Do Not Invade:
A Virtual-Reality-Framework to Study Personal Space

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Abstract: The bachelor thesis' aim was to develop a framework allowing to design and conduct virtual-reality-based user studies gaining insight into the concept of personal space.

Keywords: virtual agents, personal space, user studies

Thesis Description

Navigating through social environments largely involves nonverbal behaviors such as choosing an appropriate distance to others. Thus, personal space, defined as a flexible protective zone maintained around oneself, is a key element of social interactions [Hal66]. However, the personal space is regulated dynamically and its size depends on numerous social and personal characteristics, e.g., the nature of the relationship between the interaction partners and the other's sex and age. Furthermore, violating the protective zone evokes different levels of discomfort and physiological arousal, evident in, e.g., changes in heart rate and skin conductance [Hay78].

In order to gain more insight into the characteristics of and influences on personal space, social and behavioral studies conducted in immersive virtual environments are beneficial (e.g., [ASOB+15, BBBL03]). In these environments, human participants interact with virtual agents, i.e., embodied, computer-controlled, human-like characters. By this, all human participants are exposed to the exact same, fully controllable, immersive settings, minimizing human-evoked confounding effects biasing the results.

During the bachelor thesis, a basic framework was developed, easing the design and conduct of these behavioral studies. Based on XML-descriptions of the individual study tasks, the framework sets up the study and logs all relevant parameters, e.g., the human participant's as well as the virtual agent(s) position and orientation in the scene during task execution, for the later-on analysis. In this basic setup, the human participant is centered in a defined scene, while being approached and passed by either a single virtual agent (see Figure 1a) or a cohesive small group of virtual agents (see Figure 1b). Thereby, the XML-descriptions contain information about which virtual agents should be present in which scene, which facial expression or body gestures they should show and, mainly, which (advanced) movement patterns they should follow. During the task execution itself, the human participants are then asked to indicate two areas of their personal space, the transition 'social' to 'personal' space as well as the transition

Figure 1: (a) A subject indicating her personal space (green: transition 'social' to 'personal' space, red: transition 'personal' to 'intimate' space) while being approached by a female virtual agent. (b) A group of three approaching male virtual agents.

'personal' to 'intimate' space, exemplarily shown in Figure 1a.

In conclusion, the framework will support researchers in sampling the personal space and thus allows a better understanding of the influencing factors. By providing crucial insights into the complexity of social interactions, open research questions in the area of social behavior can be answered. In addition, the virtual agents' behavioral control required in the area of social virtual reality can be improved, turning them into more advanced (emotional) human interfaces.

References

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