Investigating the Influence of an Approaching Virtual Agent's Emotional Expression on a User's Personal Space Preferences

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Personal Space (PS) is regulated dynamically by choosing an appropriate interpersonal distance when navigating through social environments. This key element in social interactions is influenced by numerous social and personal characteristics, e.g., the nature of the relationship between the interaction partners and the other's sex and age (e.g., [9]). Moreover, affective contexts and expressions of interaction partners influence PS preferences, evident, e.g., in larger distances to others in threatening situations [8] or when confronted with angry-looking individuals [12]. PS violations evoke discomfort and physiological arousal [8] and may trigger avoidant or aggressive reactions [10].

However, the wealth of influencing factors presents a challenge for balancing experimental with ecological validity. Experimental research mainly relies on stop-distance paradigms, in which actors approach the subjects until they report feeling uncomfortable [11]. Given the dynamic nature of social interactions, using real humans as interaction partners is likely to compromise experimental control, in particular, reliability. Thus, desktop-based, computerized stop-distance paradigms, in which subjects drag virtual space invaders towards their own virtual representation, are often used instead. However, the abstract third-person view onto the social environment is a drawback. The usage of Virtual Reality (VR) was proven to be beneficial for the social and behavioral PS studies (e.g., [7]): while providing naturalistic contexts as a direct, first-person experience, maximal experimental control is maintained.

Previous CAVE and head-mounted display (HMD) experiments already indicated that VR provides a valid assessment of physical PS preferences for interacting with virtual and real-life interaction partners (e.g., [1]-[3], [6], [9], [13]). However, these studies mainly focused either on the Virtual Agent's (VA's) alignment to a user or on the VA's appearance in terms of visual representation and gazing behavior. Given the prominent role of emotional expressions in our everyday social interactions, our work in progress is to expand this research by investigating how emotions affect PS adaptions. Thereby, we plan to compare the results between three display systems: desktop, HMD, and CAVE.

Our talk will cover two aspects: First, a pre-study in which we sampled PS preferences from 27 healthy German males, published at this year's IEEE Virtual Reality [4] will be presented. In the study, either a single VA or a group of three VAs approached the subject standing in a CAVE. In order to investigate the influence of a VA's emotions, we altered the VAs' facial expression between angry and happy. Our results corroborate previous findings of an elliptical PS shape and provide evidence that an increasing amount of interaction partners also increases the distance kept between the subject and VAs. Furthermore, they indicate that the emotion expressed by approaching VAs has an influence on the PS preferences as larger distances were chosen to angry VAs compared to happy ones. Second, building on our

experiences from the pre-study, we are currently improving our study design by also focusing on the VA's body posture and footstep sound to express the respective emotions. Furthermore, we want to extend the range of displays used, by comparing a CAVE as well as an HMD setting with a desktop-based version comparable to the computerized stop-distance paradigms. Thus, we want to discuss the planned design changes, which were also presented at this year's IEEE VHCIE workshop [5], and share some first interim results of our ongoing efforts if possible.

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