

Walk this way: Evaluating the effect of perceived gender and attractiveness of motion on proximity in virtual reality

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ABSTRACT

In human interaction, people will keep different distances from each other depending on their gender: males will stand further away from males and closer to females. However, many other variables influence proximity, such as appearance characteristics of the virtual character (e.g., attractiveness, etc.). Our study focuses on proximity to virtual walkers in virtual reality (VR), where gender could be inferred from motion only. We applied a set of male and female walking motions (motion capture) to a wooden mannequin, and displayed them to the participant embodied in a virtual avatar in VR. Participants used the controller to stop the approaching mannequin when they felt it was uncomfortably close to them. We hypothesized that proximity will be affected by the gender of the character, but also the gender of the participant. We additionally expected some motions to be rated more attractive than others and that attractive motions would reduce the proximity measure. Our results show support for the last two assumptions, but no difference in proximity was found according to the gender of the character's motion. Our findings have implications for the design of virtual characters in interactive virtual environments.

1 INTRODUCTION

When designing virtual characters for interactive applications, appearance and animation are critical factors which influence the level of engagement with these characters. It has been shown before the gender of the person [2] and his/her perceived attractiveness [1, 7] can affect how closely the viewers allow them to approach them before they start feeling uncomfortable (proximity distance [3]). The proximity pattern between the interactive diads was typically described as $MM > MF > FF$ ($M = \text{male}$; $F = \text{female}$) [2]. Previous studies replicated this result in virtual reality with virtual characters of different gender [5, 6].

Since gender can be recognised from motion cues only [8], we designed a novel experiment where the gender of the virtual walker could only be inferred from motion, since the walking animation was applied to an androgynous wooden mannequin. Thus, we investigate if information coming from motion alone is strong enough to influence people's proximity distance when interacting with virtual characters. As walking motion of the virtual character was previously shown to affect perceived attractiveness [4], we also expected more attractive motions will reduce the proximity distance between the participants and the character. We formed the following hypotheses:

H1: the gender of the character's motion affects viewers proximity to this character.

H2: female participants indicate further proximity distances to virtual characters than male participants.

H3: less attractive motions increase the proximity distance to that character.

2 STIMULI CREATION

We used motion captured, natural walking motions from an existing database [4]. We selected 10 male and 10 female actors with similar speeds (mean: $1.56m/s$, $SD : 0.05m/s$) and applied the animations to an androgynous character (wooden mannequin, similar to studies of McDonnell et al. [9, 10]). The motions were then individually exported to Unreal Engine 4.23. onto the character placed in a simple virtual room environment.

3 EXPERIMENT DESIGN AND PROCEDURE

Twenty participants (10 males) between the ages of 18-37 took part in this experiment. Using a head mounted display (HTC Vive Pro) with the controllers, the participants were embodied into a wooden mannequin, while observing another character of the same appearance walking towards them. They had to indicate (trigger of the controller) as soon as the distance between them and the virtual character *made them feel uncomfortable*. In a separate task, they rated the attractiveness of motion, on a scale from 1 (*not attractive at all*) to 7 (*extremely attractive*). We also collected gender recognition responses to the motions (by pressing left or right trigger, participants responded with either '*male*' or '*female*' answer).

4 RESULTS AND DISCUSSION

Proximity – Using a repeated-measure ANOVA of proximity responses (minimum distance in cm), with factors Motion Gender, Actor Motion and Participant Gender, we found a main effect of Participant Gender, where female participants were stopping the character at a greater distance than male participants. We found no difference in proximity according to Motion Gender.

Our gender recognition task revealed that the average recognition rate for individual actors was above chance (75%), therefore sufficient to form conclusions related to gender effects.

Attractiveness – With the initial main effect of Actor Motion being significant, we grouped the attractiveness ratings into 3 groups: *Low* (6 motions), *Medium* (6 motions), and *High* (8 motions). A significant effect of Attractiveness on the proximity results and post-hoc analysis showed that participants were stopping the character at a greater distance in the Low than in the Medium or High Attractiveness groups.

In summary, we did not find support for **H1** - participants in virtual reality do not change their comfortable distances to characters based on the gender of the character's motion. **H2** was confirmed - female participants require larger space to feel comfortable than males when approached by a virtual character. We also confirmed **H3** - participants keep further away from characters with unattractive walking motions than those with attractive motions. These results allow us to discuss the implications on interactions between users and virtual characters, in particular how personal space around the viewer is affected by their gender and attractiveness of the virtual character.

REFERENCES

- [1] G. Banziger and R. Simmons. Emotion, attractiveness, and interpersonal space. *The Journal of social psychology*, 124(2):255–256, 1984.
- [2] A. T. Brady and M. B. Walker. Interpersonal distance as a function of situationally induced anxiety. *British Journal of Social and Clinical Psychology*, 17(2):127–133, 1978.
- [3] L. A. Hayduk. Personal space: Where we now stand. *Psychological bulletin*, 94(2):293, 1983.
- [4] L. Hoyet, K. Ryall, K. Zibrek, H. Park, J. Lee, J. Hodgins, and C. O’sullivan. Evaluating the distinctiveness and attractiveness of human motions on realistic virtual bodies. *ACM Transactions on Graphics (TOG)*, 32(6):204, 2013.
- [5] T. Iachini, Y. Coello, F. Frassinetti, and G. Ruggiero. Body space in social interactions: a comparison of reaching and comfort distance in immersive virtual reality. *PLoS one*, 9(11):e111511, 2014.
- [6] T. Iachini, Y. Coello, F. Frassinetti, V. P. Senese, F. Galante, and G. Ruggiero. Peripersonal and interpersonal space in virtual and real environments: Effects of gender and age. *Journal of Environmental Psychology*, 45:154–164, 2016.
- [7] C. Kmiecik, P. Mausear, and G. Banziger. Attractiveness and interpersonal space. *The Journal of Social Psychology*, 108(2):277–278, 1979.
- [8] L. T. Kozlowski and J. E. Cutting. Recognizing the sex of a walker from a dynamic point-light display. *Perception & psychophysics*, 21(6):575–580, 1977.
- [9] R. McDonnell, S. Jörg, J. K. Hodgins, F. Newell, and C. O’Sullivan. Virtual shapers & movers: form and motion affect sex perception. In *APGV '07: Proceedings of the 4th symposium on Applied perception in graphics and visualization*, pp. 7–10, 2007.
- [10] R. McDonnell, S. Jörg, J. K. Hodgins, F. Newell, and C. O’Sullivan. Evaluating the effect of motion and body shape on the perceived sex of virtual characters. *ACM Transactions on Applied Perception (TAP)*, 5(4):20, 2009.