Beware of virus!

Wearing a face mask against COVID-19 results in a reduction of social distancing

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Abstract

In the context of the Covid-19 pandemic, barrier gestures such as regular hand-washing, social distancing, and wearing a face-mask are highly recommended. Critically, interpersonal distances depend on the physical and emotional dimensions involved in social interaction, two factors that might be affected by the current Covid-19 context. In the present internet-based experimental study, we analyzed the preferred interpersonal distance of 457 participants when facing a character either wearing a face-mask or displaying a neutral, happy or angry facial expression. Interpersonal distance was significantly reduced when the characters were wearing a face-mask compared to the other conditions. Importantly, it was more reduced in participants infected with Covid-19, or living in low-risk areas. The present findings are of dramatic importance as they reveal that interacting with people wearing a face-mask enhances the feeling of safety, but with detrimental effect on the most basic behavior in the context of pandemic, namely social distancing.

Introduction

The Covid-19 pandemic began in China in December 2019 and quickly spread around the world, with 3 889 841 cases reported in 187 countries as of May 8, 2020 (Covid-19 interactive dashboard, Dong, Du & Gardner, 2020). To slow down the pandemic, it is critical to ensure that human behavior with respect to preventing infection is represented appropriately. In accordance with WHO guidelines, many governments recommended the use of barrier gestures in social contexts such as regular hand-washing, maintaining an inter-individual distance of at least 1 meter, and wearing a medical mask (World Health Organization, 2020). Although highly encouraged due to its obvious sanitary impact, the wearing of a mask has social consequences that have not yet been studied in depth, and its interaction with other barrier gestures such as social distancing is unknown.

Indeed, since the pioneering work of Hall (1966), social interactions are known to require a fine adjustment of interpersonal distances (IPDs). Selecting an appropriate IPD involves two constraints: the need to approach conspecifics given the interaction's physical constraints and the need to maintain a margin of safety to protect the body from potential hazards (Dosey & Meisels, 1969; Hayduk, 1983; Siegman & Feldstein, 2014). IPDs are thus not consistent across social situations, but are modulated by physical, cognitive and affective factors. For instance, increasing the dimensions of conscious body representation using tools (Canzoneri et al., 2013) produces IPD extension (Quesque et al., 2017). Likewise, IPD increases when facing confederates with angry compared to happy or neutral facial expressions (Cartaud et al., 2018, 2020; Ruggiero et al., 2017), and is also atypically large in people with socio-emotional deficits (Kennedy et al. 2009; Nandrino et al., 2017; Givon-Benjio et al., 2020). Importantly, interacting with people wearing a mask might alter both the physical and emotional aspects of social interactions.

Given the social context associated with Covid-19, it is essential to understand how IPD, a determining factor in blocking contamination, might be influenced by barrier gestures such as wearing a mask, especially in view of the current and general deconfinement of populations around the world. The effects on IPD might be even harder to anticipate as quarantine periods generally lead to massive behavioral and emotional changes (Brooks et al., 2020). This is a critical issue, as a potential negative effect could be that wearing a mask significantly enhances the feeling of safety despite the pandemic context and could jeopardize other health recommendations such as social distancing. This is precisely what we demonstrate in the present study.

Method

Participants

Four hundred and fifty-seven adult participants (323 women), self-volunteers, completed the entire experiment (*M*age = 31.53, *SD*age = 13.37). The sample size was not determined a priori as the authors expected to include as many participants as possible before the end of the Covid-19 quarantine period in France. However, the sample obtained largely exceeds the minimal sample size (n=50) required to reasonably observe an effect characterized by a relatively small effect size (Cohen's d =0.4) and a standard power criterion (0.8). Written informed consent was obtained from each participant and the protocol received approval by the local institutional ethics committee (CESC Ref. 2020-425-S83).

Apparatus and stimuli

The experiment was created on lab.js builder (Henninger et al., 2019), run online, and hosted on the CNRS web server. Advertisement was shared on social and professional networks. The stimuli consisted of eight male and female virtual characters selected from the ATHOS database (all stimuli are available at: https://osf.io/sp938/?view_only=7a5c397f51864d88a7f71af2c18bf478). Each character (randomly assigned across participants) was associated with an angry, happy and neutral facial expression (FE), or a neutral FE with a white face mask and presented in an empty room. Both the characters and the empty room were built on Unity (2018.2.21f1 version). The characters were presented at different distances along the virtual mid-body sagittal axis of the participants. The distances were comprised between 28 to 140 cm with respect to the proximal side of the virtual room (see Fig. 1 for an illustration). The distance increment was of 8 cm, resulting in 15 possible distances. Variables were manipulated with a within-subjects design and the order of the 240 stimuli presented was fully randomized (Gender of the virtual character [2] * FE [4] * Distance [15] * Repetition [2]).

Procedure and design

After having completed a short questionnaire concerning general information (the full questionnaire is available in supplementary material), participants had to perform two tasks. The first task was to judge whether the IPD between themselves and a virtual character was appropriate for social interaction or not. The characters (female and male) were presented one by one, stationary at a distance ranging from 28 to 140 cm, and with different FE (anger, happy, neutral, neutral + mask). Each virtual character was presented twice. Responses were provided by pressing the “L” (appropriate) or “S” (inappropriate) keyboard keys (which are separated

apart symmetrically on “Azerty” keyboard). Participants were instructed to respond spontaneously and as fast as possible. A 10-trials training session on independent virtual characters (not used in the following task) was administered before the experimental session to operationalize the associations between responses and keys. After 120 trials, a break was proposed to participants, if needed. The second task consisted in explicit judgements of the characters’ attributes. Participants were presented sequentially with the different characters used in the first task displayed 61 cm away, and several questions appeared below. The characters, presented in random order, were evaluated on whether they were “threatening”, “determined” and “trustworthy” (Cuddy, Fiske, & Glick, 2008) and also “healthy” due to the obvious interest given the present health context. Responses were provided by positioning a cursor on a horizontal line (100 units) with the label "really agree" on the right side and "really disagree" on the left side. Participants used their trackpad or mouse to position the cursor.

Data analysis

All statistical analyses were carried out using generalized linear model regressions (GLM) and linear model regression using R (version 3.5.1) and R Studio software (version 1.1.463). Post-hoc comparisons were carried out using Bonferroni correction for the GLM and using the Tukey HSD test from the lsmeans package (version 2.30-0) for the two-by-two comparison of the linear models.

The proportion of “appropriate” responses was analyzed using a logistic regression model with a Binomial distribution as a function of the virtual character’s FE (angry, happy, neutral, face mask), Covid-19 contamination (yes, no), participants’ and characters’ gender (male, female), and area risk level (low, high), according to the model:

$$
\begin{aligned}
Response \sim \text{Distance} &+ \text{FE} + \text{Covid19 contamination} \\
&+ \text{area risk level} + \text{Participant gender} \\
&+ \text{Virtual character gender} \\
&+ \text{FE} \times \text{Covid19 contamination} \\
&+ \text{FE} \times \text{Participant gender} \\
&+ \text{FE} \times \text{Virtual character gender} \\
&+ \text{FE} \times \text{area risk level}
\end{aligned} \tag{1}
$$

The boundary of appropriate IPD was determined from the participants' responses at each distance using the equation:

$$y = \frac{e^{(\alpha + \beta X)}}{1 + e^{(\alpha + \beta X)}} \tag{2}$$

in which y is the participants' (appropriate/inappropriate) response, X is the distance, and (-α/β) is the critical value of X corresponding to the transition between appropriate and inappropriate responses, thus expressing the preferred IPD. The participants' subjective evaluation of the characters attributes (threat, health, trust and determination) were analyzed using linear regressions as a function of the character's FE (angry, happy, neutral, face mask), participants' Covid-19 contamination (yes, no) and risk level of geographical area (low, high).

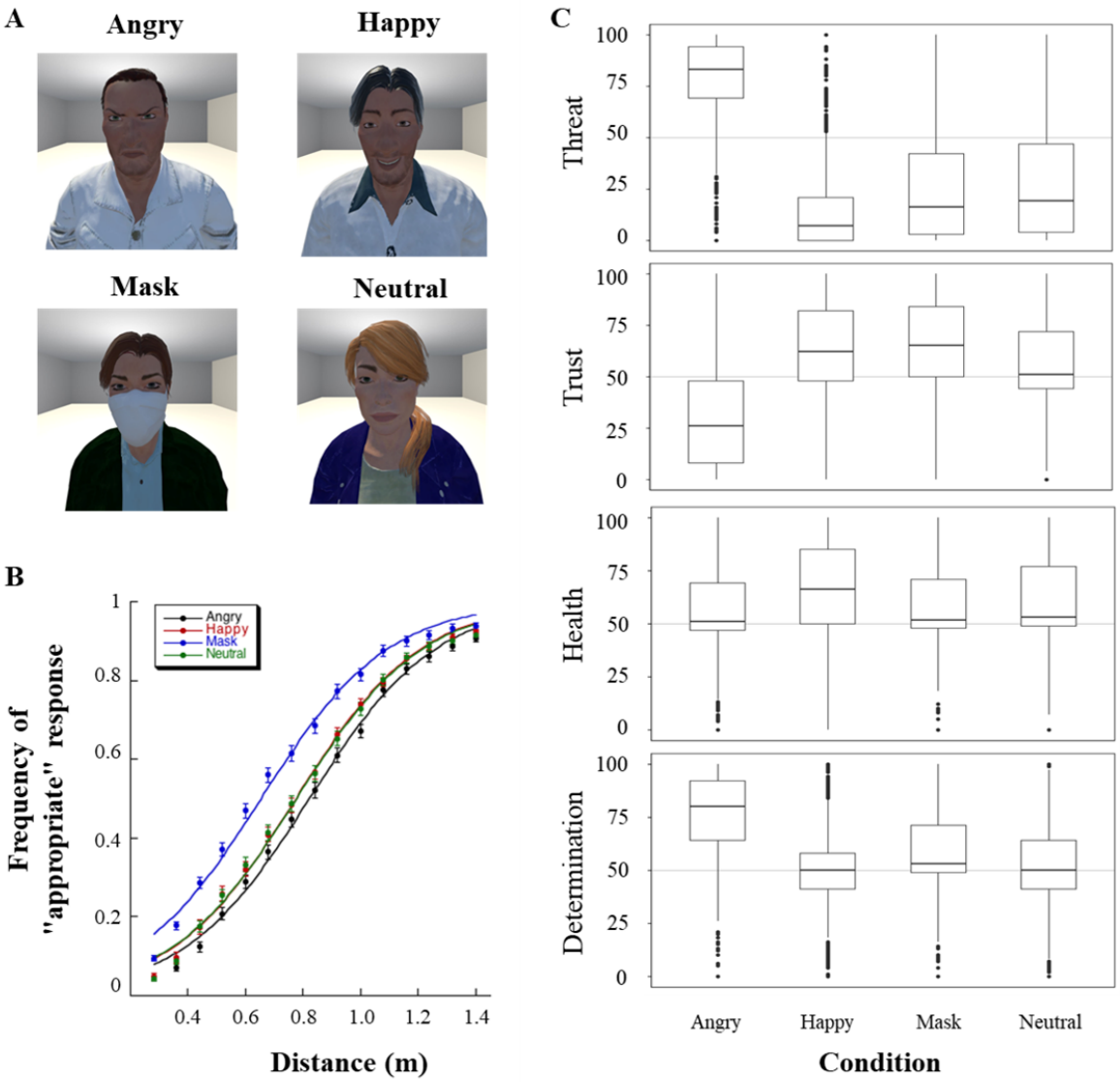

Fig. 1: (A). Example of characters used in experiment (distance of 36 cm). (B) Logistic regressions of frequency of "appropriate" response as a function of distance for different types of characters' facial expressions (Angry, Happy, Mask, Neutral). (C) Boxplot evaluation of characters' features (Trustworthy, Threatening, Healthy, Determined) as a function of characters' facial expressions (Angry, Happy, Mask, Neutral)

Results

Out of all participants living in 55 different French departments, 51 declared being or having been contaminated by Covid-19 and 341 lived in a high-risk area (according to the French government's classification). When testing how participants judged IPD, the results showed that the appropriate distance was on average 76.6 cm (Fig. 1B), but that it depended

on the character's FE (Table 1, statistics are expressed in odds ratio). The preferred IPD was much shorter for the character with a face mask (66.41 cm) than when he/she had a neutral (78.50 cm), happy (78.21 cm) or angry (83.1 cm) FE (all $p<0.01$). These distances were modulated by individual factors. On average, IPD was shorter for male (74.81 cm) than female (77.35 cm, $p < 0.001$) participants and with female (75.38 cm) than male (77.82 cm, $p < 0.001$) characters. Preferred IPD was shorter when participants had been contaminated with the Covid-19 (3.2 cm, $p<0.01$) or when they lived in a low-risk area (3.79 cm, $p <0.01$). However, no interaction with the FE emerged.

Regarding the character's attributes (Fig. 1C), a main effect of FE emerged for threat ($F= 1453.46$, $p < 0.001$), health ($F =41.24$, $p <0.001$), trust ($F =404.68$, $p < 0.001$) and determination ($F = 277.36$, $p <0.01$) evaluations. Characters with a face mask were evaluated as slightly more threatening (*M*threat = 23.33, CI = ± 1.51) than those with a happy FE (*M*threat = 14.63, CI = ± 1.27, $t = 8.24$, $p <0.001$), but less than those with an angry FE (*M*threat 77.26, CI = ± 1.49, $t= -51.13$, $p<0.001$), and not different from those with a neutral FE (*M*threat = 25.60, CI = ± 1.57, $t = -2.15$, $p = 0.14$). They were evaluated as less healthy (*M*health = 58.31, CI = ± 1.32) than those with a happy FE (*M*health = 66.82, CI = ± 1.41. $t = -8.5$, $p<0.001$), but not different from those with an angry (*M*health =56.35, CI = ± 1.40, $t = 1.96$, $p = 0.20$) or a neutral FE (*M*health = 60.83, CI = ± 1.41, $t = -2.51$, $p = 0.058$). The latter were significantly different from each other ($t= 4.47$, $p <0.01$). They were rated as more trustworthy (*M*trust = 65.1, CI = ± 1.48) than characters with an angry FE (*M*trust = 29.73, CI = ± 1.6, $t =31.38$, $p<0.01$), neutral FE (*M*trust = 55.38, CI = ± 1.51, $t =8.62$, $p < 0.001$) or happy FE (*M*trust = 61.78, CI = ± 1.66, $t =2.94$, $p = 0.02$). Furthermore, they were evaluated as being more determined (*M*determined =58.16, CI = ± 1.38) than characters with a happy (*M*determined = 49.28, CI = ± 1.46, $t = 8.67$, $=< 0.001$) or neutral FE (*M*determined = 50.79, CI = ± 1.49, $t = 7.21$, $=< 0.001$), but less than those with an angry FE (*M*determined = 75.54,

CI = ± 1.34, t = -16.99, =< 0.001). Finally, a main effect of the risk level emerged from the evaluation of threat (F= 6;24, p = 0.01) and trust (F = 6.69, p = <0.01). Individuals living in a low-risk area rated the characters as less threatening (*M*threat = 33.6, CI = ± 2.15) than those living in a high-risk area (*M*threat = 35.76, CI = ± 1.25, t = 2.5, p = 0.01). They also evaluated the characters as more trustworthy (*M*trust = 54.77, CI = ± 1.77) than individuals living in a high-risk area (*M*=trust = 52.4, CI = ± 1.05, t =2.59, p = 0.01).

Table 1. Coefficients of logistic regressions for the different variables (odds ratios represent odds of answering "appropriate" when exposed to a Condition compared to answering "appropriate" when exposed to the Reference).

Reference	Estimate	Coefficient	Standard Error	z value	p	Odd ratio
Face Mask	Neutral	-0.353	0.017	-20.304	<0.001	0.702
	Angry	-0.489	0.017	-28.113	<0.001	0.613
	Happy	-0.344	0.017	-19.759	<0.001	0.709
Neutral	Happy	0.009	0.017	0.549	ns	1.009
	Angry	-0.135	0.017	-7.896	<0.001	0.874
Happy	Angry	-0.145	0.017	-8.444	<0.001	0.865
No Covid-19	Covid-19	0.079	0.019	4.041	<0.001	1.082
Risk-related high	Risk-related low	0.111	0.014	7.848	<0.001	1.118
Female participants	Male participants	0.065	0.014	4.818	<0.001	1.067
Female characters	Male characters	-0.074	0.012	-6.058	<0.001	0.928

Discussion

The Covid-19 pandemic represents a massive global health crisis with an unprecedented social and behavioral impact. The consistent message conveyed by health stakeholders is that the struggle against it requires significant behavioral changes. In the present study, we investigated to what extent wearing a face mask impacts social distancing, an essential

measure against Covid-19 transmission. Although not intuitive, we observed a significant decrease in preferred IPD when the social interaction involved a character wearing a face mask in comparison to a character displaying a happy, angry, or even a neutral facial expression. The fact that characters wearing a face mask were evaluated as more trustworthy than the others could have led to the reduced IPD, as morality judgments determine approach–avoidance tendencies (Fiske, Cuddy & Glick, 2007). In addition to this important result, we found that an area's risk level regarding Covid-19 contamination affected preferred IPD. The lesser the expected risk, the less social distancing seemed paramount to individuals. Moreover, a similar effect held for individuals contaminated with Covid-19, who felt that shorter IPDs were appropriate. One interpretation could be that being already affected by Covid-19, they might not experience the need to adopt barrier measures to protect themselves. Both findings suggest the need to foster vigilance regarding individual practices, especially in "low-risk" areas. Recent works (Van Bavel et al., 2020) highlighted the difficulty of making public policy and government decisions based solely on rationalization, as multiple cognitive biases stand in the way of risk prevention in social contexts. Among these biases leading to maladjustment of social behaviors, people generally underestimate health-related risks, find it unnatural to respect strict isolation as a means of protecting others, and have only a limited awareness of the actions that pose a health risk. Although the present study calls for generalization in more ecological settings, it provides further evidence of these biases by showing that the mere sight of a person wearing a face mask is enough to trigger a strong sense of security that acts against the simplest rule of social distancing.

Authors' Contributions

All authors contributed to the study design, data collection and interpretation. A.C. programmed the online experiment and performed the data analysis. All authors contributed to drafting the manuscript and provided critical revisions. All authors approved the final version of the manuscript for submission. The authors would like to thank Laurent Ott for taking care of the data and managing the server, as well as all the participants who contributed to the study.

Funding Sources

This work was funded by the French National Research Agency (ANR-11-EQPX-0023). A.C. was financed by a grant from the Region Hauts-de-France and the University of Lille.

Declaration of Interest statement

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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