

Pointing Accuracy in Collaborative Virtual Environments

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Abstract. Pointing is ubiquitous and important in everyday life, and should also be important in collaborative virtual environments (CVEs). However, pointing is not well supported in common CVEs, such as World of Warcraft and Second Life. To better support pointing in CVEs, we first need to understand the fundamental – how well people can interpret the direction that another person is pointing. We conducted two studies to investigate this question. The first identified several ways that people point towards distant targets, and established that not all pointing requires high accuracy. The second study looked more closely at how accurately people can produce and interpret the direction of pointing gestures. We found that although people are more accurate in the real world, the differences are smaller than expected. Our results show that pointing can be successful in many situations in CVEs. Ultimately, we want to better support pointing and find out how pointing can support collaboration in CVEs.

Observations of Distant Pointing

In order to determine issues that are important for pointing in CVEs, we carried out an observational study to look at the way that people point (and interpret others' pointing gestures) in the real world.

We recruited four pairs of participants. They were asked to perform a series of activities in a fifth-floor room that had large windows overlooking a city. The activities involved the production and interpretation of pointing gestures. The referents were things outside the room including different objects (e.g., an apartment building, a car, or a sign), general areas (e.g., a parking lot containing many cars), and paths (e.g., a path between two buildings). The targets could be either directly visible, partially occluded, or completely out of view. The

participants used different communication channels (pointing gesture only, pointing plus speech, and pointing plus written notes) to indicate the targets.

Our main finding shows that the degree of precision needed for pointing depends on how difficult it is to describe the target using the available verbal channel.

Interpreting Pointing Direction

In the second study, we investigate people's ability to interpret the direction of a pointing gesture. While pointing gestures are complex and have multiple stages, our focus was on the 'holding' state of pointing gestures because it conveys the most information about direction. The main research questions are how accurately people could determine what others were pointing at, how accurately people could point at objects themselves, and how interpretation of pointing direction differed between the real world and a CVE.

The study had five factors: two *task types* (production of the pointing gesture or interpretation of the gesture), two *environments* (real world and CVE), two *distances* (600cm or 300cm to the targets), two *field-of-view widths* (85° or 120°, only used in the CVE), and two *observing locations* (behind or beside, only used for interpretation tasks).

The study was conducted in two environments. In the real-world setting (a 750cm x 400cm room), a 1024 x 768 projector displayed targets on a 400cm-width wall. The projected area was 300cm x 225cm. The image was horizontally centred on the wall and 100cm above the ground. In the CVE, we created a room that replicated the real world setting. Ten participants were asked to produce and interpret pointing gestures toward the targets. Each participant performed 15 trials per condition (counterbalanced using a Latin square design).

The main result shows that people are more accurate in producing and interpreting pointing gestures in the real world; however, the differences are smaller than expected.

Conclusion and Future Work

Pointing is a natural and expressive part of human gestural communication, but current CVEs do not yet provide good support for pointing. We carried out two studies. The results suggest that pointing can work well in CVEs.

In future, we will investigate different control mechanisms over different levels of expressiveness of avatar pointing. We will also observe pointing activities in more realistic settings in CVEs. In addition, we will explore situations where pointing in CVEs can enhance collaboration. Our goal is to improve pointing activities, which in turn improves collaboration in CVEs.