Article

Effect of Gaze on Personal Space: A Japanese–German Cross-Cultural Study

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Abstract

In East Asian cultures, people maintain larger interpersonal distances than in European or American cultures. We investigated whether a preference for averted gaze might be responsible for this difference. Typically, when measuring interpersonal distance, participants are asked to maintain eye contact. This request might bias findings due to cultural differences in the interpretation of direct gaze. We had Japanese and German participants adjust preferred interpersonal distance in a standardized laboratory task, using averaged faces with straight-ahead or averted gaze direction. In line with previous findings, Japanese participants preferred overall larger interpersonal distances, and female–female dyads preferred the smallest distances. In contrast, there was no pervasive effect of gaze on interpersonal distance, as confirmed with Bayesian statistics. Thus, differences in the reactions to mutual gaze cannot explain the cultural preferences for interpersonal distance.

Keywords

personal space, interaction distance, gaze, averaged faces, cross-cultural, German, Japanese

Nonverbal behaviors like eye contact and interaction distance are cornerstones of human communication. Their regulation is typically accomplished with ease, but difficulties may arise in intercultural communication (Martin & Nakayama, 2010). For instance, in some cultures, the preferred level of eye contact and interpersonal distance may differ substantially from levels common in other cultures (Hasler & Friedman, 2012). This may lead to discomfort in social situations where members of different cultures interact.

Cultural Differences in Personal Space

Gestalt psychologists have provided the first documented attempts to conceptualize action possibilities in terms of a force between the acting person and the objects of potential actions (see,

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for example, the field theory developed by Kurt Lewin, 1936, exploiting mathematical ideas of topology). In the 1960s, this idea was then taken up in more or less qualitative terms in the research field of proxemics. Anthropologist Edward Hall (1966) posited an invisible, protective bubble around the individual, a portable territory (Sommer, 1969), which—if intruded—leads to discomfort and arousal.

Hall (1966) defined four categories of interpersonal distance according to their level of intimacy: *intimate space* (0-50 cm), *personal space* (50-120 cm), *social space* (120-360 cm), and *public space* (>360 cm). Although *personal space* referred to only one of these categories, the term is nowadays often used interchangeably with *interaction distance* (see Bechtel, 1997). An informal bibliometric analysis on PsycINFO for the term *personal space* revealed that the topic had its publication peak in the late 1970s (508 publications between 1975 and 1980), with a renewed interest during the last 15 years, reaching a new high point between 2011 and 2015 (334 publications). More recent studies extended the classical research to clinical populations (e.g., Schienle, Wabnegger, Schöngassner, & Leutgeb, 2015; Schoretsanitis, Kutynia, Stegmayer, Strik, & Walther, 2016), neural correlates (e.g., Holt et al., 2014; Schienle, Wabnegger, Leitner, & Leutgeb, 2017), and virtual reality as a new paradigm for the assessment of interaction distance in highly controlled environments (e.g., Bailenson, Blascovich, Beall, & Loomis, 2001; Park et al., 2009).

The investigation of personal space classically involved the measurement of interpersonal distance in a number of different ways. Field studies employed unobtrusive observation and staged space invasions by confederates. Laboratory studies included (a) covert observation in staged experiments; (b) unconcealed measurement where participants assumed a preferred distance from the experimenter, a confederate, or another participant; (c) projective tests using drawings, figures, or silhouettes; and (d) measurement of the distance toward inanimate objects such as dolls, virtual humans, or pictures (Sommer, 2002; for methodological discussions see also Hayduk, 1983).

Gender differences following a pattern that male–male dyads prefer larger distances than male–female and female–female dyads are frequently cited in the personal space literature. However, the evidence is mixed. According to Hayduk (1983), of all studies conducted until 1982, merely 25% found gender differences, 26% found no gender differences, and 49% were inconclusive. A meta-analysis revealed a small effect of gender, which was highly dependent on decade, culture, and measurement technique (Daigle, 1996). Problematically, gender is highly confounded with body height, which in turn is correlated with interaction distance (Caplan & Goldman, 1981; Hartnett, Bailey, & Hartley, 1974).

Cross-cultural differences have been implicated from the beginnings. For instance, Hall suggested a distinction between contact and noncontact cultures; categories borrowed from the observation of proximity behavior in different animal species. Contact cultures are defined as preferring closer distances, whereas noncontact cultures prefer larger distances (Baldassare & Feller, 1975; Hall, 1966). Some authors have also used additional dimensions like body orientation, speaking volume, and eye contact to characterize the two groups (e.g., Watson, 1970). East Asian cultures are considered to be extreme noncontact cultures compared with Northern European and North American cultures (Hasler & Friedman, 2012). Most recently, Sorokowska et al. (2017) have conducted a large international survey to assess preferred interpersonal distance in many nations. Based on a paper-and-pencil illustration, their participants chose the preferred distance toward an acquainted person to range on average from 60 cm (in Argentina) to about twice this distance (in Hungary). Collett (1971) demonstrated that Englishmen trained in Arab nonverbal behavior—which they took to involve close interpersonal distance, maintenance of eye contact, and frontal body orientation—were viewed more favorably by Arabic raters after a brief conversation, compared with an untrained control group. Similar results have been reported by Dew and Ward (1993), demonstrating the practical utility of knowledge about cross-cultural differences in communication.

Sussman and Rosenfeld (1982) found that Japanese dyads sat farther apart than American and Venezuelan dyads, confirming the idea of Japan being an extreme noncontact culture. Beaulieu (2004) tested participants with different nationalities and measured their preferred seating distance to a European confederate at an academic conference. Asian participants chose larger distances than Caucasians and Latinos. Hasler and Friedman (2012) used a virtual environment to compare European (mostly Swiss and German) with East Asian (mostly Chinese) participants. They found that Asian dyads preferred greater virtual distances than did Europeans, although the average distance of mixed dyads did not differ from European dyads. Thus, there is evidence that people from East Asia prefer larger interpersonal distances, but it is not clear why. It could be that they have a lower intrusion threshold, or it could be that there are environmental or cultural factors influencing their distance regulation. One such factor could be gaze preference. The measurement paradigm of interpersonal distance often forces mutual gaze, which may be appreciated differently in different cultures.

Personal Space and Gaze

Equilibrium theory states that during interactions, people strive for a context-specific, individually determined level of intimacy, marking an equilibrium between approach and avoidance tendencies toward another person (Argyle & Dean, 1965). Situational intimacy is seen as a function of verbal and nonverbal behaviors like interpersonal distance, eye contact, body orientation, amount of smiling, and conversation topic. If, for instance, person A shifts the level of situational intimacy away from person B's aspired intimacy level by increasing eye contact, person B can restore equilibrium by increasing the interpersonal distance or choosing a more averted body orientation. The theory has received substantial empirical support regarding the compensatory relationships between interaction distance, eye contact, and body orientation (Patterson, 1973).

In other words, people can increase eye contact to compensate for inappropriately large interpersonal distance, and vice versa. This would explain Aiello's (1977) data with a roughly linear increase of the amount of eye contact with interpersonal distances between 76 and 320 cm in male participants. In female participants, the same parameters produced an inverted *U*-shaped relationship. The author interpreted these findings to reflect a communicational withdrawal of female participants when they perceived the interaction distance to be uncomfortably large. Similar findings emerged for virtual environments (Bailenson et al., 2001; Wieser, Pauli, Grosseibl, Molzow, & Mühlberger, 2010). In addition, equilibrium theory offers a framework to explain cultural differences by linking motivational forces to nonverbal communication behavior. For example, one study has shown that approach motivation is less pronounced in Japanese compared with U.S. Americans (Hamamura, Meijer, Heine, Kamaya, & Hori, 2009).

Watson (1970) reported cultural differences in the amount of direct gaze used in conversations, with noncontact cultures preferring less eye contact. Thus, it is possible, however, that the farther interpersonal distances preferred by Japanese observers is due to a similar withdrawal in the face of eye contact forced upon them by the experimental paradigm typically used.

To address this issue, we tested whether direct gaze has a differential effect on personal space in German and Japanese samples. Contrasting these two cultures is particularly of interest, as they differ in their cultural meaning of direct gaze in communication. In Germany, it is widely believed that eye contact during conversations is an expression of politeness (Nees, 2000; Watson, 1970), whereas the opposite is true for Japanese culture (Akechi et al., 2013; Argyle, Henderson, Bond, Iizuka, & Contarello, 1986; Hawrysh & Zaichkowsky, 1990; Watson, 1970).

In our experimental paradigm, we asked participants to enter a room and choose a comfortable interaction distance toward an unfamiliar person, as typical for a situation when asking a stranger for directions. The unfamiliar person was indicated by printed pictures of human models presented to the participant at matched eye-height. We created averaged faces of Caucasian and East

Asian male and female models to test the effects of race[1] and gender. We hypothesized that Japanese participants prefer larger interaction distances than Germans and that participants' nationality moderates the effect of gaze. This question is also addressed using Bayesian statistics. Furthermore, we hypothesized that both German and Japanese observers prefer smaller distances toward own-race faces, reflecting a preference for in-group members (Leibman, 1970; Novelli, Drury, & Reicher, 2010; Willis, 1966), and that women of both cultures prefer smaller distances, specifically when viewing female faces (Hayduk, 1983).

Finally, we asked participants to guess the nationalities of the presented faces and assessed their preconceptions concerning the spacing behavior of the named nationalities. We did this to explore whether effects of nationality and gender on interpersonal distance are paralleled by similar effects on distance stereotypes (e.g., Japanese might prefer smaller distances toward Caucasian faces and also expect Caucasians to stand too close). Expectation theory (Burgoon & Jones, 1976) posits that expectations about social norms are a main determinant of personal space evaluations. For example, small distances might lead to discomfort for an individual in a formal conversation, but might be completely benign in another social context, where small distances represent the norm, for example, in a crowded train. It is therefore plausible that expectations about another person's personal space preferences, based on a cultural stereotype, influence one's own behavior toward that person.

Method

Participants

The sample comprised 40 German (21 females) and 42 Japanese (19 females) adults. All German participants were students of Mainz University; all Japanese participants were students of Kyoto University. Inclusion criteria were that participants and their parents had German/Japanese nationality, spoke German/Japanese as their first language, and had not lived in another country for more than 12 months at a time. Table 1 contains statistics of age and height separated by nationality and gender. Males were on average 8.3 cm taller than females, $F(1, 78) = 51.1$, $p < .001$, $\eta_p^2 = .40$, and Germans were 9.5 cm taller than Japanese, $F(1, 78) = 64.7$, $p < .001$, $\eta_p^2 = .45$. There was no significant interaction of gender and height, $F(1, 78) = 0.01$, $p = .757$, $\eta_p^2 = .00$. Participants were asked to rate their experience communicating with people from other cultures on a 6-point Likert-type scale, ranging from *very low* to *very high*. Germans rated themselves as significantly more experienced than Japanese, MG = 4.0 cm, SDG = 0.9; MJ = 2.6 cm, SDJ = 1.4; $t(72.2) = 5.4$, $p < .001$, $g = 1.18$. In both samples, between 7% and 8% reported they have studied in a foreign country for at least 3 months.

Stimuli and Design

The stimuli were neutral portrait photographs of East Asian and Caucasian male and female models, who were students of Kyoto University. All models of the East Asian category were of Japanese nationality; models of the Caucasian category were of German, Swedish, French, and Dutch nationality. Their age ranged between 20 and 27 years. For each of the four combinations between race and gender, we obtained six models. Pictures were taken once with direct gaze into the camera and once with gaze direction averted 10° downward. The degree of downward gaze deflection was chosen to be directed toward the participant but outside the range of mutual gaze (see Gamer & Hecht, 2007).

Rather than presenting six images per category, we presented one original face and an average of the remaining five faces in each category. This resulted in 2 (normal vs. averaged) × 2 (Asian vs. Caucasian) × 2 (male vs. female) = 8 different faces. Every participant saw these eight faces,

Table 1. Descriptive Statistics for Age and Height Separated by Nationality and Gender.

	German		Japanese		Total	
Gender/variable	*n*	*M* (*SD*)	*n*	*M* (*SD*)	*n*	*M* (*SD*)
Female						
Age	21	26.1 (7.4)	19	21.3 (1.8)	40	23.8 (6.0)
Height	21	171.7 (7.4)	19	161.1 (4.2)	40	166.7 (8.0)
Male						
Age	19	26.7 (6.0)	23	22.0 (2.6)	42	24.2 (5.0)
Height	19	180.4 (5.4)	23	170.6 (5.4)	42	175.0 (7.3)
Total						
Age	40	26.4 (6.7)	42	21.7 (2.3)	82	24.0 (5.5)
Height	40	175.8 (7.8)	42	166.3 (6.8)	82	170.9 (8.7)

Note. Height in cm.

either with direct or averted gaze, depending on the experimental condition to which they were assigned. We created the averaged faces to minimize the necessary number of trials while preserving generalizability. For every category, one model was randomly chosen and the pictures of the remaining five models were averaged using the software psychomorph 2.0 (Benson & Perrett, 1993). The averaged faces are depicted in Figure 1. The faces were scaled to a height of 24 cm, measured from the bottom of the chin to the top of the head, and printed on DIN A3-sized paper. During the experiment, the pictures were mounted on a magnetic board (width: 123 cm, height: 194 cm) such that the eyes of the portraits could be aligned with the participant's standing eye-height. Dimensions of the experimental room in Kyoto were approximately 5.0 m × 2.7 m; dimensions of the experimental room in Mainz were approximately 5.2 m × 3.2 m.

Procedure

Participants were tested either in a direct gaze or an averted gaze condition to conceal the purpose of the study. They were randomly assigned to one condition, counterbalanced for nationality and gender. All verbal and written instructions were given in Japanese or German, respectively.

Next, eye and body height of the participants was measured, as was shoe size. We used the shoe size to estimate the vertical center of the participant, which we took to correspond to the center of the shoe. The pictures were mounted at the participants' eye-height on the magnetic board. A rectangular black cloth (width: 55 cm) below the picture indicated a human body.

The participants then received written instruction to step into the experimental room and to imagine a situation where they had just met the person in the picture and needed to communicate, such as asking her or him for directions in an otherwise unpopulated space like a corridor of their University. Participants were to approach the picture and stop at a distance that felt most appropriate (*angenehm, futsuu* 普通) for the imagined scenario. The pictures were presented in a randomized order. As gaze direction was a between-subject factor, each participant saw eight of the 16 pictures described in the stimulus section. The distance from the center of the participant's right shoe to the picture was measured with a laser distance meter (MK-LAK; Geanee, Japan).

Afterward, participants were asked to guess the nationalities of the model faces presented in the pictures with an unstructured response format, that is, participants could fill in any nationality. Then, they had to rate to which degree the model looked like a typical representative of the guessed nationality on a 6-step Likert-type scale, ranging between *not typical* (1) and *typical* (6). Finally, they were asked to rate the typical spacing behavior for the guessed nationality on a 7-step bipolar scale, ranging between *too close* (−3) and *too far* (+3), hereafter referred to as

Figure 1. The averaged face stimuli.
Note. Pictures of the direct gaze condition are presented in the upper row, and pictures of the averted condition (10° vertically downward) in the lower row. Caucasian faces are on the left, and East Asian faces on the right. Note that the raw faces are not shown.

interaction distance stereotype. For this assessment, guessed *nationality* was used to investigate stereotypes, because this categorization is more fine-grained than racial categories like *Caucasian*, which include a great variety of different cultural backgrounds, and can still be clustered afterward according to broader geographical regions.

Results

Representativeness of Faces

For Caucasian faces, most participants guessed nationalities of Northern European, Eastern European, Australian, or North American countries, although some Japanese participants also named Southern European countries. Most German participants guessed the German nationality for Caucasian faces (42%-80%). For Asian faces, all participants guessed nationalities of either East Asian or Southeast Asian countries. Within the Japanese sample, the nationality of the averaged female East Asian face was more frequently assumed to be Chinese (40.5%) than Japanese (33.3%), whereas the remaining three East Asian faces were most often assumed to be Japanese (80%-90%). The mean perceived representativeness of the faces ranged between 3.75 and 5.00 and was in all cases above the scale mean of 3.50. A paired t test indicated that averaged faces were not perceived as more representative than normal faces, $M_A = 4.43$, $SD_A = 0.72$; $M_N = 4.45$, $SD_N = 0.55$; $t(81) = 0.43$, $p = .76$, $g = 0.05$.

Interaction Distance

The average interpersonal distance of all participants was 122.8 cm ($SD = 33.9$ cm). For the main analysis, a mixed factorial analysis of variance (ANOVA) was conducted on interpersonal

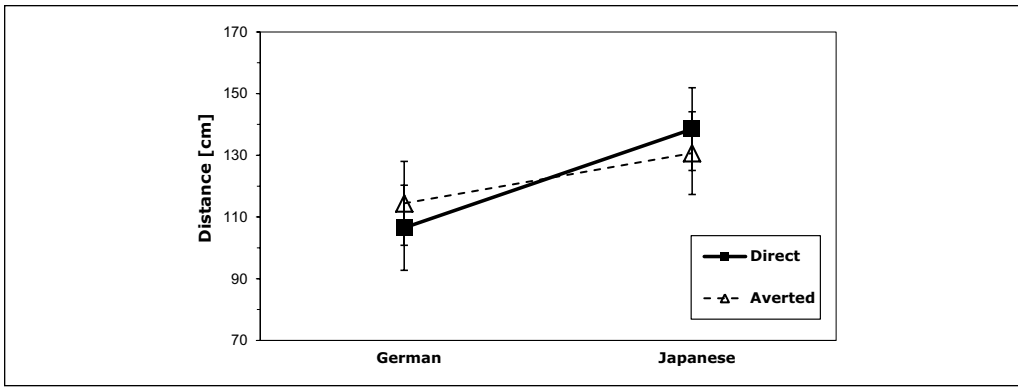

Figure 2. Interpersonal distance in cm as a function of nationality (*x* axis) and gaze direction (lines).
Note. Only the main effect of nationality was statistically significant. Error bars represent 1.96 times the standard error of the mean. The *y* axis is truncated at the minimum average distance of 70 cm, as the plausible distance range does not include zero and very low values.

distance to test the between-subject effects of picture model gaze direction (2), participant nationality (2), and gender (2) and the within-subject effects of stimulus gender (2), race (2), and picture type (2; averaged vs. normal). A priori hypotheses were tested on an $\alpha = .05$. Exploratory analyses were performed on a Bonferroni-corrected $\alpha = .001$.

As hypothesized, there was a significant main effect of participant nationality, $F(1, 74) = 12.3$, $p = .001$, $\eta_p^2 = .14$. Japanese chose significantly larger distances than Germans ($M_J = 134.6$ cm, $SD_J = 32.6$; $M_G = 110.5$ cm, $SD_G = 28.7$). All other between-subject effects were not significant ($p > .16$), including the hypothesized effects of gaze direction, $F(1, 74) = 0.001$, $p = .97$, $\eta_p^2 < .01$, and the interaction between gaze direction and nationality, $F(1, 74) = 1.16$, $p = .29$, $\eta_p^2 = .02$. The results are illustrated in Figure 2. A sensitivity analysis of the interaction was conducted with gpower 3.1.9.2 (Faul, Erdfelder, Lang, & Buchner, 2007). Given the parameters $\alpha = .05$, $N = 82$, $df_{num} = 1$, eight groups, no covariates, and a power of $1 - \beta = .80$, the effect size required for significance was 0.09, representing a moderate to large effect (Ellis, 2010).

As expected, there was a significant main effect of stimulus gender, $F(1, 74) = 6.40$, $p = .014$, $\eta_p^2 = .08$, and a significant interaction between stimulus and participant gender, $F(1, 74) = 21.0$, $p < .001$, $\eta_p^2 = .22$. As illustrated in Figure 3, female participants chose smaller distances toward female stimuli, compared with male stimuli. All other effects were not statistically significant.

Bayesian Analysis

In contrast to the frequentist statistics reported above, Bayes factors can quantify the evidence for the null hypothesis and indicate how conclusive the data are regarding the (non)existence of an effect on a continuous scale. In general, a Bayes factor compares two hypotheses by calculating their individual likelihood to be correct given the data and then comparing the size of the two likelihoods in a ratio. To evaluate a null hypothesis, the likelihood of a model without the effect of interest is divided by the likelihood of a model including the effect. Values above 1 are in favor of the null hypothesis, indicating that the model without the effect is more likely, but by convention only values above 3 are considered conclusive evidence (e.g., Jarosz & Wiley, 2014; Jeffreys, 1961).

To quantify the evidence against a main effect of gaze direction and an interaction between gaze direction and nationality, Bayes factors were computed, using the R package *BayesFactor* with default noninformative priors (Morey, Rouder, & Jamil, 2015; Rouder, Morey, Speckman,

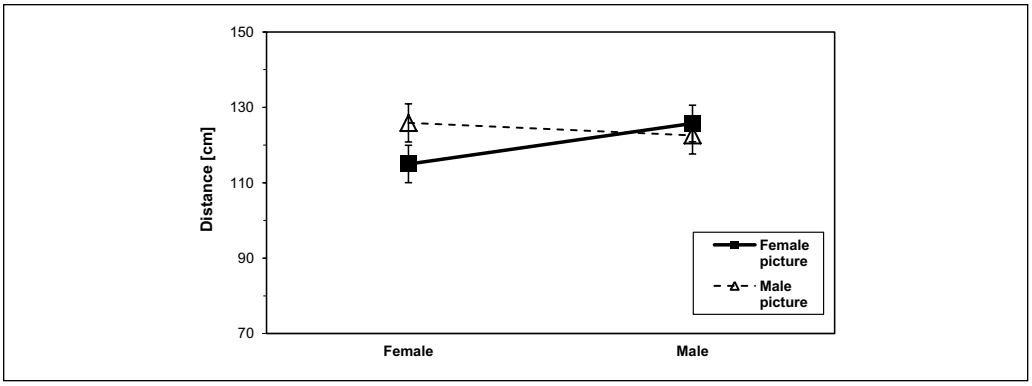

Figure 3. Interpersonal distance in cm as a function of participant gender (*x* axis) and stimulus gender (lines).
Note. Error bars represent 1.96 times the standard error of the mean. The *y* axis is truncated at the minimum average distance of 70 cm, as the plausible distance range does not include zero and very low values.

& Province, 2012). Noninformative priors, also called "objective", do not require scientists to include their subjective expectations in the model, a criticism often applied to Bayesian statistics. For simplification, these analyses were conducted on each participant's average distance.

First, a model including only the main effect of nationality (numerator) was compared with a model including the main effects of both nationality and gaze direction (denominator).[2] A Bayes factor of 4.29 (±0.86%) was in favor of the model without a main effect of gaze direction. Second, a model including only the main effects of gaze direction and nationality (numerator) was compared with a model including these main effects as well as their interaction (denominator). A Bayes factor of 1.92 (±8.45%) was slightly in favor of the model without the interaction between gaze direction and nationality but did not cross the threshold of 3 for sufficient evidence.[3]

Interaction Distance Stereotypes

A mixed factorial ANOVA was conducted on interaction distance stereotypes as the dependent variable to explore the effects of participant nationality (2), stimulus race (2), participant gender (2), stimulus gender (2), and picture type (2; averaged vs. normal). The Bonferroni-corrected significance level was $\alpha = .002$. There was a significant main effect of participant nationality, $F(1, 73) = 11.84$, $p = .001$, $\eta_p^2 = .140$, qualified by a significant interaction between participant nationality and stimulus race, $F(1, 73) = 17.76$, $p < .001$, $\eta_p^2 = .196$. Germans and Japanese did not differ in their stereotypes concerning Caucasians. Both expected Caucasians to stand slightly too close, but Germans expected East Asians to stand too far away, whereas Japanese expected both Caucasians and East Asians to stand too close (Figure 4).

There was a nonsignificant trend for participant nationality and stimulus gender to interact: In our sample, stereotypes for women were more extreme than stereotypes for men, $F(1, 73) = 3.93$, $p = .051$, $\eta_p^2 = .051$. Germans rated women as standing "too far" ($M = 0.26$, $SD = 0.53$) compared with men ($M = 0.10$, $SD = 0.59$), whereas Japanese rated women as standing "too close" ($M = -0.26$, $SD = 0.64$) compared with men ($M = -0.15$, $SD = 0.67$). All other effects were not statistically significant as well ($p > .06$).

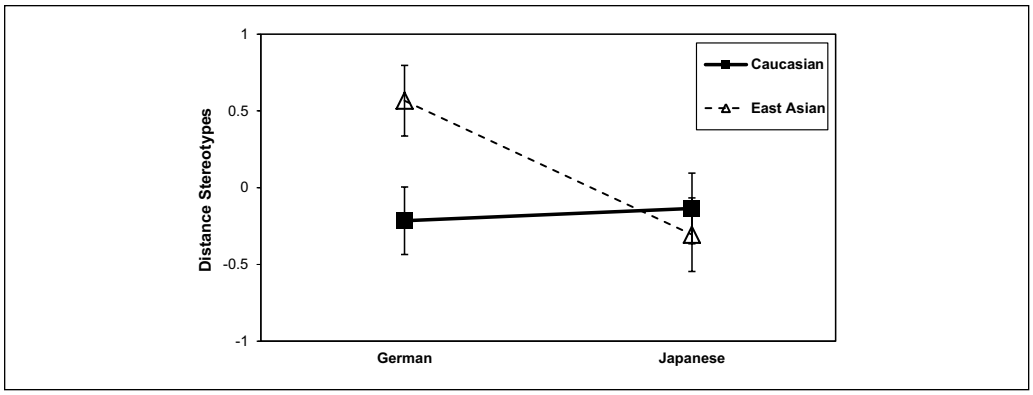

Figure 4. Assumed interpersonal distance in Caucasian and East Asian cultures as a function of participant nationality (*x* axis) and stimulus ethnicity (lines).
Note. Error bars represent 1.96 times the standard error of the mean. Values larger than 0 indicate that people were judged as standing too far; values smaller than 0 indicate that people were judged as standing too close.

Discussion

In line with past research, we found that Japanese students preferred larger interpersonal distances than German students, even in a highly controlled laboratory setting. This effect cannot be explained by body height, as the German sample was taller, and greater height is associated with larger interpersonal distances (e.g., Caplan & Goldman, 1981). Likewise, we confirmed the finding that female–female dyads are associated with the smallest interpersonal distances. If the effect of gender were explained merely by participant body height, one would expect female participants to choose smaller distances toward both male and female stimuli, which was not the case.

The hypothesized in-group preference could not be confirmed. There was no significant interaction between participant nationality and stimulus race. Still, it is not clear whether having the same race is sufficient for in-group identification, as the perceived nationality might be a confounding factor. Note, however, that nationality of the stimuli was made salient only in the questionnaire *after* the experiment and, except for two faces, participants most often named their own nationality for faces of self-congruent race. This should not be taken for granted, as it might feel unnatural for participants to give the same answer (e.g., "Japanese") on several consecutive questions. Naturally, there was greater variety in named nationalities for the Caucasian stimuli, which after all were created from models with and without German heritage. This variety of responses made it unpractical to test the in-group hypothesis based on nationality instead of race in this particular study.

In accord with the actual interpersonal distance preferences, Germans expected East Asians to prefer larger interpersonal distances than Caucasians. There was no difference in distance stereotypes within the Japanese sample. This is compatible with our previous finding that Japanese students took their own population norms as reference when judging body height and weight from facial pictures (Schneider, Hecht, Stevanov, & Carbon, 2013). We initially hypothesized that cultural stereotypes about a person's interaction distance might affect one's preferred interpersonal distance, based on Burgoon's expectation violation theory (Burgoon & Jones, 1976). If we found, for example, (a) that Japanese prefer smaller distances toward Caucasians than toward East Asians and (b) a corresponding stereotype in the Japanese sample that Caucasians stand too close, this would have implied that Japanese employ a different cultural norm that affects their preferred interpersonal distance. This hypothesis could not be tested, as there was generally no effect of

stimulus race. How interaction partners with different cultural norms negotiate their interpersonal distance is a complex phenomenon that might be better investigated with real dyads or in virtual reality (Hasler & Friedman, 2012). Still, establishing a robust cultural difference in interpersonal distance, as we were able to do in this study, is an important stepping stone toward that goal.

The results are overall not compatible with equilibrium theory, as the gaze manipulation between mutual and averted did not prompt participants to re-equilibrate the social situation by changing interpersonal distance. There was no main effect of direct gaze on interpersonal distance, according to both frequentist and Bayesian inference. There was also no significant interaction between gaze direction and nationality, even though the Bayes factor indicated that more data are needed to confirm the nonexistence of this effect. In addition, the sensitivity analysis demonstrated that the study had only adequate power to detect moderate to large effects.

Contrasting German and Japanese samples is especially valuable, as their cultures differ according to the social meaning of direct gaze. We had initially surmised that Japanese observers prefer larger interpersonal distances because they react to the exposure to mutual gaze with retreating by a step or two. This would maintain the equilibrium. However, we have to refute this hypothesis. In all cases, Japanese observers maintained larger interpersonal distances than did German observers.

Could the downward gaze deflection by 10° not have been sufficiently strong to be perceived as averted? This seems unlikely as the vertical width of the *cone of gaze* is on the order of 12°, that is, 6° downward, such that a gaze deflection of 10° would be well outside this cone (regarding the robustness and shape of the gaze cone, see Hecht, Hörichs, Sheldon, Quint, & Bowers, 2015). Likewise, we can rule out that the use of pictures instead of real observers has failed to produce impressions of mutual versus downward gaze. The gaze cone width measured with pictorial stimuli is very similar, albeit somewhat larger, to that found in rather tedious experimentation with real observers (Gamer & Hecht, 2007). Thus, the eyes that were averted by 10° downward should have been clearly perceived as averted. This is also supported by a study on a Finnish and a Japanese sample, where gaze started to be clearly perceived as averted when the gaze direction exceeded deviations from straight ahead by more than 6° and 8° laterally (Uono & Hietanen, 2015). However, all these studies investigated the horizontal gaze cone. The vertical gaze cone might still be particularly larger in Asian than in Caucasian observers. In this case, the Japanese participants could have perceived the 10° of the averted gaze condition as mutual gaze, potentially eliminating an effect of averted gaze in this subsample.

Could the active approach of the participants have distorted the perceived gaze angle? This is unlikely, as it has been shown that the ability to differentiate between direct and averted gaze is rather stable across the approach distances used in this study. In extreme cases, our participants chose distances ranging from 50 cm up to 270 cm. The average angle of the *cone of gaze* only narrows slightly at considerably larger distances (Gamer & Hecht, 2007).

We have used only two gaze directions as a between-subjects factor, because employing additional angles in a within-subjects design would have unduly lengthened the experiment (the repeated physical approaches should not tire the participants) and might have led participants to guess the experimental hypothesis. Bearing these challenges in mind, it might however be desirable to include additional larger angles in further experimental groups or use repeated measures of different angles while controlling for demand characteristics of the experiment. Larger angles would have possibly induced larger effects and therefore, as well as a within-person design, provided greater statistical power. Larger angles are also more likely to be perceived as averted regardless of the participant's cultural background. A greater number of angles would also permit the modeling of nonlinear relationships between gaze and interpersonal distance (Aiello, 1977; Bailenson et al., 2001; Wieser et al., 2010).

Note that even if the effect of *perceived* gaze direction were perfectly uniform across Germans and Japanese, we would still expect a smaller effect for Japanese, due to cross-cultural

differences in early perceptual processes, as Japanese appeared to be less sensitive to angular gaze changes compared with a Finnish sample (Uono & Hietanen, 2015). Similarly, some studies have shown not only that East Asians and Europeans have different fixation patterns when looking at faces but also that these differences depend on the gaze direction of the targets (Gobel, Chen, & Richardson, 2017; Senju et al., 2013).

Patterson (1976) formulated the arousal model of interpersonal intimacy that builds on equilibrium theory and might salvage the equilibrium idea of interpersonal distance regulation. He proposed physiological arousal as the driving force behind people's compensatory behavior for intimacy intrusions by others. Arousal might be smaller when using inanimate stimuli compared with live faces. If arousal mediates the effect of direct gaze on interaction distance, this would lead to smaller effects on preferred interpersonal distances, which in turn would necessitate larger samples than used here to rule out equilibrium theory. In line with this argument, some studies demonstrated that viewing faces with direct compared with 30° averted gaze increased autonomic arousal and left-sided frontal electroencephalographic asymmetry, but only when stimuli were live faces instead of pictures (Hietanen, Leppänen, Peltola, Linna-aho, & Ruuhiala, 2008; Pönkänen, Alhoniemi, Leppänen, & Hietanen, 2011; Pönkänen, Peltola, & Hietanen, 2011). In a similar vein, Gobel, Kim, and Richardson (2015) have demonstrated that the behavior of participants changed depending on whether they believed their faces would be used as stimuli and be shown to other participants after their experimental session. Thus, even though pictorial stimuli have the advantage of ensuring high internal validity, they might suffer from their relatively low ecological validity. Regardless of these challenges, pictorial stimuli can often be sufficient to elicit social responses. For example, a meta-analysis on the watching eye effect demonstrated that the mere presence of a picture of human eyes increases the probability to make a donation in the dictator game (Nettle et al., 2013).

In sum, our study represents the first empirical test of the cross-cultural generalizability of equilibrium theory. The unconditional effect of gaze on interaction distance, which it predicts, did not materialize in our data. More importantly, the preference of Japanese participants for larger interpersonal distances appears to be robust across different gaze directions. Future research should account for the role of arousal, preferably comparing naturalistic and controlled laboratory settings, and employ a greater variety of angles for vertically averted gaze.

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Notes

1. We are aware that cultural habits are not necessarily correlated with race. However, when using merely a pictorial representation of a person, the two cannot be disentangled. We presumed that the race of the stimulus and the nationality of the participants best represent the two cultural backgrounds. Thus, we use the term *race* to refer to the stimuli in cases we operationalized their cultural membership according to physiognomic stereotypes. We used the term *nationality* to capture the cultural socialization of the participants.
2. This procedure is described in the *ANOVA, fixed effects*–section on the webpage of the Bayes factor package: http://bayesfactorpcl.r-forge.r-project.org/
3. As the test of this nonsignificant but inconclusive effect was central to the main hypothesis, we provide more detailed information to aid sample size estimation for future studies: In the Japanese sample, the mean distance increased from 130.7 cm in the averted gaze condition (95% confidence interval

[CI] = [117.3, 144.1]) to 138.5 cm in the direct gaze condition (95% CI = [125.1, 151.9]); in the German sample, the mean distance decreased from 114.4 cm in the averted gaze condition (95% CI = [100.7, 128.2]) to 106.5 cm in the direct gaze condition (95% CI = [92.7, 120.2]). Thus, we have a trend that German and Japanese observers might react in opposite manners to direct gaze.

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