Social human communication during shared object manipulation

Oliver Otto, Inhabited Information Systems Group

Keywords: virtual reality, CAVE, interaction, human psychology

Abstract

Social human communication (SHC) improves the effectiveness of collaboration. Core to social communication is human interactive behaviour, which plays a significant role in allowing humans to structure their interactions meaningfully, thus facilitating communication between individuals. This includes verbal and nonverbal communication, as well as interaction with and around objects. Many real world tasks require the shared manipulation of objects. Supporting all of these forms in collaborative virtual environments (CVE) increases the range of tasks that may be undertaken by a distributed team. The interface provided by different display devices may affect both the communications between the group and interaction with objects.

Experimentation

- structured task of building a gazebo with distinct scenarios of sharing the manipulation of an object
- Verbal and non-verbal communication are required to archive the task and to agree on the work-sharing
- forms of social communication (Table 2) should create the feeling of presence enabling co-working with others
- user behaviour and manipulation of objects may be affected by the different display devices

Collaboration and Contribution

- the effect of asymmetric devices is perceived to play considerably less of a role in the level of contribution, in fixing a beam than in carrying it

Table 1 ANOVA results for contribution to carry a beam

Condition	ANOVA results (α=0.05)	Significant difference*	Mean & SD results
C1	F(2,48)= 5.12, MS_W=2.79, p=0.010	IPT1 & DT2	IPT1 (M=81.0, SD=17.7) DT1 (M=67.5, SD=23.9) DT2 (M=54.3, SD=29.7)
C2	F(2,34)= 4.67, MS_W=3.21, p=0.016	IPT1 & DT2	DT1 (M=65.5, SD=28.2) IPT1 (M=83.5, SD=20.9) DT2 (M=52.4, SD=27.5)
C3	F(2,30)= 2.65, MS_W=3.40, p=0.087	IPT1 & DT2	DT2 (M=51.4, SD=31.0) IPT1 (M=77.9, SD=25.0) DT1 (M=65.5, SD=23.2)
C4	F(2,19)= 8.29, MS_W=2.44, p=0.003	(IPT1, IPT2) & DT2	IPT1 (M=67.9, SD=29.3) IPT2 (M=78.6, SD=20.2) DT1 (M=31.0, SD=10.8)
C1-C3	F(2,118)= 12.96, MS_W=2.94, p=0.000	IPT1 & (DT1, DT2)	IPT1 (M=81.0, SD=20.4) DT1 (M=66.3, SD=24.4) DT2 (M=52.9, SD=28.5)

Where: α is the limit of significant deviance; MS_W is the mean square within groups; F(a,b) is the variance between groups / MS_W; p is the actual deviance, with four decimal places; M is mean; SD is standard deviation; *significant differences: as found by the posthoc test (Tukey)

- Immersive users are considered by all to contribute more than desktop users (Table 1)

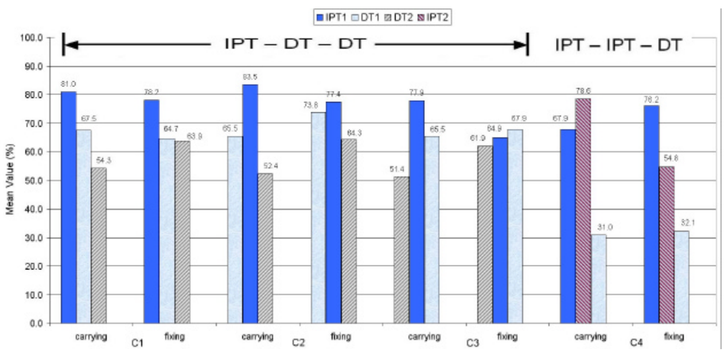


Figure 1 Comparison of perceived contribution for carrying and fixing

- Where a team comprised of two immersed and one desktop user, the latter was left out of most of the activity (Figure 1 & 2)

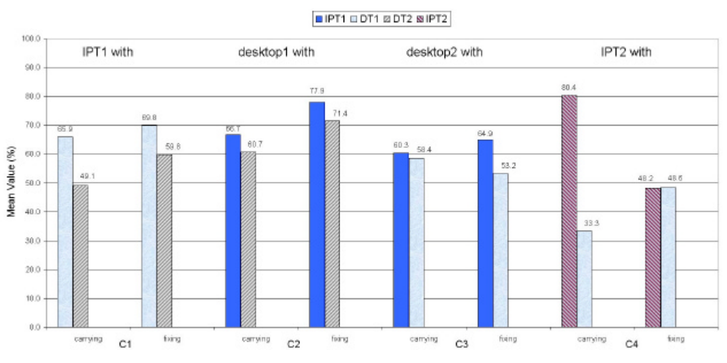
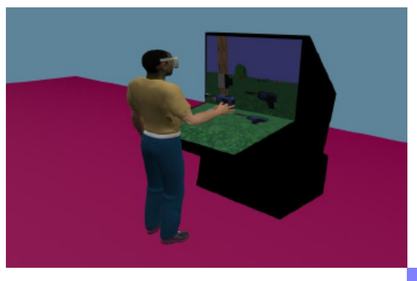


Figure 2 Comparison of perceived collaboration for carrying and fixing

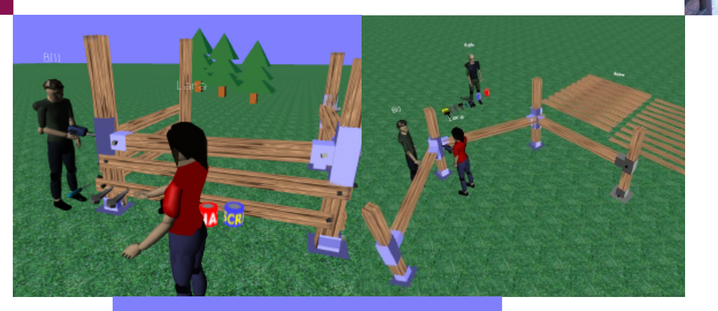
Table 2 Supporting SHC across distance

Forms of SHC, including …		 Telephone	 Video conference	 Typical CVE	 Immersive CVE
Verbal	Natural speech	natural	natural	natural	natural
Non-verbal	Gesture, posture and facial expression		natural	unnatural	natural
Objects	Artefacts of interest, person and non-person related		Not shared / natural	Shared / unnatural	Shared / natural
Environment	set the scene for natural collaboration and communication		Look into others	Look into Shared	Physically situated in shared

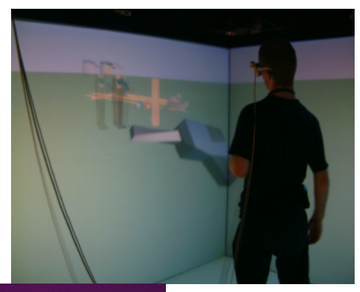


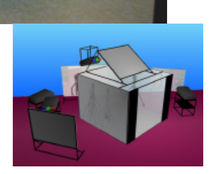
Focus:
shared object manipulation with a distributed team in a task requiring close collaboration

Investigation:
Effect of display type on collaboration and the influence of different forms of SHC on such a collaborative task

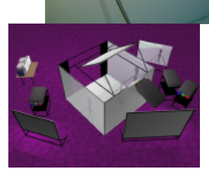


Application:
Building a virtual gazebo, requiring collaboration and communication to finish the task





After a successful day users may shake hands.



SHC in a co-operative task

The comparison of two user trials showed a significant differences in SHC when communication devices are not hidden (Figure 3 & 4).

- Increased verbal communication
- Higher interaction and more collaboration
- More use of gestures

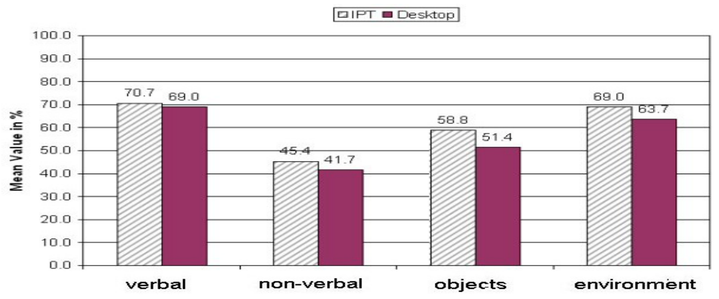


Figure 3 Influence of SHC, trial 1

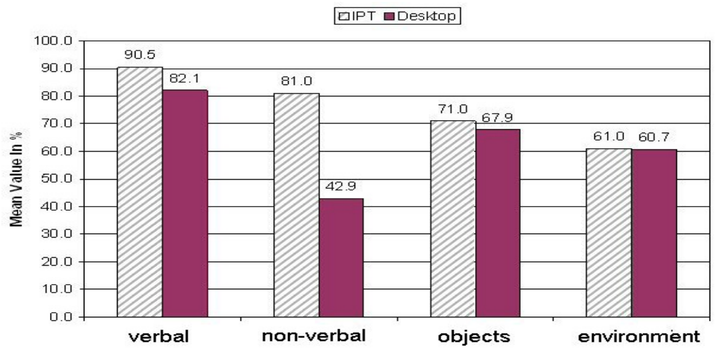


Figure 4 Influence of SHC, trial 2

Further questions to the participants strengthen the results shown above.

- They had a feeling of presence and co-presence, which increases when working with another immersed user
- The social feeling increases when users get more engaged with others and the task

Conclusion

The current state of technology is still some way from providing natural social human communication between remote participants. Improvements must be made in interface, representation and underlying communication. We should not, however, address this in a adhoc manner. Understanding real world social interaction and communication is key to emulating it. The classic taxonomy adopted in this poster is well accepted for co-located groups and we propose that it is useful for reasoning about the requirements and effectiveness of CVE technology.

Future Work

- Mapping fundamental principles from psychology into avatar design.
- Further test trials with multiple immersive displays (CAVE's, workbenches)

Acknowledgment

We wish to thank all involved in facilitating collaboration between the University College London, the University of Reading and the Johannes Kepler Universität Linz.

References

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