The current global pandemic situation due to the Covid-19 has implied several consequences at all psychological levels. One of the main differences with respect to the pre-pandemic life in most of countries around the world is the obligation to wear a mask for citizens. This new habit could have several issues for human relationships. The current research aimed to explore the effect of wearing a mask on both emotion recognition and perception of attractiveness. Two hundred and two participants completed a task consisting of 24 face images presented twice, with and without mask. Of them, there were six images for emotion: anger, sadness, fear, and happiness. The results showed that emotion recognition was worse when wearing a face mask except for surprise: happiness, η^2 = .84; anger, η^2 = .74; anger, η^2 = 52. Moreover, wearing a mask enhanced the perception of attractiveness both in male and female in all emotions except for happiness: sadness, η^2 = .22; surprise, η^2 = .05, and anger, η^2 = .03. Finally, social implications and limitations of the study are discussed.

Keywords: Covid-19; mask; emotion recognition; attractiveness

Introduction

The ability to recognize facial emotions is probably a strongly developed skill by human beings. In this sense, the recognition of facial emotions corresponds to a universal ability that allows an adequate social interaction (Ekman, 1993). In addition, facial emotions are considered as signals of high biological value, since they have evolved to respond to a communicative function between conspecifics (Pavlova, Scheffler, & Sokolov, 2015).

Also, facial expressions can transfer essential information for proper communication and social interaction, for example, about static conditions of the face such as age or gender, and even dynamic issues such as eye or lip movements (Wegrzyn, Vogt, Kireclioglu, Schneider, & Kissler, 2017). The information extracted from facial emotions provides an insight into the emotion experienced at the moment of recognition. It also contributes to the way emotion is perceived and the development of a behaviour in the observer (Dyck et al., 2008; Reissland, Francis, Mason, & Lincoln, 2011).

During facial emotion recognition, an ocular sweep of the face occurs holistically, which allows the interpretation of the emotion by identifying the underlying muscles involved in the emotion (Martinez, 2017; Wang, Li, Fang, Tian, & Liu, 2012). In this way, observers seek to focus their attention on significant parts to distinguish facial emotions (Rapcsak, 2019). According to (Guo, 2012), the eye region is usually the frequent area of observation to differentiate emotional expressions, as well as the nose

and mouth. Other studies indicate that basic emotion expressions would be associated with a set of features; for example, the emotion of fear would be linked to the eyes mostly in order to identify this facial feature. In contrast, joy would be mostly linked to the mouth for its better identification, although the region of the eyebrows, cheeks and lower eyelid tension contribute to its detection (Guo, 2012; Smith, Cottrell, Gosselin, & Schyns, 2005). Therefore, to carry out proper emotion recognition, observers decode this information to effectively access emotional information (Jack & Schyns, 2015).

Currently, the global pandemic period has forced the use of face masks, with the aim of decreasing the Public Health burden of COVID-19 infection worldwide (Li et al., 2020). Considering that the use of face masks is currently a COVID-19 infection mitigation strategy, the world population is forced to use them daily along with other measures to prevent the spread of the virus (Asadi et al., 2020). This could influence the recognition of facial emotions, since an important part of the face is not available for analysis (Dhamecha, Singh, Vatsa, & Kumar, 2014). In this sense, there are studies that indicate that observing the face in a partial manner can contribute to a significant loss of emotional cues (Koster, Verschuere, Burssens, Custers, & Crombez, 2007). For example, the eyes and mouth allow access to information relevant to emotional labelling, as in the case of positive emotions, where there is greater fixation in the mouth region (Smith et al., 2005). This is currently hidden by the use of surgical masks or others. On the other hand, visual fixation in the eyes is linked to negative emotions such as fear or sadness (Sullivan, Ruffman, & Hutton, 2007). In addition, the daily use of facemasks may increase the difficulty in interpreting the subtlety of some facial expressions (Freud, Stajduhar, Rosenbaum, Avidan, & Ganel, 2020; Gao & Maurer, 2010).

Therefore, it is worth noting that facial emotion recognition accuracy is significantly reduced when important elements of the face (eyes, nose, and mouth) are excluded (Stephan & Caine, 2007). Other studies with similar findings suggest that the use of surgical masks may strongly affect facial emotion recognition performance (Carragher & Hancock, 2020).

Additionally, to the difficulties shown after the use of surgical masks or other tissues, the difficulty of beauty perception can be added. Facial attractiveness is a powerful signal that influences social communication and sexual behaviour (Parsons et al., 2013). In this sense, the lower face has been strongly linked to beauty traits (Patel, Mazzaferro, Sarwer, & Bartlett, 2020). Some studies have pointed out that the areas related to beauty would be those where the nasolabial fold would be narrow, labial commissure wide, and upper lip vermilion prominent (Maestripieri, Henry, & Nickels, 2017). However, there is still no consensus on what would be considered beauty, although many point to previously described facial features among other issues (Brielmann & Pelli, 2019; Brielmann, Vale, & Pelli, 2017). In addition, people who are singled out as having greater attractiveness are often treated more positively compared to those whose facial features are considered less attractive. This could contribute to cognitive biases, such as attributing facial beauty to good features (if it is beautiful it is good) (Langlois et al., 2000). In relation to the above, there are studies that suggest that facial features displaying greater beauty would be processed by the limbic system and the involvement of the reward system. This is a relevant issue, since it could increase the liking to and desire for faces with more attractive facial features (Chelnokova et al., 2014). Consequently, the use of face masks could conceal important parts of the perception of the beauty of faces. However, some studies suggest that it could increase

the perception of beauty after this loss of information (Patel et al., 2020). This could facilitate social interaction and even sexual interaction.

From all of the above, the present study has two objectives. The first one is to analyse how the use of a mask affects both male and female recognition of facial emotions after its use. The second one is to analyse the influence of mask use on the perception of facial attractiveness according to sex. The use of surgical-type masks was hypothesised to hinder facial emotion recognition of any emotion (happiness, sadness, anger, and surprise). Conversely, the perception of attractiveness was hypothesized to increase when a surgical mask was utilized when experimenting any emotion.

Method

Participants

The study sample was made up of 202 participants incidentally taken from the Spanish general population. Their ages ranged from 18 to 63 years (M = 26.06, SD = 10.65). Of them, 53 (26.2%) were men and 149 (73.8%) were women. Regarding their marital status, 153 (75.7%) were unmarried, 44 (21.8%) were married or living with their partners, and 5 (2.5%) were divorced. The educational level distribution of the sample was as follows: elementary studies not completed (n = 2, 1.0%), elementary studies completed (n = 35, 17.3%), secondary studies (n = 20, 9.9%), professional education (n = 6, 3.0%), and possessing a university degree (n = 139, 68.8%). Finally, regarding the socio-economic level, the annual income distribution was as follows: 31 (15.3%) earned less than 5000 euros; 17 (8.4%) earned 5000-10000 euros; 34 (16.8%) earned 11000-15000 euros; 33 (16.3%) earned 16000-20000 euros; 34 (16.8%) earned 21000-30000 euros; 22 (10.9%) earned 31000-40000 euros; 16 (7.9%) earned 41000-

50000 euros; and 15 (7.4%) earned more than 50000 euros. The only requirement for taking part in the study was being 18 or older.

Instrument

FACES (Ebner, Riediger, & Lindenberger, 2010). A racially heterogeneous set of 24 male and 24 female faces was randomly obtained from the Face Database. It is a set of high-resolution images of subjects' faces aged between 18 and 50 years, which is available to researchers as a free resource. Each face was presented twice, with mask and without mask; to do so, the faces were altered to simulate the appearance of wearing a surgical mask using Photoshop 7.0 (Fig. 1). The basic emotions of happiness, anger, sadness and surprise were included. There were six pictures for each emotion and each condition (with and without mask). The mask used throughout the test was a light blue surgical-type mask, whose measures were similar to the real ones (9 centimetres wide and 17 centimetres long).All the masks had white elastic ear loops to be worn around the ears, and displayed the same design (three folds in the middle of the mask). In addition, all the masks had white top, bottom and side borders with dotted patterns of four successive lines). In all the faces, approximately the same measure of the face was covered (a 4-centimetre distance between the eyebrows and the top of the surgical mask).

All in all, there were 12 images of males wearing a mask, 12 images of males without a mask, 12 images of females wearing a mask, and 12 images of females without a mask. From another viewpoint, there were 6 images per emotion x 4 emotions x 2 conditions (with / without mask).

Procedure

The data-gathering procedure was carried out via Google Form, using the snowball technique with the general population over the age of 18. This procedure is based on research suggesting the validity of data gathered via the Internet (Herrero-Fernández, 2015). The link of the survey was sent out via different Internet-based applications, such as email, Facebook and WhatsApp. The survey started with an explanatory letter containing the following information: organisation supporting the study; content and main general goals of the study; duration and elements to be measured; informed consent; willingness to do the study; and confidentiality and anonymity of the obtained data. The participants agreed to participate in the study by clicking the option "I agree to the conditions derived from taking part in the study". No identification data were collected. The study was approved by the Ethics Committee of the European University of the Atlantic. A series of 24 masked and 24 unmasked faces were then randomly presented. Participants had to indicate the type of emotion (happiness, sadness, anger, surprise), as well as to rate the attractiveness of each face on a scale from -5 (extremely unattractive) to +5 (extremely attractive), being 0 = neutral.

Results

First, the ability to perceive the emotion of the faces was analysed through a one-way mixed MANOVA (Wilk´s lambda). The gender of the participant was the between-subject variable, whereas the fact of taking or not mask in each one of the four emotions was the within-group variable. In this case, both significance and effect size (η^2) of between-subject, within-group and interaction were analysed. Differences in the ability in each one of the emotions with and without mask were stablished by comparing the 95% C.I of the effect sizes (Nelson, 2016). They were interpreted following Cohen´s criterion, so values under .04 were considered small effect sizes; between .04 and .14,

medium effect sizes, and above .14, large effect sizes (Cohen, 1992). Finally, statistical power (1 – β) was analysed with G*Power 3.1 (Faul, Erdfelder, Lang, & Buchner, 2007), due to the sample size being relatively small.

The results showed a significant multivariate effect for the ability to recognize emotions when taking or not mask, $F(4, 197) = 397.95$, $p < .001$, $\eta^2 = .89$ (95% CI: .87 – .90), 1 – β = 100%. However, no significant effect was obtained neither by gender, $F(4, 197) = 2.08$, $p = .084$, 1 – β = 82.31%, nor in the interaction, $F(4, 197) = 0.93$, $p = .813$, 1 – β = 82.31%. Univariate statistics suggested significant effects in the case of happiness, sadness, anger and the total score when comparing faces with and without mask. No significant effect was observed in the case of surprise. The results are detailed in Table 1. As can be observed, all the effect sizes were large, but the comparison of their confidence intervals showed that happiness was the emotion with larger differences in the ability to be perceived with and without mask, followed by anger, and then by sadness. When the total ability to recognize the emotion with mask was compared with this ability without mask, a very large effect size was also obtained.

[Table 1]

Secondly, differences in the perception of beautifulness for each emotion both with and without mask were analysed, considering the effect of the respondent´s gender. Therefore, a one-way mixed MANOVA (Wilk´s lambda) was also conducted. The gender of the participant was the between-subject variable, whereas fact of taking or not mask in each one of the four emotions was the within-group variable. Like in the previous case, both significance and effect size (η^2) of between-subject, within-group and interaction were analysed. The results showed no significant interaction effect, $F(4,$

197) = 2.22, p = .068, 1 – β = 82.31%. However, there were significant effects both in the between-subject contrast, $F(4, 197) = 4.45$, p = .002, η^2 = .08 (95% CI: .01 – .14), 1 – β = 98.65%, and in the within-group contrast, $F(4, 197) = 17.78$, $p < .001$, η^2 = .27 (95% CI: .16 – .35), 1 – β = 100%.

Univariate contrasts showed significant effects on all the emotions, except for happiness, $F(1, 200) = 1.93$, p = .166. Then, surprise, $F(1, 200) = 10.49$, p = .001, η^2 = .05 (95% CI: .01 – .12); sadness, $F(1, 200) = 55.25$, $p < .001$, η^2 = .22 (95% CI: .13 – .31); anger, $F(1, 200) = 5.40$, p = .021, η^2 = .03 (95% CI: .00 – .09); and the total score, $F(1, 200) = 19.42$, $p < .001$, η^2 = .09 (95% CI: .03 – .17).

Regarding gender, there was a significant effect only in the case of anger, $F(1, 200)$ = 7.99, p = .005, η^2 = .04 (95% CI: .00 – .10). There was no significant effect in the rest of the comparisons; happiness, $F(1, 200) < 0.01$, p = .991; surprise, $F(1, 200) = 0.01$, p = .941; sadness, $F(1, 200) = 0.46$, p = .497; and total score, $F(1, 200) = 1.60$, p = .207.

Moreover, these results were detailed in Table 2. As can be observed, more beautifulness was perceived in the no-mask condition in all the emotions, except for happiness, where there was no significant difference. On the other hand, gender differences were similar in all the cases except for anger, when male perceived same beautifulness with and without mask, but female perceived more beautifulness in the condition without mask.

[Table 2]

Discussion

The present study aimed to analyze how facial emotion recognition is affected by the use of the mask and its influence on the perception of facial attractiveness in relation to gender.

The results of the present study suggest that men and women recognize basic emotions equally. Furthermore, sex does not influence emotion perception with or without masks. However, the use of surgical masks hinders facial recognition of emotions in both sexes. In this sense, negative emotions such as sadness and anger would be affected in emotion recognition after surgical mask use. However, the emotion of happiness would be the most impaired by the use of surgical masks in relation to the perception of emotions. On the other hand, surprise is perceived equally with or without surgical mask. Similar data have been reported, indicating that facial emotion recognition shows lower accuracy when a part of the face is covered and no sex differences in emotion perception are observed (Dhamecha, Singh, Vatsa, & Kumar, 2014). Another study suggests that emotion perception is reduced when access to certain facial features is eliminated (Stephan & Caine, 2007). In addition, it has been posited that there are parts of the face relevant for adequate recognition, namely the upper part of the face (eyebrows and eyes) as opposed to the lower part of the face (e.g., mouth, nose, and chin) (Dal Martello & Maloney, 2006; Ho, Boffa, & Palanker, 2019). A miss-location or a poor attention targeting on the face viewed could affect the ability to identify emotions in others.

Although the lower part of the face is indicated as having less information load for recognition, it is worth noting that the lower part of the face may have less access to facial emotion information if it is covered. In this sense, there are studies that indicate that covering the mouth reduces the accuracy of emotion recognition compared to not covering it (Smith et al., 2005). This could be due to the implication of holistic facial

emotion recognition, since the observer loses spatial information of facial features (Freud et al., 2020). Furthermore, covering the mouth has been related to worse recognition of happiness and would affect face recognition memory (Nguyen & Pezdek, 2017). This could be related to the data obtained in the present study, indicating that the most affected emotion is happiness given that it is the facial feature denoting an implication of relevance which is covered by the surgical mask. In contrast, emotions such as anger, surprise and sadness would be less affected because much of the emotional cues would be available to the observer (Sullivan Ruffman, & Hutton, 2007).

In relation to the second objective of the present study — perception of attractiveness according to sex—, the results suggest that sex does not influence the perception of attractiveness according to sex in most facial emotions. However, in relation to the emotion of anger, women perceive greater attractiveness after the use of the mask. On the other hand, irrespective of sex, the results suggest that the emotion of happiness is perceived as equally attractive with and without a surgical mask. However, the emotions of sadness, anger and surprise are perceived as more attractive after the use of the surgical mask. In this sense, the perception of a greater degree of attractiveness in anger after the use of a surgical mask could be due to the fact that the mask softens facial features that could be more threatening (Neel, Becker, Neuberg, & Kenrick, 2012). The surgical mask serves a protective function, minimizing the cost of coping with a more aversive emotion (Oosterhof, & Todorov, 2009),taking into consideration that the low, close-set eyebrows would be uncovered and part of the mouth (as a hermetically sealed square or triangle shape) would be hidden by the use of the surgical mask (Ekman, 2016). On the other hand, although the facial features of the periorbital area and the eyes have been indicated as part of the beauty of a face, there are studies that indicate that there are other elements that contribute to the perception of

attractiveness (Patel, Mazzaferro, Sarwer, & Bartlett, 2020). Accordingly, the symmetry of the facial features of the midface covered by surgical mask could contribute to the perception of beauty (Sarwer, 2019). In this sense, facial attractiveness is not only a mere cultural issue, but can be reflected from an evolutionary perspectiveas facial symmetry contributes to the function of biological traits with reproductive potential, health or prosocial behaviours (Laeng, Vermeer, & Sulutvedt, 2013). In contrast, facial asymmetry is often considered less attractive, thus contributing to less attractive personality trait ratings (Hartung et al., 2019).

The practical implications of this study are broad and applicable to the current COVID-19 pandemic situation. In this sense, wearing a translucent mask could improve the perception of emotions, which would favour social interaction. Along these lines, the use of translucent masks could have a positive impact on the mental health context. There are pathologies that show a much poorer emotional recognition, which could be further worsened if we add the hindrance of the surgical mask.. On the other hand, those born during the COVID-19 pandemic are deprived of the possibility of accessing all facial information. This suggests an involvement in various areas of social life. On the other hand, given the difficulties in the perception of emotions with the use of surgical masks, these could be a benefit when it comes to establishing romantic relationships, given that the use of surgical masks would increase the perception of attractiveness. This could be an advantage when establishing contact with other people.

In the future, studying the influence of perceived beauty depending on the type of mask used (fabric masks with designs and colors or other materials) could prove a fruitful field of research. In addition, and given that the present study has only considered Caucasian people (both participants and stimuli), the effect of the mask-wearer's race should be analyzed. It would be useful to analyse the capacity for

socialization, stereotypes or prejudices associated with the use and type of mask. Finally, it would be useful to incorporate the perception of emotions with the use of masks on dynamic faces and not only static ones. Relevant for future studies would be the addition of new conditions, such as covering the eyes and leaving the lower part of the face visible, as well as adding other elements to new experimental conditions, with the aim of finding out their effects. Finally, future studies should also contemplate other measures of individual differences, such as the age, race equality/inequality effect of participants and stimuli.

Last but not least, the present study has some limitations that must be considered. Firstly, response time in emotion recognition, which could provide more information, has not been measured. Secondly, the sample was mostly composed of women; it would be relevant to consider a larger number of men in future studies. Thirdly, static images may not necessarily reflect the vividness and true form of dynamic facial expressions that occur in everyday life. Lastly, the fact that the mask is worn and that only the upper part of the face is visible may imply restricted to global information which should be taken into account for future studies.

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Fig. 1. Example of face with and without mask

Table 1. Univariate differences by taking or not mask in recognition of each one of the assessed emotions

	With Mask		Without Mask		*F*	η^2	95% C.I. η^2
	M	SD	M	SD			
Happiness	4.98	0.26	5.95	0.26	1052.88*	.84	.80 – .87
Surprise	5.28	0.74	5.36	0.85	1.11	.01	.00 – .05
Sadness	4.73	0.59	5.65	0.61	217.75*	.52	.43 – .59
Anger	4.58	0.59	5.85	0.45	571.60*	.74	.68 – .78
Total score	19.57	1.25	22.81	1.31	785.87*	.80	.75 – .83

*$p < .001$.

Table 2. Interaction effect of gender and condition (with or without mask) in the perception of beautifulness

	Male						Female					
	With Mask		Without Mask				With Mask		Without Mask			
	M	SD	M	SD	*F*	η^2	M	SD	M	SD	*F*	η^2
Happiness	0.62	10.56	1.19	10.84	0.91	.01	6.80	10.00	7.36	11.32	1.65	.01
Surprise	-6.00	9.24	-7.25	9.48	5.26*	.09	-3.54	8.38	-4.72	8.99	8.65**	.06
Sadness	-6.68	9.11	-9.08	9.26	20.70***	.29	-3.03	8.98	-5.91	9.05	57.60***	.28
Anger	-6.66	9.45	-6.49	9.51	0.12	.00	-4.29	9.37	-6.03	10.13	23.03***	.14
Total score	-18.72	34.92	-21.62	33.64	6.67*	.11	-4.06	30.86	-9.31	31.66	26.09***	.15

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