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ORIGINAL ARTICLE

The joint influence of social status and personal attitudes in a contact and open versus a noncontact and homophobic culture on the virtual Midas touch

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Abstract
Alongside the highly rapid development of virtual reality technology, embodied agents will become soon a common element of human–computer interactions. Our study analyzed the interactional influence of social status, personal attitudes (homophobia and social status importance), and culture on the efficiency of the virtual Midas touch effect. From a human perspective, we focused on the cultural background related to the social norms of touch, homophobia, and social status importance. In Poland, a noncontact culture, men avoid same-gender touch and also score very high on male homophobia. Catalonia, on the other hand, has a contact culture, where same-gender male touch is rather common and natural. Catalonia is also one of the most inclusive and open societies in the world. From an embodied agent's perspective, we asked whether the agent's social status influences compliance with virtual touch. We used a modified paradigm of the ultimatum game to observe whether Polish and Catalan men are more compliant when touched by high- or low-status agents. Our results suggest that the virtual interpersonal touch and social status importance influence compliance with a moderating effect of culture. We found also a significant effect of the offer's value and a moderating effect of culture and homophobia on compliance.

Keywords Midas touch · Ultimatum game · Immersive virtual reality · Social status · Homophobia · Culture

1 Introduction

Immersive virtual reality (IVR) has arisen as a new, extremely powerful tool for education, medicine, real estate, marketing, and gaming industry worldwide (Uppot et al. 2019; Joda et al. 2019). With dynamically increasing accessibility and technological advancement of head-mounted displays come a growing number of applications aimed at a wide range of users. Previously, agents and avatars were of low resolution, schematic, and minimally responsive. Nowadays, embodied agents (EAs) can take a form of highly anthropomorphic entities powered by advanced artificial intelligence algorithms (Weitz et al. 2019). As a result, an international, rapidly growing community of IVR users has started to interact regularly with more and more intelligent and versatile EAs, some barely distinguishable from avatars controlled by real humans. Therefore, rich social interactions in IVR already occur not only between humans represented by their avatars but also between humans and advanced EAs. Inevitably, this will lead to high exposure to social influence techniques applied by EAs, often taking a subtle, thus far available only for humans, form. This has created an urgent need to investigate social influence techniques applied by EAs in IVR to understand better their impact on users from various cultural backgrounds (Demiris 2018; Chen et al. 2019; Lucas et al. 2019).

Despite the clear evidence that people's basic social mechanisms remain intact in IVR (Blascovich et al. 2002), virtual reality researchers have rarely studied mechanisms underlying the effectiveness of social influence techniques. The few exceptions include Eastwick and Garner's (2009) experiments on classic sequential techniques—foot-in-the-door and door-in-the-face; Bailenson and Yee (2005)

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study on the effect of mimicry; and Bailenson et al.'s (2001) research on the mutual gaze phenomenon. Additional evidence for agents being successful in these techniques also comes from experiments that use classic computer games like Minecraft and Garry's Mod (Pochwatko et al. 2019).

One of the most intriguing yet poorly understood social influence techniques, which has been tested in IVR, is the Midas touch effect (Crusco and Wetzel 1984). In field studies conducted mainly in the last three decades of the twentieth century, a brief touch of one's arm usually secured higher odds for evoking various behaviors, like receiving small change to make a phone call (Kleinke 1977a). Similarly, a personality questionnaire was more likely to be completed by those participants who were asked to do so while their arm was gently held at the moment the request was delivered (Patterson et al. 1986). Guéguen et al. (2010) demonstrated, in turn, that if a doctor touches the arm of a patient leaving the surgery, that patient will be more likely to adhere to the medical advice given.

Research has shown that even a touch mediated by a vibrating band may evoke a delayed spontaneous helping behavior in the real world (Haans and IJsselsteijn 2006, 2009). It evokes generosity and compliance both in the standard and the IVR version of the decision-making ultimatum game (Güth et al. 1982; Spapé et al. 2015; Harjunen et al. 2018).

According to Crusco and Wetzel (1984), the Midas touch effect occurs when "the touch is unobtrusive and free of status and dependency connotations" (p. 512). However, it seems unlikely that a touch in a waitress–client situation described by these authors was in fact status-and-dependency-free. Social interactions and influence never take place in isolation; in fact, they always occur within a particular sociocultural context and cannot be fully understood without it (Gallace and Spence 2010). Social touch, due to its immediacy and physical closeness between the touching and the touched, is limited by many factors including culture, social norms, and attitudes. We will analyze them briefly now.

1.1 Culture

In some cultures, interpersonal touch is common and natural and in others, rare and restricted to special occasions. Hall (1966) described the first as contact and the latter as noncontact cultures. An analysis of recordings of naturally occurring social interactions conducted by Remland et al. (1995) supported Hall's classification. The authors observed more frequent touch between Greek and Italian dyads than between English, French, and Dutch dyads. This was confirmed by another cross-cultural study carried out by Sorokowska et al. (2017) in 43 countries, including Poland and Spain. It demonstrated that mean temperature and gender influence personal distance toward strangers with shorter distance preferred in warmer areas and by men. Greater social proximity naturally brings also more frequent touch, which adds evidence to the classification of the Polish as noncontact and the Spanish (including Catalan) as contact cultures. Moreover, among the countries with the strongest gender differences was Poland, with women choosing further distance toward strangers. As the authors conclude, this may be related to a male expression of dominance. Similar conclusions were drawn from an observational study in the Czech Republic, Italy, and the USA, which demonstrated that across cultures, men in their twenties touch women in general more frequently than women in that age group touch men (Dibiase and Gunnoe 2004). Nevertheless, it is not only a question of whether the interpersonal touch is accepted in a society in general, but also (and primarily) in which circumstances. Among the potential factors, we suggest social status and prejudice to be the most important and tightly interlinked.

1.2 Social status

One of the first studies on the Midas touch effect has demonstrated that a person dressed in a stereotypical high-social-status manner receives spontaneous help more frequently than one dressed in a low-social-status manner after adding a touch to the request (Kleinke 1977b; Storrs and Kleinke 1990). For example, a "lawyer" asking for a phone to make a quick call had higher chances for receiving it than a "gas station worker" (Goodman and Gareis 1993). Social status and dominance, especially in patriarchal societies, are closely related to gender (Eagly and Crowley 1986). The extent to which social status matters differs also between cultures (Tinsley 2001; Aslani et al. 2016).

1.3 Gender

Analyzing the literature, one notices that manipulation using touch when both the toucher and the touched were male sometimes brought inconsistent or no effects. For instance, Erceau and Guéguen (2007) obtained a positive touch effect on the toucher's evaluations. Meanwhile, Guéguen and Fischer-Lokou (2003) observed no gender differences—both men and women helped spontaneously equally more often after being briefly touched by a male confederate. In yet another study, men were more effective than women, but women were more compliant than men (Guéguen and Jacob 2006). The reasons for such inconsistency remain unclear, but one possibility is prejudice.

1.4 Homophobia

In Western cultures, men generally score higher than women on homophobia scale (Herek 1988); same-gender touch

occurs also less frequently between men (Stier and Hall 1984). Men who demonstrate stronger prejudice toward homosexual men feel discomfort regarding same-gender male touch. Floyd (2000) demonstrated that in the USA, men touch other men in public more rarely due to a shared fear of being taken for a homosexual person. Conclusions from American studies resonate well with results obtained in Poland by Doliński (2010, 2013). In Polish culture, a touch between two females and between a female and a male secured compliance with various requests, just as in French or American studies. Nevertheless, when a male confederate touched a male participant while making his request, the chances for acceptance were lower than in the control condition. Doliński suggests this is a result of a strong male homophobia and patriarchal values shared among Polish men.

To summarize, there are many pervasive factors, including sociocultural and individual differences, which may influence the Midas touch effect. These factors remain relevant in virtual reality scenarios. In our study, we aimed to grasp the joint influence of social status and male homophobia in a contact and open culture versus a noncontact and prejudiced culture on the efficiency of the Midas touch effect. For this reason, we decided to conduct our study with Polish and Catalan cultures. Catalonia is a Spanish region known for its openness toward sexual minorities and pioneering law regulations against discrimination of LGBT persons (País 2007) which stands in clear contrast to Polish culture. All Central/Eastern Europe, including Poland, rank high on homophobia (Bolzendahl and Gracheva 2017), and studies carried out by Doliński (2010, 2013) provided evidence of prejudice toward homosexual men modulating the effect of touch on men. We used the paradigm of the decision-making game ultimatum to control compliance with the EA. The game consists of two players who divide given amount of money (pie) between each other. Player A offers a split, and player B accepts or rejects it. If (s)he accepts the deal, players receive the agreed piece of the pie. Rejection means none of the players receives anything (Güth et al. 1982). From studies which used this paradigm offline, we know that contrary to initial expectations, people do not play in line with the game theory (maximizing their own gain, offering nothing to other players) but share the pie:

On average, players in the game tend to offer around 40–50% of the pie in the standard version of the game. Such offers are almost always accepted. Responders' acceptance rates decrease with smaller offers, and they approach zero quite quickly for offers below 20% (Güth and Kocher 2014).

A recent study by Schuster (2017) suggests that players follow the optimality principle, based on the golden ratio (about 0.618/0.382). The acceptance and rejection of an offer depend on many additional factors and can be influenced in numerous ways, also by touch (Spapé et al. 2015; Harjunen et al. 2018). We predict that touch of EA will increase compliance (H1) and that the EA's social status will moderate that effect (H2) with high-social-status EA being more influential. Knowing that there are cultural factors influencing compliance (Chen et al. 2006), we also ask the following question: Will the effect of touch be moderated by culture? Moreover, based on previous Polish studies (Dolinski 2010, 2013), we test a supplementary hypothesis that stronger male homophobia will reduce compliance with EA's touch (H3).

2 Methods

2.1 Experimental design

We designed a mixed-design experiment with two within-subject factors, 2 *touch* (touch, control) × 2 *status* (high/low social status) and one between-subject factor, 2 *culture* (Catalan/Polish). In the *touch* condition, the EA was delicately leaning forward toward the participant and touching briefly his left arm. In the non-touch condition, the EA was sitting idly in a natural way. The social status of the EA was manipulated by their apparel, profession, and name (Salamanca and Pereira 2013). The high-status EA was dressed in an elegant dark suit and tie, and participants learned from the instructions that he worked as an architect. The low-status EA was a bricklayer dressed in a colorful tank top with a tribal print on it, casual shorts, a baseball cap, and plastic sunglasses. Each EA had a name pretested in a pilot online survey where responders from corresponding culture rated a stereotypically associated social status of a list of names.

2.2 Sample and data collection

We collected data in Barcelona (Catalonia, Spain) and Warsaw (Poland, Eastern Europe). The study was approved by the University of Barcelona and the Institute of Psychology, Polish Academy of Sciences ethics committees. In Barcelona, 27 men between 18 and 37 years old (mean ± SD = 24 ± 5) participated. All of them were either students ($N = 13$) or graduated professionals. The Polish sample consisted of 25 men between 20 and 30 years old (mean ± SD = 27 ± 5). More than half held a university degree ($N = 14$), one-third were students, and the rest (12%) had graduated high school. In both groups, in order to secure high safety requirements necessary in VR experiments, we included the same specific inclusion and exclusion criteria, which were listed in the participant information sheet. The exclusion criteria were: (a) a history of epilepsy episode, PTSD, or other psychological disorder, (b) taking psychoactive medication, (c) having visible facial hair (important for facial EMG), (d) drinking two or more units of alcohol up to 6 h before the study. Participants were asked to sign the consent form acknowledging they had been aware of these

Fig. 1 UltimatumVR stages: embodiment (**a**) and training (**b**, **c**)

conditions. They were informed both verbally and in writing that they would be free to withdraw at any time without giving a reason for their decision. After the experimental procedure was over, the participants were debriefed about the purpose of the study. Catalans were rewarded 10€ per hour for their participation, and Polish received a cinema voucher of a comparable value[1] which they could have exchanged for any movie ticket in almost all cinemas in Warsaw in the following 6 months.

2.3 Overall procedure

Participants came to the laboratory at the agreed hour where a female experimenter greeted them and asked them to carefully read and sign the participant information sheet and informed consent form. They were informed that the study belongs to a series of studies exploring human behavior in immersive virtual reality and that the goal is to test a new game. Next, they were invited to the laboratory and instructed to sit in the indicated chair. The experimenter handed them the rules of the game to familiarize the participant with the experimental task. After that, the experimenter placed the electrodes to measure skin conductance, heart rate, and facial electromyography of three muscles: *corrugator supercilii, levator labii alaeque nasi*, and *zygomaticus major*. Next, the experimenter tested the quality of the signal, with a particular focus on the facial EMG electrodes. Then, the participant donned the head-mounted display, and the experimenter tested the EMG signal again. If any of the electrodes moved, the procedure was repeated until the signal was clear and the electrodes were placed correctly. In the next step, the experimenter recorded a baseline signal for five minutes and then the IVR experience began. After the experience, the participant was asked to fill in the questionnaires. Later, the experimenter talked with the participant about their feelings and impressions, and finally, they were debriefed about the goals of the study and given the compensation.

2.4 Procedure in VR

The UltimatumVR game was based on the classic economic decision-making game ultimatum, invented by Güth et al. (1982). The aim of the UltimatumVR game is to divide in each trial a hundred coins between the participant and the co-player, an EA. The environment was designed in a way to minimalize head movements and, therefore, avoid motion sickness. Moreover, to increase virtual body ownership, we located a mirror in the participant's field of view, so that they could see their virtual body throughout the virtual reality experience. They could also see the EA sitting on their left and touching their arm.

The game consisted of three parts: embodiment, training (Fig. 1), and the actual game (Fig. 2).

[1] In Poland, due to fiscal regulations, paying in cash was not possible.

Fig. 2 Left: high- and low-status embodied agent; right: the moment of touch of the agent

1. Embodiment. In the first step, we verified whether the participant could clearly see the environment. Then, the experimenter calibrated the participant's virtual body position. After calibration, the embodiment stage started. The participant could see the virtual room. Embodiment was accomplished using a synchronous visuomotor cue. A voice that the participant heard through the headphones instructed them to do simple physical exercises (moving head and arms) while looking at themselves in the mirror. Next, they were asked to pay attention and describe briefly what was surrounding them. These two elements built the illusion of body ownership and the presence.
2. Training. In the same room as previously, there was a woman (an EA) sitting on a stool on the participant's left. She gesticulated and maintained natural eye contact with the participant. Her task consisted of explaining to the participant how each button works and the rules of the game. To ensure the participant understood how to play, at certain points the virtual trainer asked them to perform an action (e.g., to accept or make an offer). She also touched the participant's arm and explained when and how both players could use the touch.
3. Game. The game consisted of eighteen trials grouped in two equal blocks. Block order was pseudo-randomly distributed between participants, while the trial order in each block was fixed. As in the original ultimatum game, when the offer was accepted, both players obtained what they agreed to and when it was rejected, none of the players received any points.

In the **P** trial, the participant played as the proposer. They saw the EA sitting next to them and waiting for their move. The instructions explained that they could either touch the EA or select the button "Do nothing" on the screen. The participant could move their arms freely throughout the experience, and their movements were tracked using the Vive controllers. The moment of touching the EA was accompanied by a vibration of the corresponding controller. After taking an action, on the screen the participant could see the EA's personal information. The instruction below indicated to choose the split the participant wanted to offer and confirm it. Then, after a short randomized time the EA reacted either by nodding and saying, "I accept the offer" or by shaking their head and saying, "I do not accept the offer." The responses were recorded by native Spanish and Polish speakers. Then, the scene faded to black and the next trial was loaded. The EA's responses were partially randomized, based on Güth and Kocher's review (Güth and Kocher 2014). The EA accepted all the offers above 50 for the EA. There was a 10% probability of accepting the offers below 35 and 50% probability of accepting offers between 50 and 35.

In the **R** trial, the participant played as the responder. After the scene loaded, the participant could see the EA's personal information as in the P trial. In the **touch** condition, the EA leaned slightly toward the participant and touched them briefly on their left arm. To ensure that the participant saw the EA touching them in the exact same place on their body where the vibrating band was located, inverse kinematics were applied. An inverse kinematic system computes, given a target point, the transformations for a three-joint chain. This provided a collection of transformations applicable to each of the EA's upper limbs in order to reach the participant's arm while maintaining the participant's freedom of movement. Simultaneously, the vibrating band would vibrate for 3 s, as long as the contact lasted. In the control condition, the EA simply sat and maintained eye contact at a rate of 70/30. The time of gaze was calculated by continuously monitoring the probability that the EA was looking at the participant with 70% chance and when it was below that level, the gaze was directed to the participant. When the participant could see the offer on the screen, they could decide whether to accept or reject it by selecting one of the buttons ("Accept the offer" or "Reject the offer"). The offer was partially pre-programmed and

belonged to one of three categories: *generous* (46–52 coins offered to the participant), *fair* (38–45 coins for the participant), or *unfair* (25–35 coins for the participant). Each time the new R trial loaded, the exact offer was randomly selected from the pre-programmed range. This way we maintained control over the offer's fairness in each trial while randomizing its final value. Shortly after the participant made a decision, the scene faded out and another one was loaded. After the last trial, the game automatically ended, and the data were saved.

2.5 Scales

All scales were included in the post-experimental questionnaire online.[2]

2.5.1 Manipulation check

To test whether the EAs were perceived as we planned, we displayed a picture of the EA for four seconds and asked three questions:

1. In your opinion, how low/high on a social ladder is this person? (agent's status) (0 *very low* to 100 *very high*);
2. In your opinion, how effeminate/masculine this person is? (masculinity) (0 *very effeminate* to 100 *very masculine*)
3. In your opinion, how attractive this person is? (attractiveness) (0 *very unattractive* to 100 *very attractive*).

Responses were slider-type questions to which the participants could answer on a 0 to 100 scale (Mauss and Robinson 2009). The order of EAs was randomized.

2.5.2 Virtual reality experience

To make sure that participants felt the virtual body was their body and that the EA was really playing with them, we measured two phenomena: social presence and embodiment.

Social presence. The social presence (SP) questionnaire (Bailenson et al. 2003) measured the strength of the illusion that we are co-present with others in the virtual environment. To the five items, the participant could respond on a Likert scale from 1 (*I strongly disagree*) to 5 (*I strongly agree*). The scale has high reliability (Cronbach's $\alpha = 0.91$).

Embodiment (EM). Embodiment is the illusion of virtual body ownership and the agency over that body. To measure embodiment (i.e., to which extent the virtual avatar replaced the participants' real body), we used a six-item questionnaire based on the scale published by Maselli and Slater (2013). Each question was scored on a Likert scale from -3 (*I strongly disagree*) to 3 (*I strongly agree*). The reliability (Cronbach's α) was 0.88.

2.5.3 Attitudes

Social status importance (SSI). SSI was a five-item own questionnaire measuring how much a person cares about his/her and others' social status and whether his/her behavior is modified depending on the status relationship with others. Items were scored on a Likert scale from 1 (*I strongly disagree*) to 5 (*I strongly agree*). The scale has been shown to be reliable (Cronbach's $\alpha = 0.84$) (see "Appendix").

Male homophobia. To control whether the participants present a homophobic attitude toward men, we used an adaptation of the attitudes toward lesbians and gay men (ATLG) subscale (Cárdenas and Barrientos 2008; Herek 1988). Attitudes towards gay men (ATG) contains ten questions to which the participant answered using a nine-point Likert scale from 1 (*I strongly disagree*) to 9 (*I strongly agree*). All scales without Polish and/or Spanish adaptation were translated by the authors and then consulted and proofread by natives in each language, respectively.

2.6 Materials and apparatus

2.6.1 Laboratory setup

The tactile feedback imitating the EAs touch was transmitted in both groups by the same vibrating band with a 3 V motor vibrator. The band was powered by Arduino Mega, which communicated directly with the virtual environment written in Unity version 2017.2. The models of EAs were designed in Adobe Fuse CC. The base consisted of one model of a man (Caucasian male), adopted to represent comparable levels of attractiveness and masculinity, but of different social status. The game was displayed both in Poland and in Catalonia on the HTC Vive head-mounted display (90 frames per second, 110 degrees field of view).

2.7 Statistical analyses

All results were calculated and plotted using Python 3.6 libraries: statsmodels, pandas, matplotlib, and numpy.

2.7.1 Manipulation check

We ran three ANOVAs with the ratings of EA's status, attractiveness, and masculinity as dependent variables and the culture (0—Catalan, 1—Polish), the EA (0—low-status EA, 1—high-status EA), and the interaction between them

[2] https://science.immergo.eu.

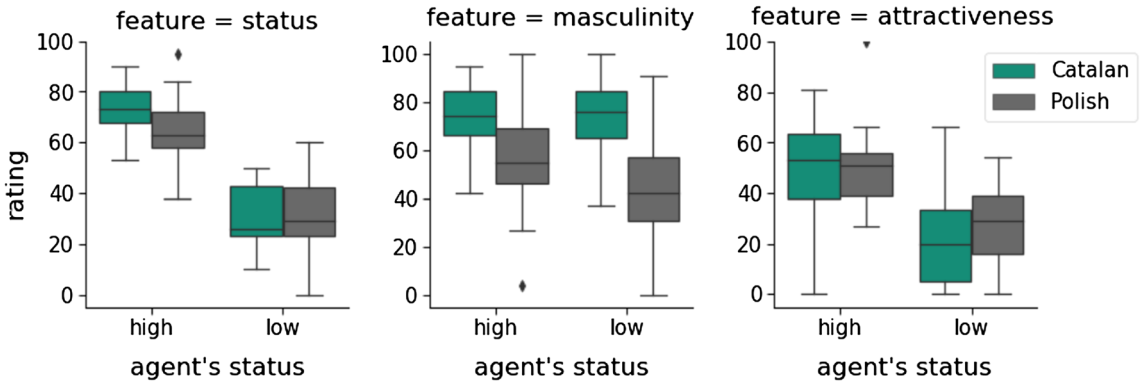

Fig. 3 Distribution of ratings of the social status, masculinity, and attractiveness of the EAs in the Polish and Catalan group

as independent variables to verify whether the status manipulation was successful and whether there are any cultural differences in perception of the EA.

2.7.2 Attitudes and IVR experience

We also ran separate ANOVAs to verify whether there are any group differences between Polish and Catalans in embodiment, social presence, male homophobia, and social status importance scores.

2.7.3 Compliance

To verify the joint influence of touch, EA's characteristics, and personal attitudes on compliance, we used the generalized estimating equation (GEE) model with global odds ratio covariates structure which fits the multilevel structure of collected data. The model consisted of 624 observations, which built 52 clusters. The independent variable in the model was the offer acceptance (1—accepted). The dependent variables were: the offered to participant value (0–100), the presence of touch (1—touch), the interaction between the offer and the touch, the group (1—Polish), the EA in each trial (1—high status), the interaction of touch, group, and EA, and the scores on two scales: (1) the ATG and its interaction with the group and with touch, and (2) the SSI and its interaction with the group and touch. All scores were standardized so that they all had a mean of 0 and a standard deviation of 1. The ATG, due to big group differences, was standardized to subgroup means (separately for Catalans and Polish).

2.7.4 Physiological measures

We report heart rate and skin conductance changes in "Appendix." Unfortunately, massive artifacts on the EMG signal, probably due to the weight of the HMD, meant that the results were inconclusive; therefore, these data are not reported.

3 Results

3.1 Manipulation check and descriptive statistics

We found a significant main effect of EA's perceived social status ($F(1,50) = 224.87$, $p < 0.001$, $\eta^2 = 0.68$) and no group differences. Both EAs were rated in line with the aim of the study. The second ANOVA verified whether the EAs seemed equally masculine. There was a significant effect of the group ($F(1,50) = 48.52$, $p < 0.001$, $\eta^2 = 0.31$) and the interaction between the EA and the group ($F(1,50) = 4.13$, $p = 0.045$, $\eta^2 = 0.03$). Catalans assessed both EAs equally highly masculine and Polish rated the high-status EA as slightly effeminate and the low-status EA as effeminate, although the effect size was very small (Fig. 3).

There was a significant effect of EA on attractiveness, with the high-status EA seen as more attractive in both groups ($F(1,50) = 46.87$, $p < 0.001$, $\eta^2 = 0.32$). Unfortunately, this might have influenced the results, but since usually people of higher status are perceived as more attractive, this effect was difficult to avoid (Frevert and Walker 2014).

The ANOVA results yielded no group differences between Polish and Catalans in the strength of the virtual reality experience, nor in the SSI (Table 1).

Both groups reported strong embodiment and satisfactory social presence illusion. The Polish group scored significantly higher on the ATG scale, which is in line with the European Social Survey (2016) and Doliński (2010, 2013). None of the variables correlated with each other.

3.2 Fairness

In the first step, we verified whether the participants played the UltimatumVR with the EAs as if they probably would

Table 1 Means, standard deviations for questionnaires, and ANOVA results for between-group differences

Questionnaire	Catalan		Polish		$F(1,50)$	η^2
	M	SD	*M*	SD		
EM	1.31	.93	.80	1.18	2.99	
SP	2.84	.81	2.69	.83	.47	
ATG	2.17	1.37	4.89	2.26	30.61	.38***
SSI	2.41	.87	2.60	.72	.75	

***$p < .001$, *EM* embodiment, *SP* social presence, *ATG* attitudes toward gays, *SSI* social status importance

Table 2 GEE model—predictors of compliance

Effects	Coefficient	Wald ξ^2	*df*	*p*	97.5% CI for Exp(B)	
					Lower	Upper
Intercept	− 10.60	40.52	1	< .001	− 13.86	− 7.34
Offer	.24	37.90	2	< .001	.16	.32
Touch	− .62	.10	2	.751	− 4.47	3.23
Offer × touch	.02	.15	4	.700	− .07	.11
Agent	.36	.93	2	.336	− .37	1.09
Touch × agent	− .11	.06	4	.814	− .99	.77
Group	− .49	1.08	2	.298	− 1.42	.44
Touch × group	1.29	6.56	4	.010	.30	2.28
Agent × group	.54	1.06	4	.303	− .49	1.57
Touch × agent × group	− 1.20	2.40	8	.122	− 2.73	.32
ATG	− .38	3.77	1	.052	− .77	.00
Touch × ATG	.21	1.99	2	.158	− .08	.50
Group × ATG	1.31	14.80	2	< .001	.64	1.98
Touch × group × ATG	.09	.04	4	.845	− .77	.94
SSI	.12	.32	1	.571	− .31	.56
Touch × SSI	− .12	.61	2	.435	− .41	.18
Group × SSI	− .19	.29	2	.592	− .90	.51
Touch × group × SSI	− 1.05	7.92	4	.005	− 1.78	− .32

OR odds ratios calculated for dichotomous variables = 0, *ATG* attitudes toward gays, *SSI* social status importance, *EM* embodiment, *SP* social presence

with humans. This implied they would make rather fair offers (60 participants/40 EAs) because of altruism and/or fear of being punished for playing greedily (Fehr and Gächter 2000). On average, in both groups, the participants offered 44 coins to the high-status EA in both groups. Catalans offered on average 46 coins to the low-status EA and Polish offered 43. These results support the conclusion that even though the participants knew they were playing with EAs and not humans, they still wanted to play fair by sharing almost half of the coins.

In the next step, we analyzed the acceptance of offers proposed to the participants by the EAs. We found a rather low acceptance rate, probably due to the fact that the most generous offers from the EA remained close to 50/50 split with maximal offer for the participant at 52 points (Table 2, "Appendix").

Table 3 The acceptance rate of offers made by the EA in Catalan and Polish group

Agent	Group	Touch			
		No		Yes	
		N	% *M* (SD)	*N*	% *M* (SD)
High status	Catalan	81	32.10 (46.98)	81	46.91 (50.22)
	Polish	75	36.00 (48.32)	75	46.67 (50.22)
Low status	Catalan	81	24.69 (43.39)	81	46.61 (50.22)
	Polish	75	20.00 (40.03)	75	49.33 (50.33)
Total		312	35.26 (47.85)	312	40.38 (49.15)

M mean, *SD* standard deviation

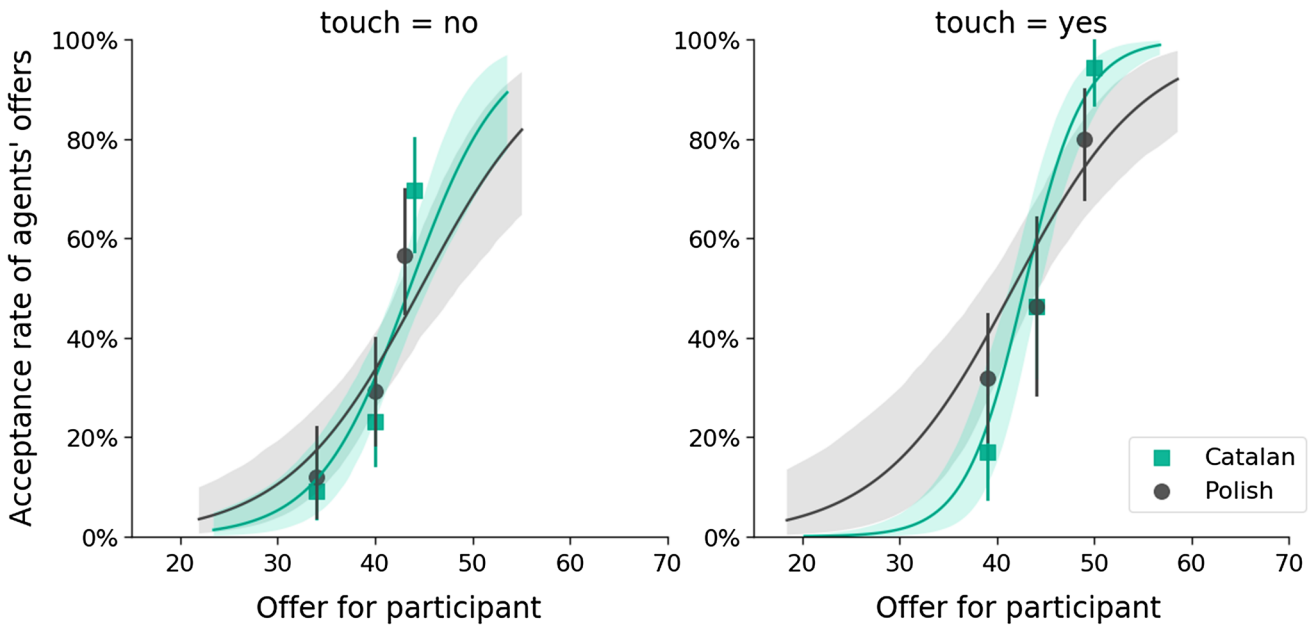

Fig. 4 Influence of the offer's value and touch on acceptance of EAs' offers in Polish and Catalan men. Points mark the acceptance rate at three levels of the independent variable; the error bars mark confidence interval of 95%

3.3 The joint influence of a touch, social status, and attitudes on compliance

We found a significant effect of the offer: The higher the offer, the more likely it was to be accepted. Moreover, there was a significant interaction between touch and group, touch, group, and social status importance, and homophobia and group (Table 3).

After being touched, the acceptance of the EA's offer increased by 20%. Moreover, there was an interaction with group: In control trials, the acceptance raised proportionately to the offer's value in both groups. Meanwhile, in touch trials, the chances for accepting the offer by Catalan men were lower than by Polish men for unfair offers and higher (up to 100%) for more generous offers (Fig. 4).

Although we did not find a significant direct influence of the EA's social status characteristics on compliance, touch also had interactional influence with social status importance and group. After being touched, Polish men, who value social status more, were less keen on accepting offers from the EA. Meanwhile, Catalans accepted the offers regardless of how important social status is for them (Fig. 5).

We found also a significant interaction between homophobia and group. In the Catalan group, where homophobia was significantly lower, participants with stronger prejudice were less keen to accept the EA's offer. Surprisingly, the effect in the more homophobic Polish group was reversed: The stronger the prejudice, the higher the acceptance of offers (Fig. 6).

4 Discussion

Our study explored the joint influence of social status, personal attitudes, and culture in a contact and open versus a noncontact and homophobic culture on the efficiency of the virtual Midas touch effect.

Compliance depended mainly on the value of the offer proposed by the embodied agent, which replicates previous findings on the virtual Midas touch effect in the ultimatum game (Harjunen et al. 2018). The study also shows that a brief touch by the embodied agent increases compliance in men, which confirms H1, and that this effect is modified by the interactional influence of culture and social status importance. Although the facade status of EA did not matter, the status importance modulated compliance. We also observed an interactional effect of culture and prejudice toward homosexual men on compliance, even though the scores on the ATG scale were standardized to group means. This partially confirms H3, since in Poland, stronger prejudice predicted higher compliance, while in Catalonia stronger prejudice predicted lower compliance. We found a small effect of interactional influence between touch and culture. It seems that for small offers, touch did not make Catalan men as compliant as Polish men, while for more generous offers, the effect was reversed. Polish men seemed to accept all offers equally more frequently after being touched. Furthermore, our data do not support H2, which stated that the facade social status of the EA, represented by his apparel and profession, moderates the strength of the Midas touch

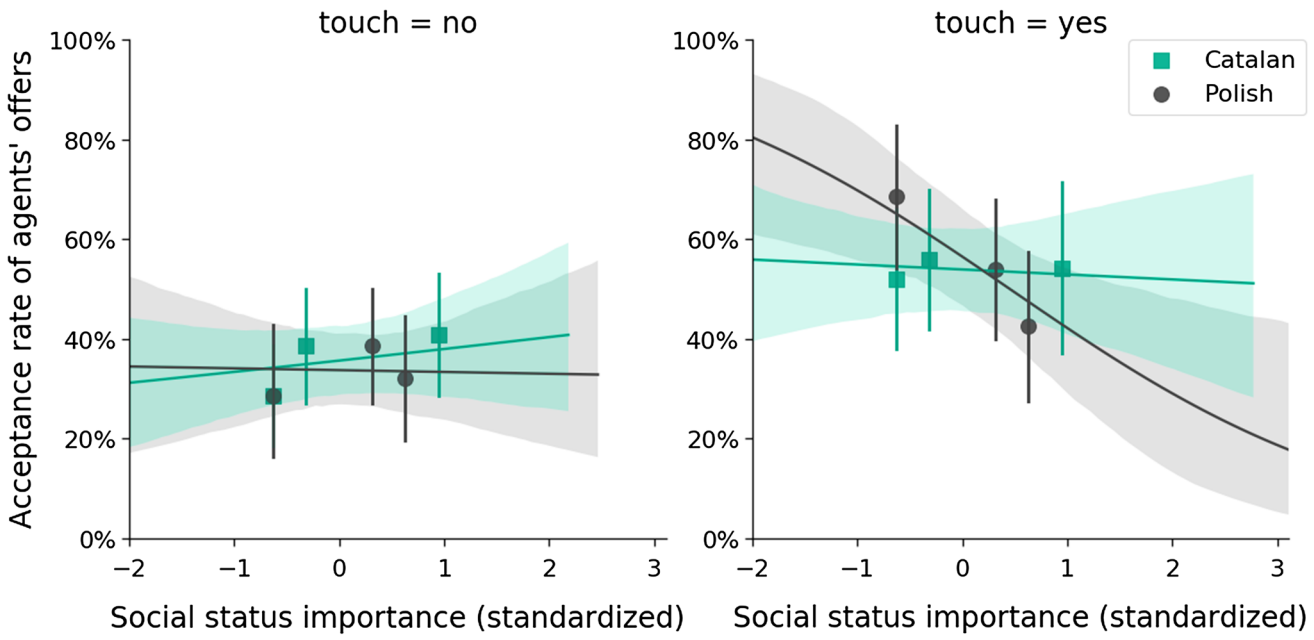

Fig. 5 Influence of social status importance and touch on acceptance of EAs' offers in Polish and Catalan men. Points mark the acceptance rate at three levels of the independent variable; the error bars mark confidence interval of 95%

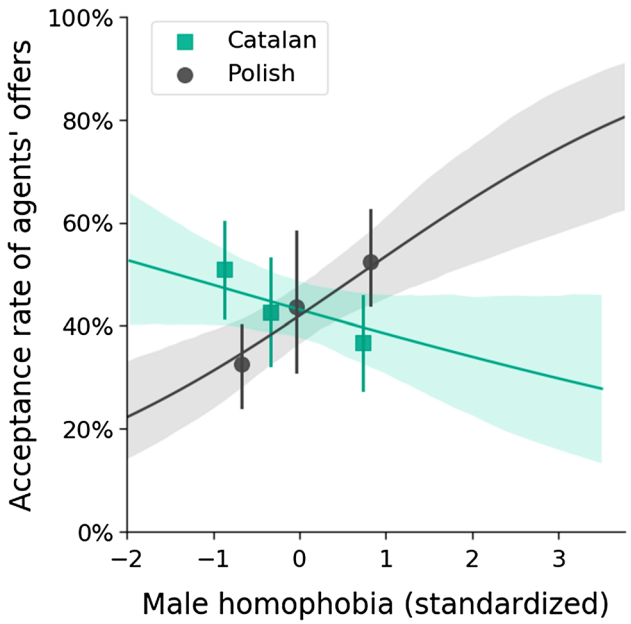

Fig. 6 Influence of homophobia on acceptance of EAs' offers in Polish and Catalan men. ATG scores werre standardized to group means; points mark the acceptance rate at three levels of the independent variable; the error bars mark confidence interval of 95%

effect. Both Polish and Catalan men treated the high- and low-status agents equally.

In Catalan group, men were equally compliant in touch and in control group regardless of their social status importance. Interestingly, touch was making men who strive social status less compliant than the ones who do not value it that much. This effect was not present in control trials. Social status is a value which people try to gain even if it does not bring any further benefits. This effect is also tied closely to cultural and gender differences with people from high-power distance cultures being more likely to perceive social status as an intrinsic value and willing to trade off some material gain to obtain it (Huberman et al. 2004). In our study, however, even though Poles and Catalans reported comparable levels of social status importance, only Poles changed their behavior after being touched: Those who do not value social status became more compliant and those who do chose none over small gain.

Polish and Catalan cultures differ on many levels. Polish men use social same-gender touch rarely compared to Catalans. Moreover, Poles and Catalans use distinct logics; it is honor and dignity (Leung and Cohen 2011). These two kinds of cultures are characterized by different negotiation styles, and that may influence the results of the ultimatum game. In cultures of honor, social status can be gained or lost in direct competition (Leung and Cohen 2011; Aslani et al. 2016). Since Polish culture is driven by logic of honor, we can hypothesize that Polish men, for whom social status is particularly important, behaved more competitively if they felt that the agent used touch to put pressure on the participant (Nasierowski and Mikula 1998; Szmajke and Kubica 2003). This seems very probable when we consider that hand touch in particular is associated with a gesture of dominance (Dibiase and Gunnoe 2004). At the same time, in dignity cultures, present mostly in Western Europe and the USA, since self-worth

is inalienable, negotiation outcome does not influence one's self-worth. Thus, individuals negotiate usually in a more egalitarian and cooperative manner (Aslani et al. 2016). We can argue that Catalan men behaved in a manner that is typical of a dignity culture, and therefore, social status importance did not play any role in the context of touch. Moreover, shortening the personal distance in order to touch the co-player was probably seen as non-intrusive by Catalan men, who live in contact culture, in contrast to Polish men who might have felt uncomfortable since Polish culture is a noncontact type (Sorokowska et al. 2017). Since Catalan culture remains heavily underinvestigated separately from Spanish culture, we see a need to investigate further this topic.

Our study demonstrated a relationship between homophobia, culture, and compliance. In Catalonia, stronger prejudice predicts lower compliance, while in Poland, it increases the chances of compliant behavior. This result seems to be paradoxical and contradicts the findings of Doliński (2013). We cannot exclude the possibility that a small sample size skewed the results. Nonetheless, the effect seems rather robust even though the scores were standardized to group means and therefore we would like to offer another explanation. In men, social status and attractiveness are correlated (Anderson et al. 2001). Additionally, more attractive people and agents are more persuasive (Debevec et al. 1986; Holzwarth et al. 2006). At the same time, male homophobia is often linked to secret/unconscious attraction to the same gender (Adams et al. 1996; Cheval et al. 2016). Therefore, an indirect effect of attractiveness could have evoked higher compliance. We may speculate that these Polish men, who presented a discrepancy between explicit homophobic attitude and implicit attraction to same gender, were more positively influenced. In the Catalan group, this discrepancy did not occur. It is crucial to notice that this is a speculative hypothesis and requires further studies with larger sample sizes.

Our findings also shed new light on compliance with agents in the ultimatum game. In our study, men accepted offers from both high- and low-status agents in the same way. Meanwhile, for example, Blue et al. (2016) reported that participants assigned to low status accepted lower offers. Moreover, Bratanova et al. (2016) showed that people primed to feel poor play along a fairness rule, while those primed to feel rich tried to pursue their own benefit over their opponent. We did not manipulate the participant's status directly but only by comparison with the EA and did not observe any differences in treatment of the high- and low-status EA. Future studies should include the manipulation of participant's social status in IVR. We know already that having a virtual body that is distinct from one's own, for instance with different age, gender, or skin color, can influence deeply one's cognition and behavior (Banakou et al. 2013; Maister et al. 2015; Hasler et al. 2017). Embodiment as a person of low or high social status may bring new interesting views on compliance and generosity and their relationships with inequalities.

Furthermore, this study strengthens the evidence of the virtual Midas touch effect in the context of human–computer interaction. A long line of research, extending from the 1990s, on anthropomorphizing of computers has provided convincing evidence that people usually treat virtual agents similarly to other humans, and that this phenomenon applies also to economic decision-taking games. For example, Spapé et al. (2015) compared the influence of touch on compliance and generosity in three conditions: when the participant was told he/she plays with a computer, with a stranger, or with a friend. They did not find group differences at a behavioral level. In our study, participants were not explicitly told whether they were playing with a human or a computer. Nevertheless, most of them admitted during the debriefing that they suspected they played with an EA and not a human. Our results replicate the effect of virtual touch and confirm that even a simple vibrating band together with congruent visual cues is enough to evoke a robust sensation of touch. Even though informed during placement of the equipment that the vibrating band on their arm served to mediate touch, some of our participants shared the opinion that the touch seemed very realistic and several even asked whether it was an experimenter touching them.

One of the possible limitations of the study was that the reward was of a fixed value. We have no data to support that if participants had played with "real" money instead of abstract coins, they would have acted differently. Also, the touch was delivered by a vibrating band, which lacks the warmth and softness of human skin. Nevertheless, as van Erp and Toet (2015) claim: "[S]ocial touch is quite robust to degradations and it may not be necessary to mediate all physical parameters accurately or at all." Another important shortcoming of this study is that we analyzed only male participants interacting with male embodied agents. We decided not to include women in this study due to clear gender differences in social touch, and we believe a separate study on this phenomenon is needed.

This study is novel in several ways. Thus far, the literature only fragmentarily analyzed the influence of cultural and social factors on the efficiency of the classic Midas touch and not at all in the context of the virtual Midas touch. To our knowledge, only one study included personality traits as variables which influence the virtual Midas touch (Harjunen et al. 2018). Furthermore, IVR as a medium is heavily understudied from the perspective of cultural psychology. A rapidly globally growing number of IVR applications, including those using mediated touch, create an urgent need for in-depth studies including sociocultural and attitudes. Our findings contribute to the psychology of masculinity and male homophobia by demonstrating that prejudice may affect male economic decision making, even when the co-player is only a virtual embodied agent.

To summarize, this study aimed to grasp simultaneously the individual and cultural factors influencing the efficiency of the virtual Midas touch. We demonstrated that social status importance modifies the influence of touch differently in Polish and in Catalan cultures. We found a simple effect of the offer's value and an interactional effect of touch and culture, and of culture and homophobia, with more homophobic Poles being more compliant and more homophobic Catalan being less compliant. Overall, our study indicates that virtual reality is a convenient tool for investigating cultural and individual differences and its joint influence on one's proneness to social influence. It also highlights the importance of considering culturally sensitive elements in the process of designing virtual embodied agents and virtual environments.

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Author contributions All authors contributed to the study conception and design. Material preparation, data collection, and analysis were performed by Justyna Świdrak, Grzegorz Pochwatko, Xavi Navarro, and Laura Osęka. The first draft of the manuscript was written by Justyna Świdrak, and all authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.

Compliance with ethical standards

Conflict of interest The authors declare that there are no conflicts of interest regarding the publication of this paper.

Ethical approval The study was approved by the University of Barcelona and the Institute of Psychology, Polish Academy of Sciences ethics committees.

Appendix: Scales

Table Social Status Importance (SSI)

English	Polish	Spanish
High social status is important to me	Wysoki status społeczny jest dla mnie ważny	Un alto estatus social es importante para mí
I have chosen my educational and/or professional path mainly due to its prestigious character	Wybrałem moją ścieżkę edukacji i/lub zawód głównie ze względu na ich prestiżowy charakter	Yo elegí mi trayectoria educativa o profesional principalmente debida a su prestigio
I show particular respect to people higher than me	Osobom postawionym wyżej ode mnie okazuję szczególny szacunek	Para las personas de posición más alta que la mía muestro un respeto especial
I treat everyone in the same way, regardless whether they stand higher or lower than me on the social ladder	Każdgo traktuję tak samo, niezależnie od tego, czy stoi na drabinie społecznej wyżej czy niżej niż ja*	Trato cada persona de la misma manera, independientemente de que estén en la escala social más alta o más baja de lo que esté yo
1—I strongly disagree	1—zdecydowanie się nie zgadzam	1—totalmente en desacuerdo
5—I strongly agree	5—zdecydowanie się zgadzam	5—totalmente de acuerdo

Psychophysiological reaction to touch

Data analysis

We used the BIOPAC MP150 system with a set of amplifiers: GSR100C, 3xEMG100C, BioNomadix BN-ECG, and RSP100C for recording the skin conductance, heart rate, and facial electromyography signal. Event markers were recorded by the UIM100C module. Statistical models were run in SPSS 25, and plots were prepared in Python's seaborn library.

Skin conductance

A low-pass filter of 10 Hz and a 0.5 Hz high-pass filter were used to clean the signal. The record was pre-examined, and artifacts were corrected (Benedek and Kaernbach 2010). Next, it was divided into six 1-second-long epochs: one before the marker (baseline) and five after it. The epochs were standardized by subtracting the baseline value and dividing by the standard deviation.

Heart rate

We applied to the raw heart rate signal a low-pass filter 35 Hz, 50 Hz and high-pass filter 1 Hz. It was divided into six 1-second-long epochs: one before the marker (baseline) and five after it. In the end, each epoch was baseline-corrected. Both skin conductance and heart rate were analyzed with two general linear models with repeated measures. In each model, the factor consisted of five baseline-corrected epochs after the marker; the between-subject factors were: group (0—Catalan, 1—Polish), agent (0—low status, 1—high status), and touch or its absence (0—no touch, 1—touch).

Electromyography

A visual analysis of the signal yielded massive artifacts. To avoid a risk of drawing false conclusions, we decided to exclude EMG analysis from the manuscript.

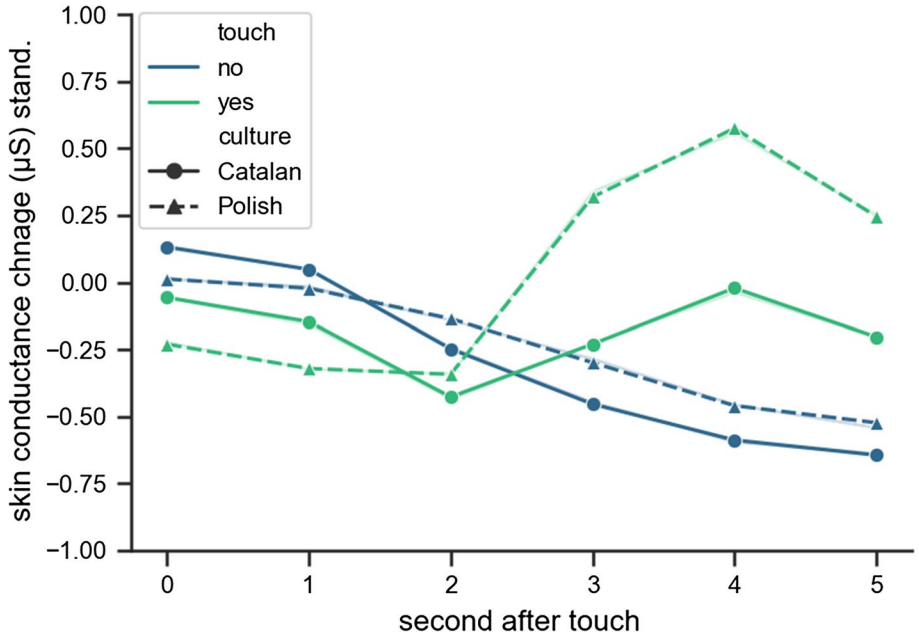

Fig. 7 Changes in skin conductance in reaction to touch in Polish and Catalan men

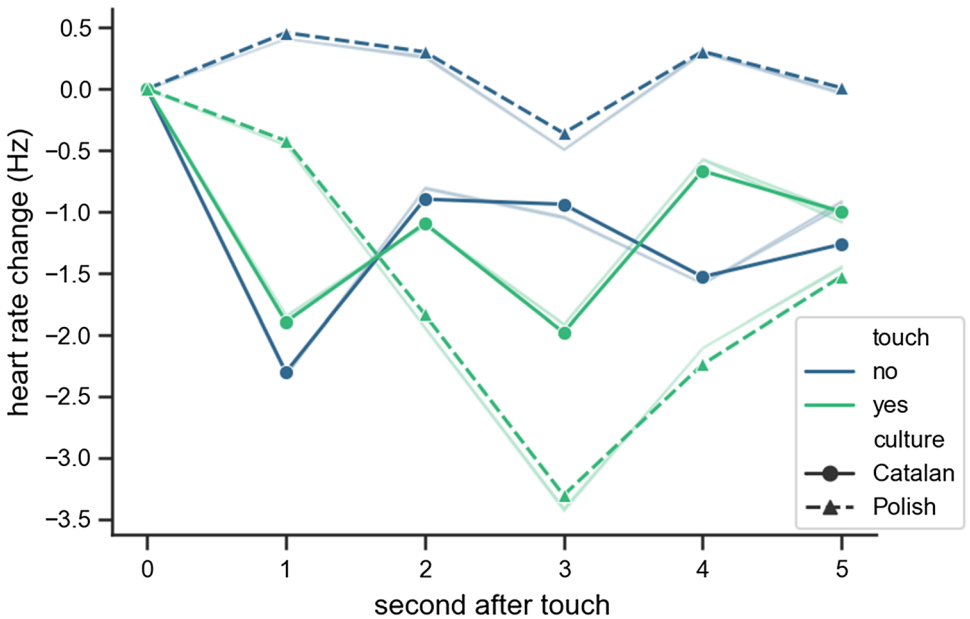

Fig. 8 Changes in heart rate in reaction to touch in Polish and Catalan men

Results

Skin conductance

Since the Mauchly's sphericity test was significant ($p < .001$), we applied the Greenhouse–Geisser correction. We found a significant change in skin conductance ($F(2.24,1000) = 9.05$, $p < .001$). Moreover, there were significant interactions with group ($F(2.24,1000) = 10.80$, $p < .001$) and touch ($F(2.24, 1000) = 46.6$, $p < .001$) (Fig. 7).

Calculated for the fourth epoch, ANOVA demonstrated a significant effect of group ($F(1,575) = 25.95$, $p < .001$), touch ($F(1,575) = 37.11$, $p < .001$), and their interaction ($F(1,575) = 8.13$, $p = .005$). Polish men reacted with the highest increase in skin conductance 4 s after the touch started. Catalans also reacted to touch of the EA but the effect was smaller.

Heart rate

There were no significant changes on heart rate (Fig. 8).

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