The Compliance of Virtual Social Interaction versus Real-life Social interaction

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Figure 1. Virtual handshake

ABSTRACT

During covid times and developments in the 21st century online collaboration and negotiation are becoming increasingly more a necessity than a demand. With Virtual Reality (VR) becoming a more and more promising collaboration tool through upcoming technologies such as the Metaverse. The immersiveness of virtual reality makes for a more promising online collaborative environment in terms of face-to-face communication.

Social touch for a user and Virtual Agent (VA) in a virtual environment could increase immersivity in this collaborative setting which in turn can provide better compliance to the collaboration itself.

For this paper, the main research question is: Does technology-mediated social touch, by means of a virtual reality haptic device, have the same effect on compliance as human touch in virtual reality?

With the purpose to find the abilities and shortcomings of virtual environments vs actual environments. Determining if the virtual environment will be able to take over the real-life applications for different sectors.

For this, the research will take on a virtual environment in an office for negotiation of bar prices by the use of a Virtual Agent. In this environment, the users will be given either No/Virtual/Real handshake to find the influence of the haptics on the compliance in the negotiation. The users will be tested on the amount they negotiated and the survey afterward about trustworthiness, immersion, and personal preferences.

From the results found in this research, we can suggest that virtual environments do provide a more immersed feeling with the use of handshakes through real-life and haptics, which in turn provided more compliance in the negotiation. By being more immersed in virtual environments the user tends to invest more energy and time into the negotiation process. From this we can suggest or conclude if the virtual environment is able to be used for realistic purposes. Though due to the limited amount of users tested this could be a fluke and should be further investigated.

From this research it is suggested the virtual haptics provide a realistic immersed effect on the compliance of the user. The Virtual environment is a perfect place for online collaboration, while the technology of haptics might not be as immersive as real-life yet. The growth in this technological field is slowly getting there and will continue to become more and more realistic and affordable.

KEYWORDS

Online collaboration, negotiation, Virtual reality, Metaverse, Social touch, Virtual Agent, immersive, mimic, real-life, handshake, environments

1. INTRODUCTION

During the COVID-19 pandemic the call for online and remote environments in institutes like higher education; confidence, student accessibility, and motivation play an important function in ICT integrated learning. [1]

With a focus on Collaboration Problem Solving (CPS) becoming a prominent feature in 21st-century skills [2]. Social interactions improve this comprehension through discussing, elaborating, and negotiating to reach a shared understanding [3]. Literature reviews suggest social interaction among humans is even crucial in learning and developing these cognitive problem-solving skills [4][5]. Following the paper of Ali Wahab[1] on online and remote learning in higher education, it is proposed that staff members should use technology and technological gadgets to enhance learning especially during these exceptional times.

Virtual Reality (VR) is a technological gadget that has the ability to create a more socially interactive environment for learning and developing such abilities. VR has become important for a large variety of training and coaching applications in the military, healthcare, and education [6].

Though if these virtual environments can not mimic the real-life application to a trustworthy degree it could lead to complications in real life.

According to Osama, M. et al.[7]:" Virtual surgical simulators offer the possibility of training surgeons without risking casualties. However, the interaction feeling and its effect should be provided to make sure that the perceptual experience in the virtual world corresponds to that in the real world. Otherwise, the training would be useless, if not dangerous."

The mental state of the virtual environment has to be close to an exact copy of real-life applications to make sure confidence is built during the learning and training process, to make sure the real-life applications will be handled in the same way as the simulated environment. This is why it is important that VR devices can closely resemble real scenarios. This paper will be researched if state-of-the-art haptic devices are able to create such a closely resembling scenario.

2. PROBLEM STATEMENT

In this paper, it is researched if a virtual handshake could mimic the real-life feeling of a handshake to investigate the immersive shortcomings and abilities of haptic gloves in a virtual environment. So as to find if the virtual environment could replicate the mental credibility for users in a real-life environment. This will be tested through compliance in a negotiation environment to find this mental credibility. If it is found that a virtual environment can not replicate this to a credible degree, applications like virtual surgical simulators could pose a problem for the real-life stress and management of likewise scenarios in an actual environment.

3. RESEARCH QUESTION

From this problem statement, the research questions follow on how haptics differ from the actual real-life comparison. This will be researched by testing the mental state of social interactions through haptic devices versus real-life social interactions. By testing the immersivity of a handshake in a negotiation it can be found if these social interactions can mimic a real handshake, which would lead to a reliable virtual social environment for learning.

For this paper, the main research question is

1. Does technology-mediated social touch, by means of a virtual reality haptic device, have the same effect on compliance as human touch in virtual reality?

By finding the authenticity and similarity of virtual social touch we can find if the haptics are able to provide a good base for different sectors. If the haptics prove to provide a realistic immersion on compliance haptics could prove to find a useful place in medical healthcare online or surgery training. Though if it does not provide enough compliance from the user it could mean a misled sense of security for the practical application of virtual environments, leading to more danger and damage than good.

By measuring the difference between real touch and virtual touch we can find this gap and make sure that we understand the difference between real life and virtual environments so we can train and use it accordingly.

4. RELATED WORK

In the paper of Sykownik et al.[8] on social touch in virtual reality:" The high and low intimacy interaction scenes induce moderate to a high perception of spatial presence and co-presence." which:" In conclusion, we retained the assumption that both conditions provided the same immersive experience and thus did not consider the immersive experience in the following analysis." In their analysis, they found that social interaction in this virtual haptic environment induces mostly relaxation and happiness which can be related to reliability. In some cases, it proved anxiety-inducing which in turn relates to inaccurate representation of real life. Though the difference in the intimacy of the interactions seemed to not change the amount of immersivity, meaning some interaction is just as immersive as a lot of interaction.

From this interaction on intimacy, we find that a short handshake could be enough. Following the paper on handshaking in a negotiation environment by Fricker S. et al. [9] we find that: "Inadequate communication and tacit assent to a demanding customer's requests make it hard to fully understand a project's requirements."Followed by "Handshaking is an efficient, flexible technique that uses architectural options to understand requirements, to make implementation decisions that create value, and to establish the foundation for a stable project." Communicating by a

handshake is a useful way of establishing the completeness of a negotiation. By handshaking on it both parties admit to a complete understanding of the project's foundation. Which could prove useful in an unknown virtual negotiation environment where both parties are new to the setting.

As an example of realism in handshaking through VR the paper of Giannopoulos et al.[10] participants were asked to partake in a virtual cocktail party. Where virtual human hands were controlled by a haptic device and an algorithm to produce realistic movements of a real human and the difference from a real human. Results showed that robot handshakes were rated similarly to handshakes from actual humans. From this, we find that handshaking can prove in an online environment to be a useful and realistic communication of social touch.

From these papers follows the methodology on how to proceed with further research into social interaction in a virtual environment. By testing the limitations and abilities of the handshake in a virtual negotiation environment by testing it against a real handshake it can be found if these haptic virtual environments can really be used to replicate and mimic the real-life environments on a business and educational level.

5. METHODOLOGY

In this study, the difference between virtual touch and real-life touch will be compared on legitimacy with the role of compliance in a negotiation environment coming from a handshake as a variable.

The negotiation environment will have the user be a representative of a student union that has to negotiate new lower drink prices with a bar representative which will be filled in by the VA. On first contact, the user will be asked to give a handshake to a VA to change the immersiveness and compliance of the online negotiation to influence the user to interact more with the environment.

In Experiment 1, a number of participants will be randomly selected to a no-touch scenario 1, virtual touch scenario 2, and real-life touch groups scenario 3 to negotiate prices in a virtual bar environment on behalf of a student society. The no-touch group is the control group to see if the virtual touch is able to mimic real-life touch on a perceptual mental level. By monitoring the level of interaction the user has with the virtual environment it can be concluded if the handshake changes the immersivity of the user which in turn means the compliance of the virtual negotiaton has changed. By comparing this to a real-life version of shaking hands it can be found if the haptic environment is able to mimic its real-life counterpart. The level of interaction will be observed by the amount the user tries to negotiate lower prices. And compliance will be measured through the survey at the end of the experiment.

This paper is expected to add to the scientific literature on the abilities and shortcomings of virtual touch in an online environment.
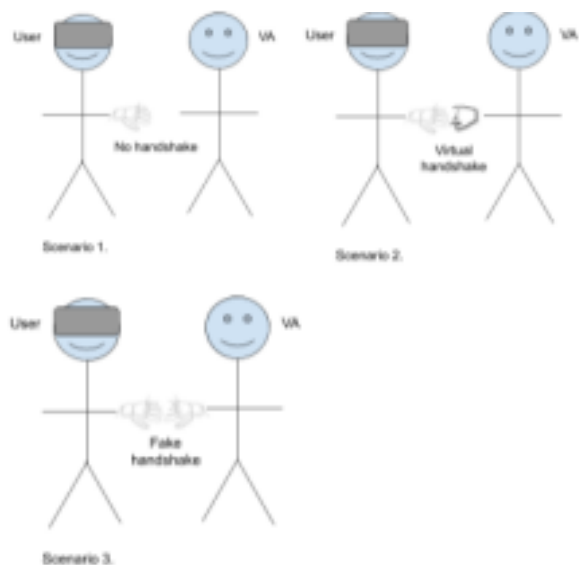
Experiment 1.

For the experiment 10 people were gathered in total. All of the participants were recruited from the university, either through WhatsApp groups/the HMI lab floor/Track meetings. Their age is between 19-24 and had atleast some experience with VR. The users were randomly selected into their respective groups in terms of who was first and following the order of No-Touch, Virtual-Touch, Real-Touch. The No-Touch group included 2 males and 1 female. The Virtual-Touch group included 2 males and 2 females. And the Real-Touch group included 3 males. The last person of the 10 made the distribution uneven thus the last person was placed in the Virtual-Touch group as to find as much data on this group as possible since this is the main research group.

The people tested were given a description of the situation which can be found in the Appendix. This description explains what they are going to be doing and the prices they should look out for. Some questions were asked to make sure all users understood what the different prices meant for their "study association" so that they would be able to focus on the beer price for example.

6. EXPERIMENT DESIGN

The experiment is based on the unpublished research done by D. Kolensnyk on the impact of virtual touch in a negotiation environment. This research will be used as a base for finding the influence of a virtual handshake, comparing this from a no-touch base to an actual handshake and virtual handshake to find the difference between virtual and real-life.

Participants are invited to a room and asked to negotiate the prices of four products in a bar, which is hosting their student association meetings. The negotiation scenario and comprehension task were adapted from Harinck and Druckman (2017). The owner of the bar (represented by the VA) was asking for higher prices, while the participants had to

negotiate the smallest possible increase, but still reach an agreement with the VA. According to the scenario, price increases for different products lead to different additional costs for the student association per month as products are consumed in different quantities. The VA was designed in UNITY, the environment (an office) is made possible by using an existing environment created by Luuk Lenders. The equipment included a VR headset with a built-in sound system (HTC Vive Pro), Trackers (HTC Vive tracker), and haptic gloves (Sense Gloves) to recreate a handshake between haptics and a real person. The study uses two measures to assess trust during the interaction: the trustworthiness sub-scale from Ohanian (1990; 4 items, semantic differential, example "honest-dishonest") and the short version of the Trust scale(Yamagishi & Yamagishi, 1994; 3 highest loading items from "Most people are basically honest/trustworthy/basically good and kind") and Distrust scale(Yamagishi, 1988; 8 items with Likert-scale items, example: "In dealing with strangers, one is better off to be cautious until they have provided evidence that they are trustworthy.").

Finally, participants filled out a questionnaire, assessing a) whether participants felt safe during the interaction (Levav & Argo, 2010; six semantic differential items, example "safe-unsafe"), b) whether they were aware of the touch ("Has the VA touched you?") and if so whether they liked it (on a 10-point Likert scale), and c) their overall receptivity to touch (Bickmore et al., 2010; 10 items using Likert scale, example item "I like people who casually touch a lot").

7. ENVIRONMENT DESIGN

The environment was edited from the existing design of Luuk Lenders. His environment included a VA that gives people a handshake on entrance see Picture 1. and sits down across from the user to talk to them. The environment was made for the purpose of finding the most realistic touch vibration. The environment was edited to include the study of Hanrick and Druckman(2017). Here no different haptic vibrations are tried on the user and only the influence of the handshake on the negotiation is measured.

Picture 1. The office setting where a handshake is asked from the user

The environment includes a book, a bottle and a table for all users to get a feeling of the haptic environment to make the

control group have something to do with the gloves instead of asking them to wear them without interaction.

For the Virtual handshake group, an extra VA was created with ragdoll physics to give a proper handshake see Picture 2. This VA will be swapped out after the handshake for the normal VA.

Picture 2. The office setting including the ragdoll VA where a handshake is requested from the user

For the Real handshake group, an extra Tracker is used to control the hand of the VA and give people a handshake in real life while inside the Virtual Reality.

8. RESULTS

During the testing the proposed 20 people were not achieved, instead 10 people were tested over the 3 different categories.This heavily influenced the outcome as only one person can skew the results for their respective group by 33%(or for VR-T 25%) of the final average. So the results can only be used as suggestive and hold no actual facts, this research is meant to be a guideline for future research and not as a quotable fact base.

From the experiment, the following baseline was found from the No-touch Group. The average of total per month extra spent was 213.33 euros. The Virtual handshake group spent on average 146.66 euros. The Real touch group spent an average amount of 120 euros. From this we can suggest that having an interaction with the VA through the form of a handshake did improve the immersion of the negotiation as was said in the paper by Fricker S. et al. [9].

From the question about if the haptic gloves provided a real-life like experience, it is found that in the No-touch handshake was divided between disagree(1) and somewhat agree(2). The Virtual handshake was divided by somewhat disagree(1), somewhat agree(2), and agree(1). The Real-life handshake the experience is divided into somewhat agree(2) to strongly agree(1). Which suggests that the Real-life touch group thought the haptic gloves were more immersive than the Virtual and No touch groups. This could be due to personal influences or the immersion of the handshake with the environment. Following the paper of Giannopoulos et al.[10] it can not be concluded in this paper that the immersion of Real-Touch and Virtual-Touch of the Virtual

Assistant is consistent. Though with a bigger sample size this might be the case.
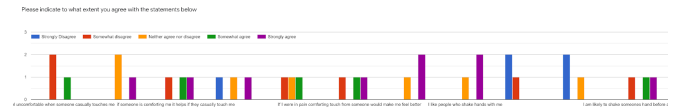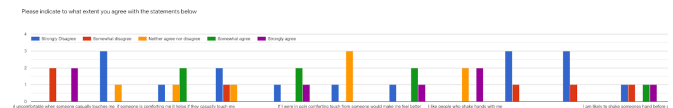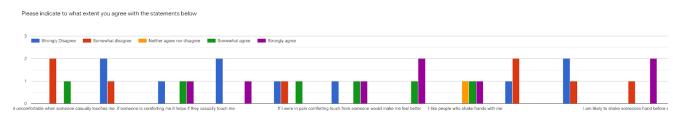

1st. Set of statements in order of No-Touch, Virtual-Touch, Real-Touch about the negotiation

In the questionnaires first set of statements, the data follows that while the No touch felt averaged at somewhat agree on: at ease, secure, protected, safe, comfortable and accepted. With the lowest being protected. The Virtual Reality group scored much lower on average with at ease being the lowest. The Real-life touch group in opposite scored really high on all of the feelings with most saying strongly agree. Leading to the suggestion that either the users in the Real-Touch group enjoyed the experience more or their personality made them more comfortable.
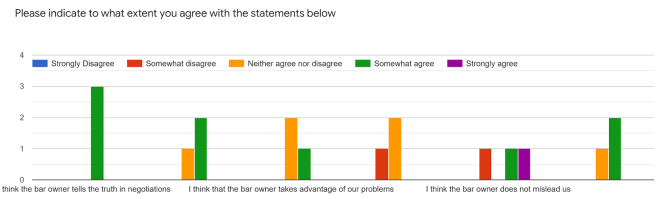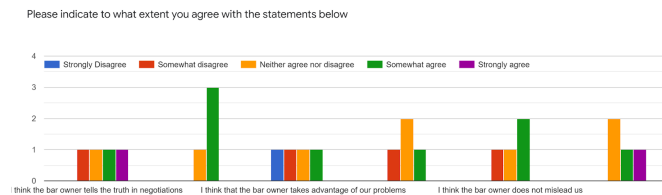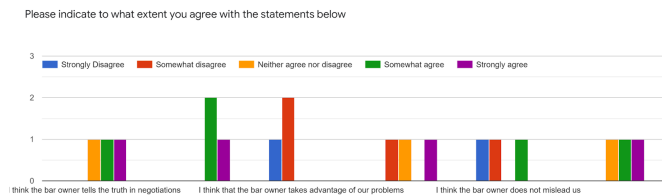
2nd. Set of statements in order of No-Touch, Virtual-Touch, Real-Touch on the bar owner experience

Overall on the scale for the statements the answers seemed to compute similar over all groups. The Real life touch seemed to score on average higher on the first set of statements in general, with I think the bar owner tells the truth scoring way higher than the other groups. The No-touch group did have an outlier in the bar owner does not mislead us being skewed much lower on average than the rest, while the question about if he is reliable and takes advantage of my problems scored better than the rest. We can see again that the Real-Touch group scores higher on average leading to the suggestion they might score higher because of a more comfortable personality. The No-Touch group scores way lower on some parts than on the negotiation questions. This could be because the bar owner did not give them a handshake leading to distrust in the bar owner.

3rd. Set of statements in order of No-Touch, Virtual-Touch, Real-Touch on personal preferences

During the third set of statements the question, if people go out of their way to interact with people who casually touch a lot, seemed to score way higher on the Real touch group. This can conclude that indeed the Real touch group just happened to have people with more comfortable personalities. The rest of the statements averaged mostly around the same for all 3 different groups. The No-Touch group scores higher on the last statement of the probability they would shake someone's hand before a conversation, which could mean the other groups did not enjoy the handshake as much. Though due to the small number of users tested this could be a personal influence.

9. CONCLUSION

Due to the limited amount of users tested the results can only be suggestive so far. The difference of one persons experience to another makes for a completely different outcome thus these conclusions should be taken into consideration with a big grain of salt. Future research should include a bigger sample size to find appropriate results to be able to conclude anything. Preferably atleast 10 per group which means 30 in total minimum.

To conclude, it can be suggested that having an interaction with the agent through a handshake in a virtual environment does prove to be of influence how much the person is interacting with the environment. Though we can also see that the virtual reality group overall scored lower on the immersion of the haptics and statements from the Real-Touch which could conclude that the haptics are not yet technologically advanced enough for such interactions as handshakes. Though this could also be concluded as the users in the Real-Touch group are more comfortable overall with the environment.

The technology of haptics can prove to provide a good improvement for business environments; online brainstorming, meetings, and negotiations. Being able to touch and interact with a book and bottle seemed to interest every group during the experiment, though for casual and formal interactions between user and a Virtual Assistant it seemed not to be ready for this yet. For agents that will focus on for example medical purposes like recalled in the paper of Osama, M. et al.[7], where there is interaction between a user and a moving VA it might not be ready yet.

So "Does technology-mediated social touch, by means of a virtual reality haptic device, have the same effect on compliance as human touch in virtual reality?" The compliance of virtual touch does suggest to come close to a real-life interaction. The immersion of the handshake tends to improve their compliance with the scenario and thus instigate the user to negotiate more.

For future research, it could be noted if User to User interaction by a handshake would influence the compliance and immersion. Though the streamlining of the negotiation so every person gets the same experience should be well constructed.

10. DISCUSSION

The environment itself was edited from an existing form from Luuk Lenders this included some limitations to the hand of the VA not being able to properly follow the hand of the user during a Virtual handshake. This was mitigated by implementing a Ragdoll clone of the VA during the handshake part see Picture 2., which for the Virtual handshake users is able to snap to the hand. Though this Ragdoll clone moves a lot more unrealistic and can be picked up by the user if excessive force is applied. This was mitigated by using him for the handshake and then switching him out for the realistic original. This is the only deviation apart from getting no handshake or a handshake in real life for the users. Though this deviation might influence the outcome for Virtual touch for the realism of the bar owner.

Due to the amount of usable/free VR-capable PCs and time limitations, the proposed amount of users was not achieved. Only 10 out of 20 proposed testers were found and tested in time. Due to the small number of people tested the results can vary highly depending highly on one person's personality not liking being touched for example. The Real-Touch group seemed suggestive to be more likely to be positive from touch to the negotiation itself.

The data collected can provide an insight into the goal of this paper, and provides a setup for future experimenting to mitigate mistakes made in this paper.

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12. APPENDIX

Description of the situation for negotiation provided to participants

You are asked to engage in a negotiation with a virtual agent in virtual reality.

In the following negotiation you are representing a client of the cafe "Het Uitje" where your student association meets frequently.

The owner of the cafe "Het Uitje" has recently renovated the place and therefore decided to increase the prices for soft drinks, beer, liquors and snacks. As a frequent customer you are not happy with this decision. It is against your interests and you and your friends are reluctant to pay higher prices.

However, the cafe has been your favorite meeting place for years and throughout these years you have built good relationships with the owner and the staff. The location of the bar is ideal for your student association and you would like to keep using it as your meeting point. Therefore, you have agreed with the owner to meet and negotiate the special prices for your group. [Study 2 additional sentence: During the first negotiation meeting, you did not reach an agreement, because you did not have enough time to review the new menu together. Now you will meet for the second time to discuss the final prices for your student association]

You have been chosen to negotiate the prices on behalf of the whole student association. It is up to you to ensure that the prices will remain the same or increase as little as possible. You want to negotiate as well as possible since you don't want to let down your friends.

In the table below you can see the different products for which the price increase is to be negotiated: soft drinks, beer, liquors and snacks. For every product there are two rows. In the first row ("Price increase") you can see the proposed increases in price. As you can see the proposed increase in prices is smaller for soft drinks and beer than for liquors and snacks. In the second row ("Extra expenses") you can see the amount that you as a group will spend extra per month, given the price increase in the first column. So, for example, if the price of beer increases by 20 cents, you as a group will spend 100 euros extra per month.

Pay attention: not every price increase results in the same amount of extra expenses. Your group consumes different quantities of each product. In your case the increase in beer price is most costly for you, while the increase in snacks price is least costly. It is your task to save as much money as possible to the group and to keep the extra expenses as low as possible.

For simplicity, please assume that only those price increases are possible.

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Soft drinks

Price increase, EUR	0.40	0.30	0.20	0.10	0
Extra expenses, EUR	80	60	40	20	0

Beer

Price increase, EUR	0.40	0.30	0.20	0.10	0
Extra expenses, EUR	200	150	100	50	0

Liquors

Price increase, EUR	0.80	0.60	0.40	0.20	0
Extra expenses, EUR	80	60	40	20	0

Snacks

Price increase, EUR	2.00	1.50	1.00	0.50	0.00
Extra expenses, EUR	40	30	20	10	0