



# Social Acceptance of Nomadic Virtual Reality

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## 1 ABSTRACT

The on hand paper provides an overview on the reviewed social acceptance of nomadic virtual reality devices in a university environment using the example oft the Oculus Rift. Within the scope of a field study data regarding fears and desires was collected with the help oft the so-called WEAR scale. Three different cases (Smartphone, Oculus Rift without gesture control, Oculus Rift with gesture control) have been reviewed. In this case the smartphone served as a comparative size due to its high acceptance as a daily used wearable. An actor and an actress that both created situations with using all of the three cases, became rated by overleaf passerbys on the basis of the above-mentioned scale in form of questionaires. The evaluation shows that virtual devices are more accepted as one thinks. The biggest difference can be found in the contemplation between smartphone and the usage of a VR device in combination with performing gestures with a VR controller. Here it becomes clear that gesture control in this context is still unfamiliar and something that makes people feel more uncomfortable compared to the handling of „ordinary“ wearables.

## 22 CCS CONCEPTS

- Computer systems organization → Embedded systems; Redundancy; Robotics;
- Networks → Network reliability.

## 26 KEYWORDS

virtual reality, social acceptance, nomadic, field study

## 28 ACM Reference Format:

Alexander Eder, Stephan Jäger, and Tom Nedorost. 2018. Social Acceptance of Nomadic Virtual Reality. In *Regensburg '19: Social*

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*Regensburg '19, June 02–??, 2019, Bayern, DE*

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ACM ISBN 978-x-xxxx-xxxx-x/YY/MM...\$00.00

<https://doi.org/10.1145/1122445.1122456>

31 *Acceptance of Nomadic Virtual Reality, June 02–??, 2019, Bayern, DE.*  
 32 ACM, New York, NY, USA, 6 pages. <https://doi.org/10.1145/1122445>.  
 33 1122456

## 34 1 INTRODUCTION

New presentation methods such as VR experiences are a growing trend as alternatives to conventional screens in different end devices for example tablets or mobile phones. These devices are always improving in measurements, functionality, and appearance because of this trend, to accommodate the mobility of modern life. Due to this development process never standing still VR devices might be prospectively used in the same way we already use mobile phones today, at any time and everywhere. To achieve a broad utilization, it is not only important to focus on the unique user and establish hardware with high usability for the users themselves, but also something that fits all the tangentially involved people and their needs for well-being, comfort, and privacy. The most important issue to start with, which also is the topic of this paper, is the question about the current state of social acceptance of VR devices in public spaces. Before spreading out this type of gear and gaining the possibility of high sales output it is essential to find out if those devices are already accepted by society and which impacts they have on society.

[4] Several researchers already tried to investigate this potential issues regarding the social acceptance by showing pictures and videos of people wearing VR devices in public spaces to a group of test persons under laboratory conditions to find out more about their opinions, feelings, and reactions confronted with this subject. With the inspection of images, people will always keep a certain emotional distance to the context shown. The spontaneous confrontation with a previously completely unexpected situation in daily life might have another effect on their emotional acceptance. VR devices might be fully accepted by society, but it can also be that they evoke discomfort because people are not used to not seeing each other's eyes while passing by or sitting next to them on the bench. Sunglasses of course act similar but since todays VR glasses still cover almost half of the wearers face it cannot be generalized and needs to be examined more accurately. In this paper, we reexamined the topic of social

72 acceptance of VR devices using a field study to achieve a  
 73 high validity.

## 74 2 RELATED WORK

75 Previous work already dealt with social acceptance and mo-  
 76 bile devices. Gesture control has also been investigated. In  
 77 the following, three papers will be analysed that already  
 78 tried to gather information about how devices of that kind  
 79 are accepted in a social context.

80 One work dealing with gesture control and mobile de-  
 81 vices and their social acceptance is a work by J. Rico and  
 82 S. Brewster [2]. It mainly observes the extent to which so-  
 83 cial acceptance can be measured. They found out that the  
 84 social acceptance of technology use is not just a question of  
 85 embarrassment or politeness, but a combination of factors  
 86 ranging from appearance and social status to culture. It was  
 87 also stressed that gesture-based user interfaces face accep-  
 88 tance problems as they require users to evaluate a range  
 89 of new actions. This would require the user to define new  
 90 standards for social acceptance. In a survey, they found that  
 91 location and audience have a significant impact on whether  
 92 a user wants to perform gestures. For example, a user would  
 93 be more likely to make gestures in front of trusted people.  
 94 This led to the conclusion that users would be more likely  
 95 to use gesture-controlled mobile devices at home. Two other  
 96 areas that were defined were the semi-public space, i.e. with  
 97 a restricted but not necessarily familiar audience, and the  
 98 public space, i.e. the sidewalk. They then carried out another  
 99 experiment to see how participants behave when they make  
 100 gestures on a busy street. Since this work is not about the  
 101 design question, the last attempt is negligible.

102 The paper "Understanding the Social Acceptability of Mo-  
 103 bile Devices using the Stereotype Content Model" [3] criti-  
 104 cized that there was no robust model to explain the underly-  
 105 ing factors why a device was socially acceptable. Therefore,  
 106 the devices were regarded as social objects and it was exam-  
 107 ined whether the stereotypical content model (SCM) could  
 108 be applied to them. The focus of this work was clearly on  
 109 whether mobile applications in themselves meet a stereo-  
 110 type. This has been proven in two studies. In the first study  
 111 it was found that different devices have a different impact  
 112 on the person wearing them. LED glasses, for example, were  
 113 viewed negatively. In the work, this was associated with  
 114 low warmth and low competence. Medical devices, on the  
 115 other hand, were rated more positively or warmer. VR head-  
 116 sets were rated well in terms of being more competitive, but  
 117 they overall were received as contemptuous. It was also found  
 118 that devices systematically trigger emotions when people  
 119 use them. This may allow the SCM to explain the results of  
 120 older work, as the social acceptance of highly competitive de-  
 121 vices such as smart glasses depends on the stereotype of the  
 122 person wearing the device. Here the comparison was made

123 between older people wearing a VR headset and other people.  
 124 A weaker attraction was also measured for VR glasses than  
 125 for other devices. It can therefore be assumed that the SCM  
 126 can be used to measure the social acceptance of a mobile  
 127 device. These assumptions were confirmed in a second study.  
 128 In this study no images of human stereotypes were used and  
 129 since it showed no significant difference to the stereotype  
 130 device combinations of the first study, it was assumed that  
 131 a possible effect of human stereotype images is negligible.  
 132 In addition, it was proven once again that VR glasses are  
 133 assigned a certain competence and that they are perceived  
 134 more competitively.

135 Schwind et al investigated the more precise acceptance of  
 136 VR glasses in 2018 [4]. It was assumed that mobile VR glasses  
 137 are therefore less frequently used in public because they are  
 138 not socially accepted. Therefore, an online experiment was  
 139 conducted to investigate the acceptance of VR glasses in six  
 140 different contexts. Prior work proved that it depends on the  
 141 environment the device is used in. So it seems to be more  
 142 acceptable to use VR glasses in bed, a train or the subway. In  
 143 public places, on the other hand, or when the user is sup-  
 144 posed to interact with a person in the environment, they are  
 145 less acceptable. In the online experiment, the test person was  
 146 shown pictures of people wearing VR glasses. They were  
 147 asked to answer a number of questions. In addition, differ-  
 148 ent places and persons of different sexes were shown with  
 149 VR glasses. Subsequently, the subjects were asked to assign  
 150 one of eight statements, which stood for Awkward, Normal,  
 151 Appropriate, Rude, Uncomfortable, Distracting, Useful and  
 152 Unnecessary, to the respective images.

153 One can therefore assume that the street is a public area.  
 154 If a gesture is performed in that place, this would be seen  
 155 as less appropriate. One should also assume that more inap-  
 156 propriate the usage of VR glasses in a certain context is the  
 157 less comfortable people feel while performing gestures with  
 158 this type of device. The SCM can be used as a classification.  
 159 The VR glasses are assigned competence but also a certain  
 160 coolness, i.e. separation.

## 161 3 STUDY: ACCEPTANCE OF NOMADIC VIRTUAL 162 REALITY

163 As already mentioned VR devices represent a potential up-  
 164 coming alternative to conventional screens in the mobile  
 165 context. The specific goal of this study was to examine more  
 166 about the current state of social acceptance in the open field  
 167 by confronting unprepared bystanders with this topic in dif-  
 168 ferent real life scenarios. This was done with the help of  
 169 a field study because of our hypothesis that the procedure  
 170 under laboratory conditions will have another result due to  
 171 emotional distances.

## 172 Study Design

173 The design of the study is a two-factorial within-subject  
 174 design and conducted with three independent variables ACTOR GENDER, WEARING OF VR-GLASSES WITHOUT PER-  
 175 FORMING GESTURES and WEARING VR-GLASSES WITH  
 176 PERFORMING GESTURES. Since VR devices always rely on  
 177 some level of gestures for interaction, gesture control with  
 178 the help of connected controllers is essential for the use of  
 179 VR devices of any kind. Since performing those gestures  
 180 might have a big impact on the acceptance this also was an  
 181 important issue to test to find out more about the general  
 182 acceptance and how people react when being confronted  
 183 with this situation. It is also important to investigate whether  
 184 the gender of the wearer has an influence on the results or  
 185 not. The questionnaire used was the 14 item WEAR-Scale  
 186 [?], a questionnaire to quantify how acceptable a device is  
 187 with regard to e.g. aesthetic, personal attitude and the wear-  
 188 ers impression on the participant. We used this scale with  
 189 a 5-point Likert scale (strongly agree="sehr"=5, somewhat  
 190 agree="ziemlich"=4, neither agree nor disagree="mittel"=3,  
 191 hardly agree="kaum"=2, don't agree="gar nicht"=1) instead  
 192 of the for this questionnaire normal 6-point Likert scale due  
 193 to an oversight.

## 195 Conditions

196 In earlier researches pictures and videoclips have been used  
 197 for probing [4]. Since we wanted to extend those results and  
 198 test their external validity we used confrontations in real life  
 199 situations in the open field rather than representations of it.  
 200 The first important factor was the gender.

201 We wanted to find out if the users gender itself plays an  
 202 important role in the acceptance of such devices in general.  
 203 Both genders have been tested without using any VR tools to  
 204 get a baseline for upcoming steps and procedures, the actors  
 205 using a smartphone instead for the baseline. Another stim-  
 206 ulus we used was the fact that both our actor and our actress  
 207 wore a VR goggle to test its influence on the pedestrians.

208 Last but not least we tested the goggles in combination  
 209 with controllers and gesture controls which is our final stim-  
 210 ulus. In this study we combined those three stimuli to receive  
 211 as much information as possible about peoples reactions on  
 212 different types of situations.

## 213 Survey Procedure

214 After handing out the informed consent, the randomly cho-  
 215 sen participants answered a short demographic questionaire  
 216 in which we request allegations to gender and age. After-  
 217 wards we handed out another Questionnaire to measure the  
 218 acceptability of wearable devices [1]. After going over the  
 219 questionnaire with the participants each of them received a  
 220 little thank-you gift.

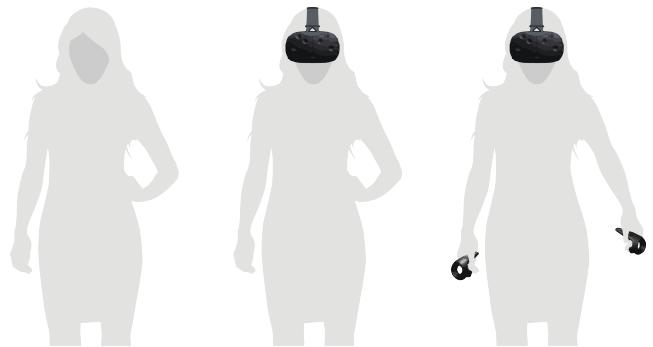


Figure 1: Three different female stimuli

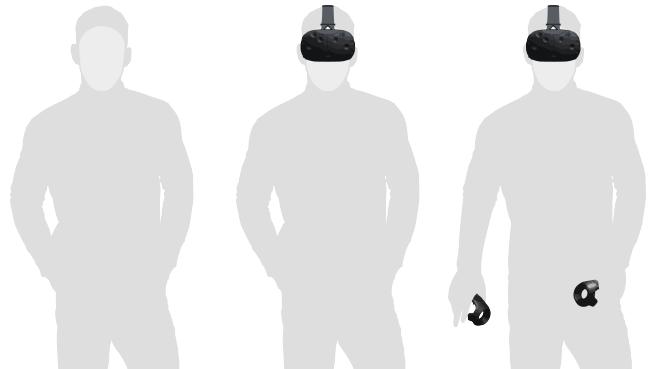


Figure 2: Three different male stimuli

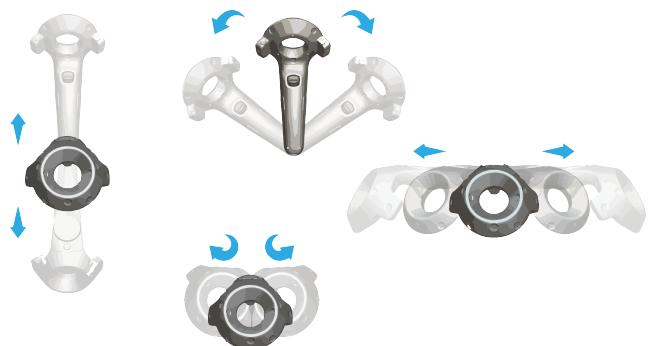


Figure 3: Used VR gestures

## 221 Participants

222 Because this study has not been researched under laboratory  
 223 conditions it was not possible to recruit test persons. An-  
 224 other reason for us to not hire subjects was, that this would  
 225 have not lead to the result we were looking for. We wanted  
 226 to examine this Acceptance Rating by collecting real life re-  
 227 actions and the opinions. For this type of field study it was  
 228 essential to blindsight pedestrians in their daily life to receive  
 229 an unbiased output. We acquired 60 Participants (33 female,

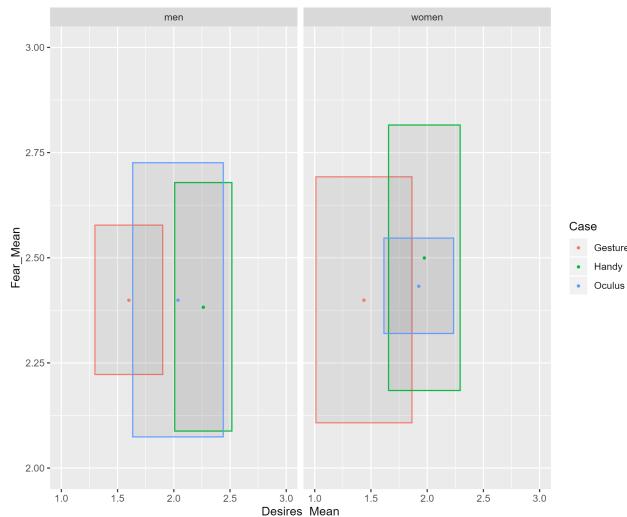
230 27 male) for the study. Their age ranged from 19 to 28 ( $M = 260$   
 231 22.65,  $SD = 2.92$ ).

## 232 4 RESULTS

233 An analysis of variance (ANOVA) was conducted to deter- 261  
 234 mine the effects of the CASE (mobile phone as control, VR 262  
 235 Glasses no gestures, VR-Glasses with gestures) on the AC 263  
 236 CEPTABILITY. Statistically significant effects of CASE on 264  
 237 DESIRES, a part of the WEAR-Scales overall metric,  $F = 5.714$ , 265  
 238  $p < 0.00561$ , were found. In contrast effects of CASE neither 266  
 239 on FEAR nor WEAR revealed any significant results. The 267  
 240 effects of the actors gender were also analysed and showed 268  
 241 no statistically significant effects either. Due to this t-tests 269  
 242 were conducted in pairs between the three CASEs, showing 270  
 243 a significant difference between the acceptance of mobile 271  
 244 phones and VR-Glasses with the usage of gestures,  $t = -3.3343$ , 272  
 245  $df = 36.391$ ,  $p\text{-value} = 0.001976$ . Thus results show that the 273  
 246 actos gender has no statistically significant impact on the 274  
 247 fieldtested CASEs. Solely on DESIRES the CASEs have a sig- 275  
 248 nificant effect. Significant differences in ACCEPTANCE only 276  
 249 exist between smartphone and the wearing of VR glasses 277  
 250 while performing gestures.

## 251 5 MAPPING AND MODEL

252 Using the WEAR scale, data to research acceptance on differ- 253  
 253 ent wearables can be determined by their relative locations 254  
 254 on a 2D map with the dimensions DESIRE and FEAR.



255 **Figure 4: Desire-Fear-Plot by CASE and GENDER**

256 As one can see in Figure 4 the colored boxes represent the 257  
 257 three different cases (mobile phone as control, VR Glasses 258  
 258 no gestures, VR-Glasses with gestures). The dot in the mid- 259  
 259 dle of each square locates the mean of the particular case. 260  
 259 The box itself shows the horizontal (DESIRES) and vertical 261

(FEARS) variance of the measurements. As the plot shows 262  
 262 the genders show only minimal differences in the acceptance 263  
 263 of the three CASEs they tested. Looking at the x-axis you 264  
 264 might realize that both the means and the variances differ 265  
 265 only minimally. Only when looking at the y-axis with rep- 266  
 266 resents the FEARS, you can see strong distinctions between 267  
 267 the two sexes regarding using the Oculus Rift with gestures 268  
 268 and without.



269 **Figure 5: Female protagonist - Oculus Rift - without gestures**

270 As long as our female protagonist only wore the VR glasses 271  
 271 without performing any gesture the interviewees were quite 272  
 272 agreed about their FEARS. In contrast the results for the 273  
 273 male protagonist were exactly the opposite. This might have 274  
 274 psychological and social reasons. Even if this is still more of a 275  
 275 cliché nowadays and no longer corresponds to the truth, men 276  
 276 of known dimensions are still considered to be technically 277  
 277 more affine than women. This could explain why the variance 278  
 278 of the acceptance of using gestures with VR devices in public 279  
 279 spaces with a male actor less scatters.

280 Considering only the case of wearing, the differences could 281  
 281 be explained by the fact that men are quickly considered to be 282  
 282 a freak when using unknown and technically looking objects



**Figure 6: Male protagonist - Oculus Rift - with gestures**

in an unusual context whereas the observer might pay more attention to looks in women, which could simply distract from such details like VR glasses.

## 6 DISCUSSION

The results show only that VR-GLASSES WITH PERFORMING GESTURES reduces the desire of bystanders to be like the user compared to the smartphone using actor, which leads us to the conclusion that there is less bias towards VR-Glasses than one might casually suspect, atleast measurably in a University environment. The significance of these results can be debatable due to the lack of personal background in the form of major or occupation in this study, though we believe it is a proof of concept still, showing that in a neutral public to semi-public environment VR-Glasses can be accepted if no social interaction is expected of the user. The lack of other statistically significant results supports that, though a bigger sample size could reveal different results, if so it stands to reason that the differences in the acceptability of a CASE to the baseline grow more distinct and pronounced, especially with a higher age range, as this study had a rather limited reach there with the ages between 19 and 28. The age, background of the participants and exact setting are probably the biggest factors for the results of a study such as this, be it in the field or in a laboratory. Specifically the performing of gestures warrants extra attention, as this lead to the only significant difference in our study, though not for reasons of social anxiety or simply accidents that could happen when moving your arms and hands in a public environment without seeing, but more from the context of DESIRE, which leads us to believe that its the self image of the people that would play the biggest role in this regard.

## 7 FUTURE WORK

Any future work building on this should prevent the mistakes that were made here first and foremost, the lack of a background in the form or occupation or major in case of students and the proper scaling for the questionnaire just to be comparable with other results delivered by this scale. Past that, a change of setting or variables could deliver a lot more interesting information, be it in a more social setting like a restaurant or cafe, or a more cramped space like most public transport which are both examples of places VR-Devices could get more and more prevalent given time and social acceptance. Even a repeat of this study in a setting that's not a university could warrant very different results, though we were unable to do that due to issues with permissions a mall would be probably the best space to get sample of most social groups.

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