The Emotional Lockdown: How Social Distancing and Mask Wearing influence Mood and Emotion Recognition

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During the COVID-19 pandemic, government-mandated protection measures such as contact restrictions and mask wearing significantly affected social interactions. In the current preregistered study we hypothesized that such measures could influence self-reported mood and the ability to recognize emotional expressions from the eye region of faces. We found that mood was positively related to face-to-face but not to virtual interactions. This suggests that contact restrictions leading to a decrease in face-to-face compared to virtual interactions may be related to negative mood. We also found slight improvements in emotion recognition from the eyes in a student sample tested during the pandemic relative to a comparable sample tested prior to the pandemic although these differences were restricted to female participants.

Keywords: Emotion perception; mood; COVID-19 pandemic; virtual interactions; social contacts

Introduction

In 2020, the COVID-19 pandemic hit the world, leading to sudden societal changes. To contain the virus, people in Germany, as in other parts of the world, were asked to avoid face-to-face contacts with other people and to wear masks (Bundesregierung, 2021). Both of these changes can have effects on social interactions. Therefore, the current study aimed to investigate the effects of these drastic measures on emotion perception and on personal emotions measured through mood.

Humans are inherently social beings (Dunbar, 1998, 2003). Social interaction may even have had evolutionary advantages, in line with the social intelligence hypothesis (Tomasello, 2014). However, due to the pandemic social contacts were severely restrained (Bundesregierung, 2021). Social contacts can be a protective factor against psychological disorders such as depression (Peirce, Frone, Russell, Cooper, & Mudar,

2000) and a lack of social contacts can lead to psychological distress (Cacioppo, Capitanio, & Cacioppo, 2014). Accordingly, increases in psychological disorders and related symptoms have been observed during the pandemic (Rajkumar, 2020; Sønderskov, Dinesen, Santini, & Østergaard, 2020; Vindegaard & Benros, 2020; Xiong et al., 2020).

Even though people were not allowed to meet face-to-face, they could still meet virtually. It is unclear how such virtual interactions compare with face-to-face interactions. Previous research showed that face-to-face contact is a protective factor against depression, whereas mere telephone or email contact is not (Teo et al., 2015). During the pandemic face-to-face meetings were strongly restricted but virtual meetings using videocalls increased rapidly, perhaps enabling more natural visual and auditory interactions. Live videocalls activate the social brain (Redcay et al., 2010) and can induce positive affect and physical reactions (Hietanen, Peltola, & Hietanen, 2020), suggesting that such

interactions are similar to face-to-face social interactions. Accordingly, a recent study suggests that both remote and face-to-face interactions were negatively related to depressive symptoms (Lee, Ferraro, & Kim, 2020), contrasting findings regarding email and phone contact. In summary, there are mixed findings in the literature regarding differences in neural and emotional responses to face-to-face and video-based communication. The first aim of the current study was therefore, to investigate effects of face-to-face and virtual interactions on mood in a typical population. We hypothesized that a lower amount of time spent with other people is associated with negative mood. We further expected that virtual interactions can replace face-to-face interactions and that the mood would therefore be unaffected by whether time with other people was spent in a live or virtual context.

The second aim of the current study was to investigate the effect of exposure to masked faces on emotion recognition from only the eyes. During social interactions, it is particularly relevant that people react to others' beliefs and emotions, a skill known as Theory of Mind (Premack & Woodruff, 1978; Wimmer & Perner, 1983). Emotions are recognized from other people's body postures, and particularly from their faces (Bänziger, Grandjean, & Scherer, 2009). Government-mandated wearing of masks led to covering of the mouth and nose, a large proportion of the face (Bundesregierung, 2021). Research suggests that perception of emotional expressions is more difficult when parts of the face are covered (Fischer, Gillebaart, Rotteveel, Becker, & Vliek, 2012; Kret & De Gelder, 2012). Preliminary studies during the pandemic also suggest that emotion recognition from faces is impaired when they wear masks (Carbon, 2020; Ruba & Pollak, 2020), and people need to increasingly rely on cues from the eyes (Barrick, Thornton, & Tamir, 2020). However, humans tend to quickly adapt to environmental change and frequent

exposure to masked faces may lead to an improvement in emotion recognition from the eye region of faces. We expected people in a sample tested during the pandemic to be better at recognizing emotions when only seeing the eye region of faces than a sample tested before the pandemic and the self-reported time people spend with people wearing masks to be positively related to emotion recognition from the eyes. As there is a female advantage in facial emotion perception across the lifespan (Baron-Cohen, Jolliffe, Mortimore, & Robertson, 1997; Olderbak, Wilhelm, Hildebrandt, & Quoidbach, 2019), we also planned to explore gender differences in the ability to recognize emotions from the eyes.

In summary, the current study analyzed effects of the government mandated Covid-19 protection measures of contact restrictions and mask wearing on mood and emotion perception.

Method

Participants

The study's design, hypotheses and analysis plan were preregistered with the Open Science framework (<http://osf.io/7g4ds>). As preregistered, participants were recruited for 2 weeks, leading to a sample of $N = 115$ German-speaking adult participants volunteered to take part in the online questionnaire after informed consent was given. One participant was excluded due to incorrectly entered self-reports of social interaction durations and six participants did not pass the control items, leading to a final sample of 108 participants (75 female, age: 18.30 - 69.82 years, $M = 30.64$, $SD = 15.77$, 95% CI [27.64, 33.65]). Participants could win one of two 15€ vouchers (Wunschgutschein.de) and receive course credit for their participation.

Study Design

In an observational between-participants design, the average self-reported time spent with people with and without masks for a typical week was measured for face-to-face and virtual situations. Further dependent variables were the ability to recognize emotion from the eyes measured through the score on the Reading the Mind in the Eyes Test - Adult Version (Baron-Cohen et al., 1997) and the current negative mood measured through the score on the Aktuelle Stimmungsskala (ASTS) (Dalbert, 2002).

A subsample including only university students between 18 and 25 years of age ($n = 65$, 50 females and 15 males) was compared with a recent student sample tested before the pandemic (Open Data by Valuch and Kulke (2020), $n = 55$, 35 females and 20 males). The full adult sample was also compared with the mean of the neurotypical sample tested by Baron-Cohen, Wheelwright, Hill, Raste, and Plumb (2001).

Procedure

Questionnaires were implemented using SoSci Survey (Leiner, 2019) and could be filled in on computers and smartphones. After providing informed consent and demographic information, participants completed the RMET, followed by two control items, which were similar to RMET items but had an easy and unambiguously correct answer to check task compliance. Participants then estimated the time they spend with people in face-to-face and virtual situations with and without masks for each day of a typical week and filled in the ASTS mood questionnaire.

Data Preparation

Data retrieved from SoSci Survey were prepared for analysis in R (version 4.0.2). *RMET score* and *ASTS score* were computed according to the manuals. For two participants, a typo was corrected¹. The same results are obtained excluding these participants. The average interaction time for a typical day of the different interaction categories was computed. The following indices were computed: The proportion of time spent in face-to-face / online / both situations with people wearing masks compared to people without masks; proportion of face-to-face in relation to all interactions. Bayes factors and effect sizes were computed using the BayesFactor package (Morey & Rouder, 2015). For linear models, robust standard errors were computed using the *coefest* function from the *lmtest* package (Zeileis & Hothorn, 2002).

Results

Table 1 shows descriptive statistics for socio-demographics, RMET score, ASTS score and the different interaction categories.

Mood

Proportion of face-to-face interaction among all interactions was a significant predictor for the current negative mood ($b = -33.55$, $\beta = -0.37$, $SE = 9.77$, $t = -3.43$, $p = .001$), whereas the overall time spent with other people did not have a significant effect ($b = -0.12$, $\beta = -0.04$, $SE = 0.29$, $t = -0.41$, $p = .680$), model: $F(2, 105) = 8.94$, $p < .001$, adjusted $R^2 = 12.93\%$, $BF = 96.872$.

¹ One participant accidentally filled in the estimations for *hours* and *minutes* together in one field. Another

participant's smartphone autocorrected a zero to *OK*, which we corrected.

Table 1

Means, standard deviations, confidence intervals and correlations for age, housemates, RMET score, ASTS score and the different interaction time variables (n = 108).

				Correlations							
	<i>M</i>	<i>SD</i>	95% CI	1.	2.	3.	4.	5.	6.	7.	8.
1. Age	30.64	15.77	27.63, 33.65	1.00							
2. Housemates ^a	2.88	1.32	2.63, 3.13	-.27**	1.00						
3. RMET score	25.81	3.51	25.14, 26.48	-.55***	.06	1.00					
4. ASTS score	52.06	16.64	49.80, 56.15	-.22*	.01	.20*	1.00				
5. Time face-to-face with mask ^b	1.15	1.53	0.86, 1.45	.11	-.00	-.05	-.03	1.00			
6. Time face-to-face without mask ^b	6.81	5.08	5.84, 7.77	.02	.20*	-.02	-.27**	.05	1.00		
7. Time virtual with mask ^b	0.03	0.18	-0.01, 0.06	.03	-.18	-.18	-.16	.10	-.12	1.00	
8. Time virtual without mask ^b	1.41	1.1	1.20, 1.62	-0.18	0.01	0.04	0.26**	-0.19*	-0.18	0.07	1.00

* $p < .05$, ** $p < .01$, *** $p < .001$

^anumber of people living together with the study participants including themselves.

^btime estimations for the different categories averaged over a typical week.

An exploratory analysis with the overall time spent in face-to-face interactions and the overall time spent in virtual interactions as predictors ($F(2, 105) = 5.71, p = .004$, adjusted $R^2 = 8.09\%$, $BF = 7.396$) revealed that mood was better if more time was spent

with people face-to-face ($b = -0.68, \beta = -0.22, SE = 0.28, t = -2.44, p = .016$), while virtual interactions had no significant relation to mood ($b = 2.60, \beta = 0.18, SE = 1.58, t = 1.64, p = .104$), see Figure 1.

Figure 1. Linear regression analyses for the current mood predicted from face-to-face, virtual, and total interaction time.

Emotion recognition

The independent sample t -test revealed a significantly higher mean of the RMET Score in our student subsample tested during the pandemic than in the sample tested before the pandemic ($M_1 = 25.82, SD_1 = 3.41, 95\% CI_1 [24.90, 26.74]$, $M_2 = 26.92, SD_2 = 3.15, 95\% CI_2 [26.14, 27.70]$, $t(118) = 1.85, p = .068$, two-sided compared to $p_{crit} = .10, 95\% CI [-0.08, 2.29]$, $d = 0.34, BF = 0.897$). The one sample t -test to compare our full sample with the mean values of typical adults tested by Baron-Cohen et al. was not significant (Baron-Cohen et al. (2001): $M = 26.2$, current sample: $M = 25.81, SD = 3.51, t(107) = -1.14, p = .256, 95\% CI [25.15, 26.48]$, $d = 0.11, BF = 0.201$).

An exploratory linear model ($F(4, 115) = 4.96, p = .001$, adjusted $R^2 = 11.7\%$, $BF = 12.040$) to control for further possible influences in the comparison between our student sample and the sample tested by Valuch and Kulke (2020) included gender ($b = -1.67, SE = 0.67, t = -2.50, p = .014$), age ($b = -0.12, SE = 0.14, t = -0.86, p = .393$), psychology student status ($b = 1.13, SE = 0.76, t = 1.50, p = .137$) and the sample (before or during the pandemic) ($b = -0.42, SE = 0.65, t = -0.65, p = .516$) as predictors. In this model, only gender was a significant predictor for the RMET Score.

Linear models for the proportion of time spent with people wearing masks in face-to-face interactions ($F(1, 106) = 0.72, p = .399, R^2 = 0.67\%$, $BF = 0.281$) and the proportion of time spent with people wearing masks among all interactions ($F(1, 106) = 1.23, p = .270, R^2 = 1.15\%$, $BF = 0.353$) were not significant. The linear model predicting the proportion of time spent with people wearing masks in digital interactions was significant ($F(1, 106) = 4.03, p = .047, R^2 = 3.67\%$, $BF = 1.217$), but contrary to our hypothesis. The effect furthermore seems unreliable due to the small variation in the proportion of time with most people not spending any time in virtual conversations with people wearing masks.

Planned exploratory analysis

A two-way ANOVA was conducted to predict the RMET score from gender (female vs. male) and sample (full current study vs. study by Valuch & Kulke, 2020), showing a female superiority in the RMET ($M_{female1} = 26.20, SD_{female1} = 3.27, 95\% CI [25.08, 27.32]$, $M_{female2} = 26.49, SD_{female2} = 3.37, 95\% CI [25.72, 27.27]$, $M_{male1} = 25.15, SD_{male1} = 3.62, 95\% CI [23.46, 26.84]$, $M_{male2} = 24.27, SD_{male2} = 3.36, 95\% CI [23.08, 25.46]$, $F(1, 159) = 10.14, p = .002, f = 0.25, BF = 17.352$). The main effect of

sample ($F(1, 159) = 0.04, p = .847, f = 0.02, BF = 0.178$) and the interaction effect between gender and sample ($F(1, 159) = 0.98, p = .323, f = 0.08, BF = 0.389$) were both not significant. Gender effects in the current sample were explored using a t -test, confirming female superiority in the RMET within the current sample ($M_{female} = 26.49, SD_{female} = 3.37, 95\% CI_{female} [25.72, 27.28], M_{male} = 24.27, SD_{male} = 3.36, 95\% CI_{male} [23.08, 25.46], t(106) = 3.16, p = .002, 95\% CI [0.83, 3.62], d = 0.66, BF = 15.84$).

Exploratory Analyses

Because of the gender differences in the student sample and the sample by Valuch and Kulke (2020) and the role of gender in the process of emotion recognition from the eyes, we divided the student sample and the sample of Valuch and Kulke (2020) in a female and a male subsample. The independent sample t -test for the male subsample was not significant ($M_1 = 25.15, SD_1 = 3.62, 95\% CI [23.46, 26.84], M_2 = 24.47, SD_2 = 2.88, 95\% CI [22.87, 26.06], t(33) = -0.60, p = .551, 95\% CI [-2.99, 1.63], d = 0.21, BF = 0.377$), but the one for the females was significant ($M_1 = 26.20, SD_1 = 3.27, 95\% CI [25.08, 27.32], M_2 = 27.66, SD_2 = 2.86, 95\% CI [26.85, 28.47], t(83) = 2.18, p = .032, 95\% CI [0.13, 2.79], d = 0.48, BF = 1.777$).

Discussion

In our sample tested during the COVID-19 pandemic, mood was better if more time was spent with people in face-to-face interactions, whereas virtual interactions had no such positive relation to mood. Emotion recognition from the eyes was marginally better in the current sample compared to a recent pre-pandemic sample but there was no relation between the time spent with people wearing masks and emotion recognition from the eyes. The previously reported female superiority in emotion recognition from the eyes was replicated. Moreover, the improvement in

emotion recognition from the eyes seemed to be stronger for the female students.

We originally hypothesized that the time one spends with other people is positively related to mood, independent of whether one meets face-to-face or virtually. This hypothesis was not confirmed by our data, as only the time spent in face-to-face situations was positively related to mood. This finding is in line with previous studies which suggested that face-to-face interactions have benefits for psychological well-being (Cacioppo et al., 2014). This finding cannot alternatively be explained by the fact that people who live with more other people were generally in a better mood and interacting with their housemates more, as the correlation between the mood score and the number of housemates was not significant (see Table 1 above). As virtual interactions did not have a comparable positive effect as face-to-face interactions but, in contrast, tended to be negatively related to mood, merely interacting with others virtually cannot simply replace face-to-face interactions. Thus, even video-based interactions, as regarded in the current study, might be similarly ineffective as phone or email contacts (Teo et al., 2015).

The current study was the first to collect data relating time spent in virtual and face-to-face contexts to mood and emotion recognition, but it has some limitations. For example, we did not collect further information on whether face-to-face and virtual interactions were with friends, family, work associates or other people. Due to the home office recommendation in Germany, many virtual meetings may be work-related and as university classes were moved online, virtual meetings may also be study-related in the student population tested in the current study. An alternative explanation is therefore, that only meetings with friends have a positive effect on mood but not meetings in a work-related or study-related context. Since the first lockdown and contact restrictions video-based communication tools have enjoyed rising

popularity (Statista, 2021), making it easier and relevant to investigate differences between video-based and face-to-face communication. This cross-sectional study reported some interesting preliminary findings; however, future research should longitudinally collect information about the time spent in virtual and face-to-face interactions and not only rely on self-reports.

As people spend more time interacting with others wearing masks, we hypothesized that they may develop improved emotion recognition from the eyes; however, this was only partially observed in the current study. It should be noted that the current study was purely observational and not experimental. As all people were simultaneously affected by the pandemic, a manipulation of mask exposure was not possible. Furthermore, both samples included different participants, tested at different points in time. Historic or demographic factors may therefore have contributed to the observed findings. Accordingly, in addition to replicating the female superiority in emotion recognition from the eyes (Kirkland et al., 2013, Olderbak et al., 2019) we observed that the differences between the samples before and during the pandemic were highest in female students. The general female superiority may be helpful for quicker or better adaptation to the current situation, leading to improvements in emotion recognition from the eyes due to the mask-wearing only for female students. As the separate

analyses for different genders were exploratory, they should be interpreted with caution and more studies are necessary to appropriately investigate the possible relationship between gender and adaptation to the pandemic situation. Moreover, the current study did not find a relation between mask exposure and RMET score. However, the variance within our sample may have been too small as all participants were exposed to others wearing masks to a similar degree.

In summary, our cross-sectional observational study investigated relations of the sudden societal changes during the pandemic, replacement of face-to-face with virtual interactions and wearing of masks on mood and emotion recognition from eyes. The ability to recognize emotion from the eyes was better during the pandemic than before, but improvement only seemed to appear for females who were also generally better at emotion recognition from the eyes. Mood was related to face-to-face but not to virtual social interactions, suggesting that the positive psychological effect of social interactions cannot simply be replaced by virtual interactions of any kind.

Data availability

All data will be openly shared on the Open Science Framework.

Disclosure statement

The authors report no conflict of interest.

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