the 42.11% of comparisons resulted in significant differences between the temporal sections. These results about the temporal distribution coordination are similar to the findings of Burtscher and also to the findings of Soós and Juhász on teamwork in high-risk environments [2,4]. This similarity shows that typical patterns of collaboration can emerge in information-intensive tasks in virtual environments and thus validate our research goals.

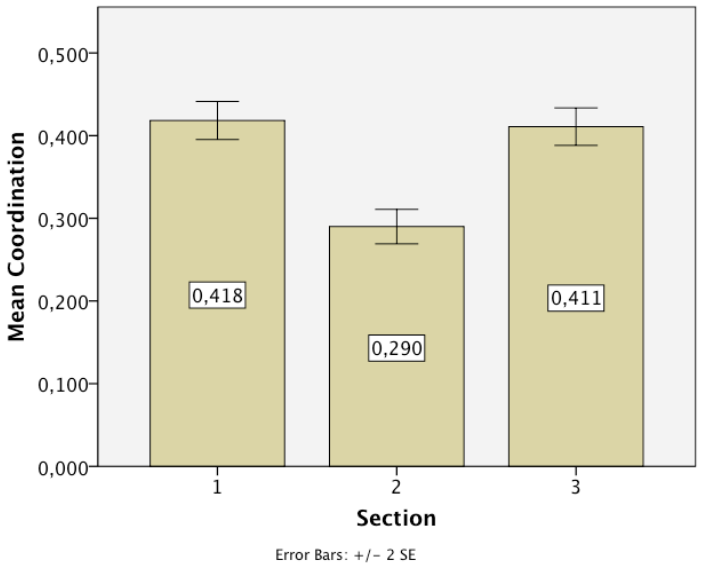


Figure 2. Ratio of coordination-related utterances in the pair communications across the beginning, middle, and end phases/sections of the experimental sessions.

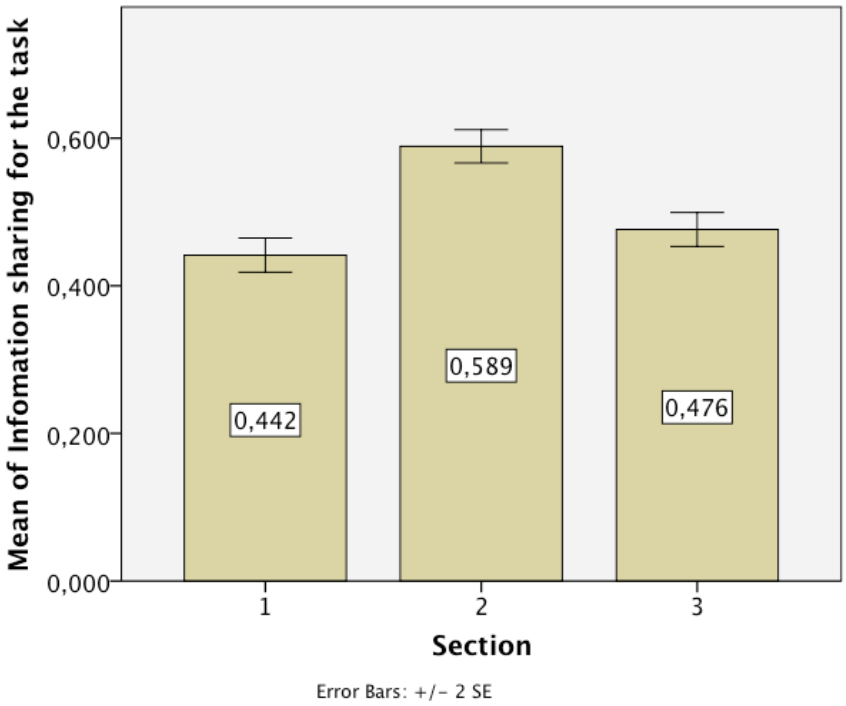


Figure 3. Ratio of utterances related to information sharing in the pair communications across the beginning, middle, and end phases/sections of the experimental sessions.

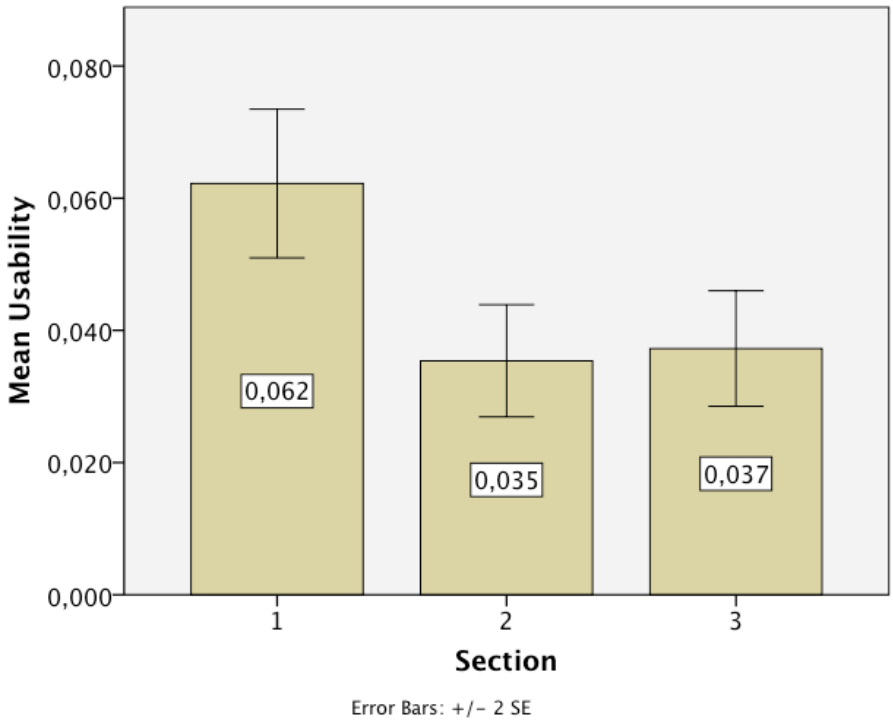


Figure 4. Ratio of usability-related utterances in the pair communications across the beginning, middle, and end phases/sections of the experimental sessions.

Expected Final Results and Impact

Further analysis on the data will be conducted. A more detailed analysis of the session recordings will further describe the *information use and collaboration strategies.* An analysis of the interview and questionnaire data will describe the nature of the collaborative information interpretation and use behavior and the effectiveness of virtual environments in supporting these behaviors. The results are most relevant for researchers and designers of these spaces.

References

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