

This document is currently under peer review, its content is provisional

Psychological and situational effects on social distancing and well-being during the COVID-19 pandemic: not a question of real risk

Tina Iachini¹, Francesca Frassinetti², Francesco Ruotolo^{1*}, Filomena Leonela Sbordone¹, Antonella Ferrara¹, Maria Arioli³, Francesca Pazzaglia⁴, Andrea Bosco⁵, Michela Candini², Antonella Lopez⁵, Alessandro Oronzo Caffò⁵, Zaira Cattaneo³, Ferdinando Fornara⁶, Gennaro Ruggiero¹

¹*Department of Psychology, Università degli Studi della Campania “L. Vanvitelli”, Caserta, Italy*

²*Department of Psychology, Università di Bologna, Bologna, Italy*

³*Department of Psychology, Università degli Studi di Milano-Bicocca, Milano, Italy*

⁴*Department of General Psychology, Università degli Studi di Padova, Padova, Italy*

⁵*Department of Educational Sciences, Psychology, Communication, Università degli Studi di Bari Aldo Moro, Bari, Italy*

⁶*Department of Pedagogy, Psychology, Philosophy, Università di Cagliari, Cagliari, Italy*

Corresponding author:

*Francesco Ruotolo, PhD

Department of Psychology

Università degli Studi della Campania “L. Vanvitelli”,

viale Ellittico 31, 81100

Caserta, Italy

francesco.ruotolo@unicampania.it

Abstract

Keeping a large interpersonal space (IPS) is one of the most important measures to counter the COVID-19 pandemic. The IPS is automatically modulated according to primary affiliation and defence needs aimed at protecting our physical and psychological well-being. Through a multicentric online survey (1293 respondents) in six Italian regions during the lockdown (April-May 2020), we investigated the psychological and situational factors that influenced the regulation of IPS and psychological well-being. The results showed that the IPS was modulated according to perceived rather than actual risk of COVID-19 infection. This perception was influenced by institutional communication and citizen satisfaction in local Healthcare Systems. Higher levels of anxiety, stress and feeling of insecurity, exacerbated by situational factors linked to the context of life, led to an increase in IPS at the expense of psychological well-being. Instead, the possibility to go out and seeing other people wearing a face-mask reduced the IPS. The findings provide useful insights into pandemic management to bring human behaviour in line with the recommendations of public health experts.

Keywords: Social Distancing; Interpersonal Space; COVID-19; Risk Perception; Media communication

Introduction

Since its first appearance in China, the COVID-19 pandemic has spread worldwide. One of the first countries to be hit after China was Italy. To contrast the pandemic, the whole country was submitted to a period of severe lockdown from March 9th to May 4th 2020 (Decree of the Prime Minister #iorestoacasa, 9 March 2020). In line with the World Health Organization (WHO, 2020) guidelines, the Italian government prescribed to keep interpersonal social distances of at least one meter in public spaces, along with wearing face-masks and frequent hand washing. In those days, marked by the number of dead and infected people that the Civil Protection communicated daily, there was a social climate of anxiety, concern and awareness of the need for confinement. The measure has been quite effective since the epidemic curve showed an increasing trend until March 20th 2020 followed by a constant decrease (National updating, ISS, May 14th 2020).

What can this lockdown tell us about how to manage a pandemic?

We are now aware that avoiding crowds while maintaining a wide social distance is a fundamental behaviour to slow down the pandemic (Arslan et al., 2020; López & Rodó, 2020) (for a review, Chu et al., 2020). The regulation of social distance from other people is automatically modulated in our daily life both by primary affiliation needs (e.g. individuals approach people if they feel lonely or need care) and by defensive needs (individuals keep risks or threats at a distance). Social psychology uses the term “personal space” to define an emotionally tinged area around our body that individuals feel like their private space and where any unwanted intrusion by others causes us discomfort, anger or fear (Hall, 1966; Hayduk, 1983; Lourenco et al., 2011). The regulation of this space between individuals is called “interpersonal space” (IPS; e.g., Hall, 1966; Hayduk, 1983; Sommer, 2002). Typically, individuals regulate IPS through two basic behaviours: people extend the distance when they feel in dangerous and uncomfortable situations (avoidance behaviour) and, vice-versa, people shrink the distance when they feel in friendly and safe situations (approach behaviour) (Hall, 1966; Holt et al., 2014; Kennedy et al., 2009; Lourenco et al., 2011; Sawada, 2003).

Proxemics literature has shown that IPS can be modulated by several psychological and situational factors (for reviews Bell et al., 2005; Hayduk, 1983; Lloyd, 2009; Sommer, 2002). In general, according to Hall's classic model (1966), the distance during more formal interactions (or social distance, up to 300 cm) is larger than the distance during more intimate interactions (or personal distance, up to 120 cm). Moreover, people prefer a larger IPS from males than females, and a larger IPS as the age of the interactants increases (Gifford, 1997; Gioiella, 1977; Hayduk, 1983; Iachini et al., 2016; Latta, 1978; Mishara et al., 1974; Winogrand, 1981). The size IPS also increases with higher anxiety levels (Brady & Walker, 1978; Iachini et al., 2015; Kaitz et al., 2004;

Layden et al., 2018) (for a review see Hayduk, 1983). Interestingly, the IPS is larger when people feel a high perceived risk in the presence of novel threats that cannot be controlled (e.g., Adams, 1995; Bish & Michie, 2010; Kappers et al., 2018; Wise et al., 2020). In this framework, how do individuals regulate the IPS if the threat is invisible? What are the consequences for our psychological well-being of having to maintain a larger IPS than we naturally implement?

To answer these questions, we tried to identify which psychological and situational factors contributed to determine the size of the IPS during the lockdown to counter the COVID-19 outbreak in Italy (in the period between April 23rd and May 2nd 2020). The Italian case is also interesting because in that period the severity of the pandemic changed strongly depending on the territorial areas. Here we focus on six regions that reflected different levels of severity of the pandemic: very high (Lombardy), medium-high (Veneto and Emilia-Romagna), medium-low (Campania and Apulia), very low (Sardinia). As shown in a report on patients who died in Italy based on data of July 22nd (Surveillance Group, ISS, 2020), the total number of deaths was 34.142, of which: Lombardy 49.1%, Emilia-Romagna 12.5%, Veneto 5.8%, Apulia 1.6%, Campania 1.3%, Sardinia 0.4%.

Our study therefore explores how the feeling of threat and perceived risk generated by the outbreak of COVID-19 infection affected the regulation of IPS. More specifically, we aimed at understanding: 1) the effect of people's age and gender, and of the face-mask wearing on the IPS; 2) the effect of perceived and actual COVID-19 risk in the six regions on IPS; 3) the factors that may have influenced perceived risk (e.g. actual risk, institutional communication on social media, satisfaction in the Healthcare Systems); 4) the effect of psychological reactions of anxiety and stress, sense of safety and social isolation on the IPS; 5) the effect of various situational factors (such as confinement days, cohabitants, housing situation and outings) on the IPS and psychological well-being.

To meet these aims, we presented an on-line survey to a sample of female and male participants (N= 1293) of different ages from the six regions representative of the Italian situation. The survey comprised a projective test on interpersonal social distance, that is the Interpersonal Visual Analogue Scale (IVAS, Iachini et al., 2016), standardized tests of anxiety (State-Trait Anxiety Inventory, STAI) and perceived stress (Perceived Stress Scale, PSS), and ad hoc questionnaires on various psychological reactions and situational factors during lockdown. The survey data were combined with objective data obtained from government sources, such as the actual risk of infection by region, institutional communication on social media and the degree of satisfaction of local health systems.

The results of the study could provide useful information on the psychological reactions and needs of the population during a lockdown (e.g., Kazak, 2020; Bavel et al., 2020; Lewnard & Lo, 2020; Götz et al., 2020). Moreover, from a theoretical perspective, they can help us to understand how social isolation and the perceived or actual risk of infection influence the anticipatory mechanisms linked to the defensive function of IPS.

METHOD

Participants

The survey was conducted over 10 days (April 23rd - May 2nd 2020) during the so-called "Phase 1" of the Italian mitigation strategy of the COVID-19 through lockdown. The sample size was estimated with G*Power 3.1 (Faul, Erdfelder, Buchner, & Lang, 2009). The α was set to .05 and Power to 0.95. Analysis indicated a total of 1145 participants to detect a small effect size (.02), 160 for a medium effect size (.15) and 74 for a large effect size (.35). A total of 1293 participants ($F=854$, $M=439$) aged 18 to 82 years ($M=35.53$, $SD=16.05$) took part in the study. Since 142 respondents did not complete the survey, they were excluded from the final sample. The survey required demographic data (i.e., age, sex, level of education, type of employment, province and region of residence). Six Italian Universities collaborated in the data collection (i.e., University of Bologna, University of Bari, University of Cagliari, University of Campania, University of Study Milano-Bicocca, University of Padova). As regards sample composition, the number of participants by each region is the following: Lombardy=218, Emilia-Romagna=211, Veneto=184, Campania=314, Apulia=210, Sardinia=156. Informed consent was obtained from all participants. Recruitment and testing were in accordance with the ethical standards of the Institutional Review Board of the Department of Psychology (University of Campania; N.8 prot.#16.20) and with the Declaration of Helsinki (2013).

Materials

1) Measures of IPS

IVAS. A modified on-line version of the IVAS (Interpersonal Visual Analogue Scale) paper and pencil test was used (Iachini et al., 2016). The IVAS measures the preferred interpersonal distance of participants. Participants were presented with images depicting two different characters on opposite sides of a line: one character (male or female) for the participant (Self), the other for

another person (Confederate). The confederate could be a male or female child, or young adult or elderly. Participants had to indicate, by moving a slider, their preferred interpersonal distance from the confederates (from 100 (max distance) to 0 (no distance)).

Interpersonal distance with or without face-mask. Participants had to indicate what was the distance from others that made them feel comfortable with or without face-mask. For this measure, two items were used: 1) “With mask”; 2) “Without mask”. Participants had to indicate the distance on an 8-point Likert scale, ranging from 1 = “.50 meter” to 8 = “4 meters”.

2. Perceived risk

Four questions investigated how risky people perceived the COVID-19 virus. The questions concerned: (i) the General perceived risk, i.e. how much dangerous people considered the COVID-19 per se, independently of their contingent situation, and (ii) the Local perceived risk, i.e. how much dangerous people considered the COVID-19 in the place where they lived. In both cases people had to relate their beliefs to two times: in the present and in the future. Scores could vary from 100 (max risk) to 0 (no risk)

3. Psychological factors

STAI. The State-Trait Anxiety Inventory (STAI, Spielberger, 2010; see also Julian, 2011) was used to measure State (S-Anxiety) and Trait anxiety (T-Anxiety) of participants. Range of scores for each sub-scale is 20–80, the higher score indicating higher anxiety. A cut-off of 39-40 is indicated to detect clinically significant symptoms on the S-Anxiety scale (Addolorato et al., 1999; Knight et al., 1983).

Perceived Stress Scale. The perceived stress of participants was assessed using the Italian version of the Perceived Stress Scale (PSS) (Cohen et al., 1983; Cohen, 1988) (Italian translation Fossati, 2010). Individual scores can range from 0 to 40: scores ranging 0-13 would indicate low stress, scores ranging 14-26 moderate stress, scores ranging 27-40 high perceived stress.

Psychological reactions to lockdown. Participants’ perceived isolation and feeling of safety inside home and outside in the external space was measured with three ad hoc questions on a five point Likert-type scale.

4. Situational factors

As regards the living situation during the lockdown, participants had to indicate their marital status (without or with a partner), having or not children, the context of residence (city, village, countryside), the number of cohabitants and the number of rooms in their house. Moreover, they

had to indicate how many days they had been locked up at home until the date of filling in the survey and how many times they had left home.

All further details about the tests and items used in this study are provided in Appendix 1.

Procedure

PsyToolkit was used for the online survey (Stoet, 2010, 2017). After reading the instructions and digitally signing the informed consent, participants started the survey. All participants answered the items and filled in the questionnaires in the following order: 1) demographic information; 2) situational factors; 3) psychological reactions to the lockdown experience and perceived risk; 4) State Anxiety Inventory; 5) IVAS; 6) Perceived Stress Scale; 7) Items about social distance with or without face-mask; 8) Trait Anxiety Inventory.

The time taken to complete the questionnaire ranged from 20 to 25 minutes.

RESULTS

A series of Analyses of Variance (ANOVAs) and regression analyses were carried out. In five sessions, the analyses assessed: 1) The determinants of IPS (the effects of gender and age, the effect of face-mask wearing); 2) COVID-19 risk and IPS in the six regions (the effect of regions on IPS, the effect of Actual/Perceived COVID-19 risk on IPS, Perceived risk in the six regions; 3) The determinants of Perceived risk in the six regions (i.e. the effect of Actual risk, Social Media communication, Healthcare Satisfaction); 4) The effect of psychological reactions on IPS; 5) The effect of situational factors on IPS and psychological reactions. Where necessary, the Bonferroni correction was used for the post-hoc tests. Finally, the partial eta-squared (η^2_p) and 95% confidence intervals are also reported.

1) The determinants of IPS

a) The effects of gender and age

A 2X2X3 mixed ANOVA was used to analyze the distance in mm (as dependent variable) with Participants' Gender (M/F) as between factor, Confederates' Gender (M/F) and Confederates' Age (Children/Young Adults/Elderly) as within factors.

Three significant main effects appeared: Participants' Gender, $F(1, 1291) = 33.79, p < .0001; \eta^2_p = .02$), Age, $F(2, 2582) = 116.44, p < .0001; \eta^2_p = .08$), Confederates' Gender, $F(1, 1291) = 28.14, p$

$< .0001$; $\eta^2_p = .02$, and Confederates' Age, $F(1, 2582) = 116.44$, $p < .0001$; $\eta^2_p = .08$. Specifically, IPS was larger in female ($M = 59.58$; $SD = 17.71$; 95% CI [58.39, 60.76]) than male ($M = 53.53$ $SD = 17.71$; 95% CI [51.87, 55.19]) participants, and from male ($M = 57.79$; $SD = 18.69$; 95% CI [55.82, 57.86]) than female ($M = 57.26$; $SD = 18.91$; 95% CI [55.24, 57.30]) confederates. Furthermore, the post-hoc test revealed that the effect of age was due to a shorter IPS with children ($M = 54.39$; $SD = 20.27$; 95% CI [53.29, 55.49]) than young adults ($M = 56.35$; $SD = 18.40$; 95% CI [55.35, 57.35]) and elderly people ($M = 58.92$; $SD = 20.36$; 95% CI [57.81, 60.03]). All pairwise comparisons were significant, at least $p < .0001$. These main effects were qualified by a significant participants' Gender x Age interaction, $F(2, 2582) = 4.02$, $p < .05$; $\eta^2_p = .003$. The preferred distance from elderly people of female participants was larger than all other conditions (at least $p < .0001$) (descriptive statistics in Appendix 2-Table 8). Moreover, a confederates' Gender x Age interaction ($F(2, 2582) = 5.64$, $p < .005$; $\eta^2_p = .004$) revealed that IPS was shorter from young females than males ($p < .0001$) and there was a similar tendency in elderly people ($p = .053$), whereas there was no difference between female and male children ($p = .10$) (descriptive statistics in Appendix 2-Table 9).

Finally, the reliability of the measure was assessed: Cronbach's alpha = .97, inter-item correlation = .87. Considering the strong inter-item correlation and reliability of the six interpersonal distance dimensions, a mean interpersonal distance was calculated and used for subsequent analyses.

b) The effect of face-mask wearing

A further ANOVA was carried out to see the effect of face-mask on social distancing in meters (i.e. no-mask vs mask). The results showed that wearing a face-mask affected interpersonal distance: $F(1, 1291) = 2294.79$, $p < .0001$; $\eta^2_p = .64$, which was shorter when other people wore a face mask ($M = 1.46$ m; $SD = .66$; 95% CI [1.42, 1.49]) than not ($M = 2.49$ m; $SD = .98$; 95% CI [2.44, 2.55]).

A Pearson correlation analysis showed a strong positive correlation between the preferred distances in meters and IVAS: all IVAS distances increased with the increase of preferred distances in meters with and without face-mask (with at least $r > .28$ and $p < .0001$).

2) The effect of perceived and actual COVID-19 risk in the six regions on IPS

a) IPS in the six regions

A one-way ANOVA with a 6-level between-factor Region on mean IVAS distance showed a main effect of this factor, $F(5, 1287) = 5.32, p < .0001, \eta^2_p = .02$. As illustrated in Figure 1, interpersonal distance was shorter in Emilia-Romagna and Veneto (i.e. regions with medium-high actual risk of COVID-19) and similar in other regions (further descriptive statistics in Appendix 2-Table 10). The post-hoc analysis showed that IPS was unexpectedly and significantly shorter in Emilia Romagna and Veneto than two low-risk regions (Puglia and Sardinia) (at least $p < .05$). We reasoned that this result could be affected not so much by the actual risk in the various regions but by how people perceive the risk related to COVID-19.

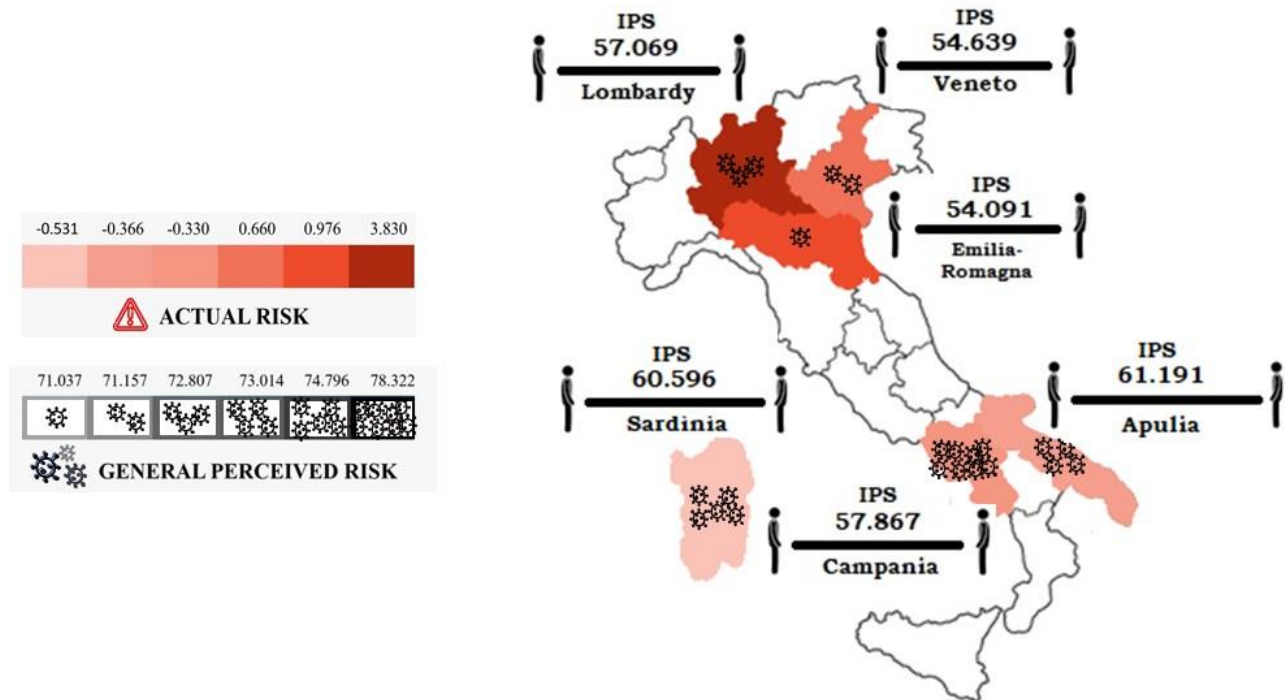


Figure 1. The Figure shows Actual risk (AR), General Perceived risk (GPR) in the present, and mean interpersonal distance (IPS) in the six regions. Darker colours indicate higher levels of COVID-19 actual risk. More virus icons indicate a higher level of perceived risk.

b) The effect of Actual/Perceived COVID-19 risk on IPS

We first computed a comprehensive index of the Actual risk of COVID-19 in the six regions where the respondents lived. The scores of seven dimensions of the severity of the infection (number of

positive subjects, number of patients in intensive care, number of all hospital discharges (inverted), number of deaths, total cases, increase of total cases compared to previous day, number of swabs) (Source: Istituto Superiore di Sanità, 2020) for each day included in the data collection period were recorded. These values were averaged across days in relation to each region. The correlations between the seven dimensions were high, ranging between .75 and .98. To obtain a composite and unique measure of the impact, a Principal Component Analysis was conducted. A single-factor solution was extracted (which explains 94% of the variance, with Cronbach's alpha of .98) and a factor score (method: regression) was calculated. Distances expressed by the factor score can be interpreted as z scores. The composite indexes of Actual risk were the following: Lombardy= 3.830, Emilia-Romagna= .977, Veneto= .661, Campania= -.331, Apulia= -.366, Sardinia= -.531. Clearly, higher indexes indicate a stronger impact of COVID-19. These indexes were used as predictor in regression analyses (see Figure 1).

To understand the effect of Actual and Perceived risk on IPS, a regression was performed with mean interpersonal distance as criterion and the following predictors: Actual risk and the four dimensions of the Perceived risk (Present-General, Present-Local, Future-General, Future-Local). The overall model was significant: $F(5,1287) = 17.703$, $p < .000$, $R = .25$, $R^2 = .06$. However, as shown in Table 1, only the Present-General Perceived risk gave a significant contribution to the model: the higher the perceived risk of COVID-19 in the present at general level the larger the social distance (see also Figure 1).

Interpersonal Space IPS										
	<i>B</i>	<i>Std.Err</i>	<i>t</i>	<i>p</i>	-95%	+95%	<i>Beta (β)</i>	<i>St.Err.β</i>	-95%	+95%
Actual Risk	-.65	.35	-1.89	.06	-1.33	.02	-.06	.03	-.11	.00
Present-General Perceived Risk	.10	.03	3.18	.00	.04	.16	.11	.04	.04	.18
Present-Local Perceived Risk	.01	.03	.27	.79	-.05	.06	.01	.04	-.07	.09
Future-General Perceived Risk	.05	.03	1.46	.14	-.02	.12	.07	.05	-.02	.16
Future-Local Perceived Risk	.06	.03	1.85	.06	-.00	.13	.10	.05	-.01	.20

Table 1. The effect of Actual and Perceived risk on IPS. B Coefficients, Standard Errors, t and significance levels for predictors of the outcome variable, Standardized Beta Coefficients and 95% CIs are reported.

3) The determinants of Perceived risk in the six regions

Different regression analyses explored the impact of Actual risk, Social Media institutional communication, Healthcare System Satisfaction on the Perceived risk.

a) The effect of Actual risk

A regression analysis model with Actual risk in the six regions as predictor and the four dimensions of Perceived risk as criteria was carried out. The multivariate analysis showed that the overall model was significant $F(4,1288) = 54.848, p < .0000, Wilks = .854$. The Actual COVID-19 risk had a significant effect on all dimensions of Perceived risk, but it was dramatically stronger on the perception of the dangerousness of COVID-19 in the Present at Local level. Therefore, the more severe the actual risk the higher the local perceived risk of COVID-19 (see Table 2).

PREDICTOR: ACTUAL RISK										
	<i>B</i>	<i>Std.Err</i>	<i>t</i>	<i>p</i>	<i>-95%</i>	<i>+95%</i>	<i>Beta (β)</i>	<i>St.Err.β</i>	<i>-95%</i>	<i>+95%</i>
Present-General Perceived Risk	-.77	.38	-2.05	.04	-1.51	-.03	-.06	.03	-.11	-.00
R²	.003									
Present-Local Perceived Risk	4.83	.47	10.4	.00	3.92	5.75	.28	.03	.22	.33
R²	.077									
Future-General Perceived Risk	-1.33	.46	-2.86	.00	-2.24	-.42	-.08	.03	-.13	-.02
R²	.006									
Future-Local Perceived Risk	1.11	.52	2.12	.03	.08	2.13	.06	.03	.00	.11
R²	.003									

Table 2. The effect of Actual risk on Perceived risk. B Coefficients, Standard Errors, Standardized Beta Coefficients, 95% CIs, t and significance levels for predictor of each outcome variable. R-squared is also reported.

b) The effect of Social Media communication

The previous regression suggested that the Actual risk played only a marginal role in the way people perceived the risk of COVID-19 in general that, instead, seems to play a fundamental role in IPS regulation. We hypothesized that the social representation of General Perceived risk could be influenced by media communication. During the lockdown, each regional government dedicated a specific space for pandemic-related communication on its institutional websites and made extensive use of social media. We thus decided to analyze the institutional social media communication of the six regions, considering the increasing important effect of social media communication in our daily life (e.g. Kim & Utz, 2019). We recorded the total number of posts related to the COVID-19 outbreak published on the institutional website of each region through Facebook from 09.03.2020 (promulgation of the Decree of the Italian Prime Minister #iorestoacasa) to 2.05.2020 (last day of submission of our survey) and we have calculated the average of the comments of users to these posts. The average number of users' Facebook comments to the posts of the regions varies quite a lot, and precisely: Lombardy= 200.792; Emilia-Romagna= 271.684; Veneto= 21.127; Campania= 496.613; Apulia= 27.768; Sardinia= 86.325. To see whether the Perceived risk dimensions were affected by the institutional Social Media communication, we analyzed the effect of the mean Facebook comments. We carried out a regression analysis with Facebook Comments as predictor and the four dimensions of Perceived risk as criteria. The regression showed that the overall model was significant, $F(4,1288) = 4.385$, $p < .005$, $Wilks = .987$. The comments on Facebook significantly contributed to the Perceived risk at General level in the Present: the more the comments the higher the perceived risk (see Table 3).

PREDICTOR: FACEBOOK COMMENTS										
	<i>B</i>	<i>Std.Err</i>	<i>t</i>	<i>p</i>	<i>-95%</i>	<i>+95%</i>	<i>Beta (β)</i>	<i>St.Err.β</i>	<i>-95%</i>	<i>+95%</i>
Present-General Perceived Risk	.01	.00	3.56	.00	.01	.02	.10	.03	.04	.15
R²	.010									
Present-Local Perceived Risk	.01	.00	1.38	.17	-.00	.01	.04	.03	-.02	.09
R²	.001									
Future-General Perceived Risk	.00	.00	1.20	.23	-.00	.01	.03	.03	-.02	.09
R²	.001									

Future- Local Perceived Risk	.01	.00	1.95	.05	-.00	.02	.05	.03	-.00	.11
R²	.003									

Table 3. The effect of Social Media communication on Perceived risk. B Coefficients, Standard Errors, Standardized Beta Coefficients, 95% CIs, t and significance levels for predictor for each outcome variable. R-squared is also reported.

c) The effect of Healthcare Satisfaction

The Italian Healthcare Service has a regional structure. To assess Healthcare Satisfaction in the region where the respondents lived, the values of four dimensions were recorded (Source: ISTAT, 2018): medical care, nursing care, hospital food and sanitary facilities. To obtain a synthetic measure, a Principal Component Analysis was conducted on the four variables. Then, on the basis of a single-factor solution (which explains 92% of the variance, with Cronbach's alpha of .97) a standardized index based on factor scores (method: regression) was calculated. Distances expressed by the factor score can be interpreted as z scores. The composite indexes were the following: Lombardy= .26, Emilia-Romagna= .81, Veneto= .99, Campania= -1.89, Apulia= -1.39, Sardinia= .52. Higher indexes indicate higher satisfaction with regional Healthcare System.

A regression analysis with the composite indexes as predictor and the four dimensions of Perceived risk as criteria showed that the overall model was significant $F(4,1288) = 13.406$, $p < .0001$, $Wilks = .960$. The levels of Healthcare Satisfaction significantly contributed to the Perceived risk at General level in the Present and Future, and at Local level only in the Future (see Table 4). In these cases, the more respondents were satisfied with their Healthcare system the lower the perceived COVID-19 risk.

	PREDICTOR: HEALTH CARE SATISFACTION									
	<i>B</i>	<i>Std.Err</i>	<i>t</i>	<i>p</i>	-95%	+95%	<i>Beta (β)</i>	<i>St.Err.β</i>	-95%	+95%
Present- General Perceived Risk	-1.88	.48	-3.88	.00	-2.83	-.93	-0.11	.03	-.16	-.05
R²	.016									
Present- Local Perceived Risk	.53	.63	.85	.40	-.70	1.76	.02	.03	-.03	.08
R²	.001									
Future- General	-2.99	.59	-5.03	.00	-4.15	-1.82	-.14	.03	-.19	-.08

Perceived Risk										
R²	.019									
Future-Local Perceived Risk	-2.68	.67	-4.01	.00	-3.99	-1.37	-.11	.03	-.17	-.06
R²	.012									

Table 4. The effect of Healthcare Satisfaction on Perceived risk. B Coefficients, Standard Errors, Standardized Beta Coefficients, 95% CIs, t and significance levels for predictor of each outcome variable. R-squared is also reported.

4) The effect of psychological reactions on IPS

A regression analysis was conducted to evaluate whether the various psychological reactions to the COVID-19 lockdown predicted the size of IPS. We used S-Anxiety ($M = 47.43$, $SD = 11.46$), T-Anxiety ($M = 44.10$, $SD = 11.02$), Perceived Stress ($M = 19.16$, $SD = 7.36$), perceived Safety Outside ($M = 2.62$, $SD = .80$) and Inside ($M = 4.08$, $SD = .70$), and perceived Isolation ($M = 2.98$, $SD = 1.05$) as predictors and mean IPS as criterion. The overall model was significant, $F(6, 1286) = 17.10$, $p < .0001$, $R^2 = .07$, $R = .27$. Five factors gave significant contributions to the model: State and Trait Anxiety, perceived stress, perceived Safety Outside and perceived Isolation (see Table 5). The more people felt anxious and stressed for the present situation the larger the IPS. Instead, Trait anxiety had a weak effect with higher levels linked to shorter IPS. Finally, the more people felt safe outside in the external space and the more they felt isolated, the shorter their preferred IPS.

Interpersonal Space IPS										
	<i>B</i>	<i>Std.Err</i>	<i>t</i>	<i>p</i>	-95%	+95%	<i>Beta (β)</i>	<i>St.Err,β</i>	-95%	+95%
Perceived Safety Inside	-.64	.74	-.9	.38	-2.09	.80	-.03	.03	-.08	.03
Perceived Safety Outside	-4.07	.66	-6.19	.00	-5.37	-2.78	-.18	.03	-.24	-.12
Perceived Isolation	-1.32	.51	-2.58	.01	-2.32	-.32	-.08	.03	-.14	-.02
State Anxiety	.23	.07	3.29	.00	.09	.36	.15	.04	.06	.23
Trait Anxiety	-.13	.07	-1.76	.08	-.28	.02	-.08	.05	-.17	.01
Perceived Stress	.19	.11	1.61	.11	-.04	.41	.08	.05	-.02	.17

Table 5. The effect of psychological reactions on IPS. B Coefficients, Standard Errors, Standardized Beta Coefficients, 95% CIs are reported, t and significance levels for predictors of the outcome variable.

5) The effect of situational factors on IPS and psychological reactions

A regression was conducted to evaluate whether the situational factors related to the life context and lockdown experience affected IPS (criterion). We considered as predictors: the Marital Status (with a partner= 457, without a partner= 836), having or not Children (with children= 381, without= 912), Context of Residence (city= 736, village= 486, countryside= 71), days of Confinement (N= 45.28, range 0-80), number of Outings, Cohabitants ($M = 3.27$, range 1 - 9) and Rooms ($M = 4.93$, range 1-15). As regards the Outings, 234 respondents had never gone out, 393 rarely went out (about twice a month), 387 went out once a week, while 155 went out often and only 120 almost every day.

The overall model was significant, $F(5,1285) = 5.38$, $p < .0001$, $R^2 = .03$, $R = .16$. Only the number of Outings gave a significant contribution to the model: the size of IPS decreased as people went more outside home (see Table 6).

Interpersonal Space IPS										
	<i>B</i>	<i>Std.Err</i>	<i>t</i>	<i>p</i>	-95%	+95%	<i>Beta (β)</i>	<i>St.Err.β</i>	-95%	+95%
Marital Status	-1.27	1.43	-.89	.37	-4.08	1.54	-.03	.04	-.11	.04
Children	-.23	1.47	-.16	.88	-3.12	2.66	-.01	.04	-.08	.07
Context of Residence	-.66	.85	-.78	.43	-2.32	1.00	-.02	.03	-.08	.03
Confinement	.00	.04	.03	.98	-.07	.08	.00	.03	-.06	.06
Outings	-2.06	.49	-4.19	.00	-3.03	-1.10	-.14	.03	-.20	-.07
Cohabitants	.63	.41	1.54	.12	-.17	1.44	.05	.03	-.01	.11
Rooms	-.06	.28	-.22	.82	-.60	.48	-.01	.03	-.06	.05

Table 6. The effect of situational factors on IPS. B Coefficients, Standard Errors, Standardized Beta Coefficients, 95% CIs are reported, t and significance levels for predictors of the outcome variable.

We also explored the possible effect of the situational factors on the psychological reactions. We used the same factors above described as predictors and perceived Safety Outside and Inside, perceived Isolation, State and Trait Anxiety and Perceived Stress as criteria.

The overall situational factors had a significant impact on all psychological reactions: Safety Inside, $F(7,1285) = 6.48, p < .0001, R^2 = .03, R = .18$; Safety Outside, $F(7,1285) = 15.16, p < .0001, R^2 = .08, R = .28$; Perceived Isolation, $F(7,1285) = 8.29, p < .0001, R^2 = .04, R = .21$; S-Anxiety, $F(7,1285) = 11.39, p < .0001, R^2 = .06, R = .24$; T-Anxiety, $F(7,1285) = 30.04, p < .0001, R^2 = .14, R = .37$; PSS, $F(7,1285) = 29.49, p < .0001, R^2 = .14, R = .37$. However, as shown in Table 7, the impact of the situational predictors was different depending on the kind of psychological reaction. In particular, people with a partner reported lower levels of state and trait anxiety and perceived stress, felt safer at home and less isolated. People with children reported less anxiety, perceived stress, and felt less isolated. State anxiety and perceived stress increased and the feeling of safety inside and outside decreased with more cohabitants and fewer rooms available. Instead, the more people went outside the home, the lower the levels of stress and anxiety and the higher sense of safety in the external space. The context of residence and the days of confinement at home did not exert significant effects.

	Perceived Safety Inside					Perceived Safety Outside					Perceived Isolation				
	<i>B</i>	<i>Std.Err</i>	<i>Beta</i>	<i>t</i>	<i>p-value</i>	<i>B</i>	<i>Std.Err</i>	<i>Beta</i>	<i>t</i>	<i>p-value</i>	<i>B</i>	<i>Std.Err</i>	<i>Beta</i>	<i>t</i>	<i>p-value</i>
Marital Status	.168	.056	.114	2.995	.003	.034	.062	.020	.538	.590	-.246	.084	-.111	-2.934	.003
Children	-.016	.058	-.011	-.294	.769	-.057	.064	-.032	-.890	.374	-.255	.086	-.111	-2.957	.003
Context of Residence	.053	.033	.045	1.589	.112	-.013	.034	-.009	-.345	.730	-.031	.050	-.018	-.625	.532
Confinement	-.001	.001	-.001	-.024	.981	.001	.002	.021	.714	.475	.003	.002	.037	1.233	.217
Outings	.023	.019	.038	1.183	.237	.159	.021	.235	7.419	<.001	.006	.029	.007	.213	.831
Cohabitants	-.044	.016	-.083	-2.773	.006	-.069	.018	-.114	-3.875	<.001	-.032	.024	-.041	-1.351	.177
Rooms	.045	.011	.124	4.188	<.001	.052	.012	.126	4.356	<.001	-.003	.016	-.005	-.171	.864
R²	.030					.0280					.040				

	State Anxiety					Trait Anxiety					Perceived Stress				
	<i>B</i>	<i>Std.Err</i>	<i>Beta</i>	<i>t</i>	<i>p-value</i>	<i>B</i>	<i>Std.Err</i>	<i>Beta</i>	<i>t</i>	<i>p-value</i>	<i>B</i>	<i>Std.Err</i>	<i>Beta</i>	<i>t</i>	<i>p-value</i>
Marital Status	-3.788	.902	-.158	-4.201	<.001	-5.165	.829	-.224	-6.231	<.001	-2.084	.560	-.134	-3.721	.001
Children	-.527	.926	-.021	-.568	.570	-3.165	.852	-.131	-3.717	.002	-3.177	.575	-.195	-5.521	<.001
Context of Residence	-.531	.533	-.028	-.995	.320	-.546	.490	-.030	-1.114	.266	-.120	.331	-.010	-.364	.716
Confinement	.034	.024	.042	1.422	.155	.015	.022	.020	.690	.490	.006	.015	.011	.395	.693
Outings	-.577	.311	-.059	-1.863	.063	-.738	.285	-.079	-2.594	.010	-.422	.192	-.067	-2.191	.029
Cohabitants	.705	.259	.081	2.724	.006	.414	.238	.049	1.742	.082	.717	.161	.127	4.463	<.001
Rooms	-.077	.173	.124	-2.624	.009	-.178	.159	-.031	-1.118	.264	-.258	.108	-.067	-2.398	.017
R²	0.060					0.141					0.135				

Table 7. The effect of situational factors on psychological reactions. B Coefficients, Standard Errors, Standardized Beta Coefficients, t and significance levels for predictor of each outcome variable. R-squared is also reported.

Discussion

Our work focused on the relationship between the sense of threat and perceived risk of COVID-19 and the regulation of interpersonal social distance. For this reason, we investigated how the dangerousness of the virus was individually and socially represented. Moreover, to understand to what extent our behaviour was influenced by risk perception rather than factual information (Bavel et al., 2020), we conducted a multicentric study in six Italian regions with different degrees of COVID-19 infection severity.

The determinants of IPS

The regulation of IPS in normal social life is particularly sensitive to the socio-emotional content and the potential threats that people perceive in their context (Argyle & Dean, 1965; Dosey & Meisels, 1969; Graziano, 2017; Ruggiero et al., 2017). The fear generated by the pandemic influenced the regulation of IPS. In fact, the interpersonal distance reported by respondents was dramatically larger (i.e. 54.86 mm) than that reported in a pre-COVID-19 study (frontal approach: 17.76 mm) that used the IVAS test (Iachini et al., 2016).

In line with previous proxemics literature, the results showed that IPS was affected by people's age and gender (Camperio & Malaman, 2002; Gioiella, 1977; Hayduk, 1983; Iachini et al., 2016; Latta, 1978; Remland et al., 1995; Sommer, 2002; Uzzell & Horne, 2006; Winogrand, 1981). The distance was wider from male than female people, and from elderly people than young adults and children. Women preferred a larger distance than men, especially from elderly people. This might reflect a higher sensitivity of women to the risk-factor represented by elderly age in the current pandemic.

Another effect related to the pandemic is that IPS was reduced by about 1 meter when other people wore a face-mask compared to when they did not. Presumably, wearing face-masks allowed people to feel safer and this led them to reduce their interpersonal distance. This reveals a worrying aspect of people's behaviour, as the fact of wearing the face-mask does not prevent contagion if it is not associated with social distancing (WHO, 2020).

Finally, the strong correlation between all IVAS distances and the metrics related to interpersonal distances with/without face-mask reinforced the reliability of the IVAS projective test.

COVID-19 risk and IPS in the six regions

As illustrated in Figure 1, a comparison among the six Italian regions shows that IPS was shorter in Emilia-Romagna and Veneto (i.e. regions with medium-high actual risk of COVID-19) and similar in other regions. The difference was statistically significant with regions characterized by medium-low (Apulia) and low (Sardinia) COVID-19 severity index. This result is explained by the fact that IPS was not predicted by the actual risk of COVID-19 infection in the regions, but by how people perceived at general level the risk of COVID-19. Precisely, the higher the perceived risk in the present at a general level, the larger the IPS. In line with proxemics literature, the finding confirms that perceived threat is one of the most salient factors in mediating equilibrium between interpersonal distance and social interaction (Argyle & Dean, 1965; Dosey & Meisels, 1969; Horowitz et al., 1964).

The results related to perceived risk are important for two main reasons. First, they suggest that people perceive the local threat less immediate than the general threat. This could be a matter of psychological distance (McDonald et al., 2015) or reflect a kind of optimistic bias of a spatial-geographical nature, as emerged in studies where the perception of environmental problems increases from the local to the global level (Gifford et al., 2009; Schultz et al., 2005). Consistently, shocking uncontrolled events (e.g., terrorism or earthquake) (Sjöberg, 2000; see also Becker & Janz, 1987) polarize people's attention towards general risks that are "far" from them (e.g., Adams, 1995; Bish & Michie, 2010; Kappers et al., 2018; Spence et al., 2011; Wise et al., 2020). Second, they show that it is the way people perceive the risk of COVID-19 in general and in the present time to influence IPS modulation. This perception reflected an "abstract" representation of the dangerousness of the COVID-19 regardless of the local context in which the respondents lived. For this reason, it was important to understand which factors could influence the perception of the COVID-19 risk.

The determinants of Perceived risk in the six regions

During the lockdown in Italy, the entire media system and the communication by the institutions was largely focused on the outbreak of COVID-19. In the areas with the highest impact of the virus, the media communication was accompanied by direct experience of the pandemic. We thus explored the possible impact of actual risk, social media institutional communication and Healthcare System satisfaction on the perception of the COVID-19 risk.

As regards the actual risk in the six regions, the results showed that it strongly influenced the perceived COVID-19 risk at a local level in the present: the higher the actual severity, the higher the perceived local risk. On the other hand, social media communication only influenced the COVID-19 perceived risk at a general level in the present: as Facebook's comments to institutional posts

increased, the general perceived risk increased. Moreover, higher levels of satisfaction in Healthcare Systems led to a reduction of the general perceived risk. Notably, satisfaction was higher in Veneto and Emilia-Romagna where social distances were reduced compared to other regions. In addition, a qualitative analysis of social media content showed that the Emilia-Romagna Facebook page supported an optimistic view ("[#coronavirusinsiemesipuòbattere](#)") compared to other regions. Moreover, the Campania Facebook page had more comments than other regions. A qualitative analysis of its content revealed a considerable effort to provide updates on the pandemic situation and clarification of what was allowed and what was not, often accompanied by a communicative style that highlighted the risk of COVID-19.

In short, the results show that the general perceived risk in the present was influenced by institutional communication on social media and satisfaction in regional Healthcare Systems. The combination of these factors contributed to the individual and social perception of the dangerousness of the virus. In turn, this general perception influenced the modulation of interpersonal distance.

Psychological reactions

During a crisis, people normally feel psychological reactions of fear, stress and anxiety (Adhanom Ghebreyesus, 2020; Bavel et al., 2020). Not surprisingly, 73% of respondents exceeded the cut-off of 39 for state anxiety (about 29% of respondents the cut-off of 54), while about 60% of respondents showed moderate perceived stress and 16% a high perceived stress.

The results showed that the more anxious, stressed and unsafe in outside space people felt, the larger the IPS was. In line with the literature, these negative feelings induced an increase in social distance during potentially threatening interpersonal situations (Brady & Walker, 1978; Iachini et al., 2015; Kaitz et al., 2004; Layden et al., 2018; for a review see Hayduk, 1983). Instead, the sense of isolation had the opposite effect: the more isolated people felt, the shorter the IPS. This can be explained by the fact that people who feel more isolated have a greater need for social affiliation (Taylor, 2006, 2011) which is a basic human response to many stressful circumstances (Taylor, 2009).

Situational factors

As regards the situational factors, we found that having a partner and children made the lockdown more bearable and therefore mitigated the levels of anxiety, stress, insecurity and the feeling of isolation. Instead, having more cohabitants and fewer rooms available increased anxiety, stress and

the feelings of insecurity inside and outside home. This highlights the importance of having living spaces that are not overcrowded but adapted to the needs of the inhabitants (Cohen 2020).

Finally, we found that the more people went outside the home, the lower the levels of stress, anxiety and insecurity in external space, and consistently the size of the IPS decreased. It is possible that the frequent outings allowed people to feel that the threats in the external world could be controlled and this reduced their anxiety and fear for the present situation. Conversely, the less people went out the more the external world looked threatening and interpersonal distances reflected this higher sense of unsafety.

Conclusions

IPS regulation during the Italian lockdown was based on a balance between defence needs generated by feelings of anxiety and threat that led to enlargement, and affiliation needs generated by social isolation that led to shrinkage. This mechanism was oriented by the degree of general perception of risk: a low degree due to confidence in Healthcare Systems was associated to shrinkage, while a high degree due to clear and timely institutional communication was associated to enlargement.

The lockdown to contrast the COVID-19 pandemic contributed to exacerbate the levels of anxiety, stress, insecurity and isolation to the detriment of individuals' psychological well-being (Brooks et al., 2020). On the other hand, the possibility of going outside, in compliance with safety requirements, improved people's psychological reaction. This could be very important for social categories that resulted particularly fragile: people without partners and without children, people who lived in small houses and were forced to share their living space with more cohabitants.

In conclusion, the institutional communication should provide clear information on the dangerousness of the infection and at the same time highlight that it can be controlled by following the health instructions (Kazak, 2020; Bavel et al., 2020). In this way, they could contribute to building a perception of risk that is functional to the adoption of effective mitigation strategies (Harper et al., 2020). From a theoretical point of view, it is the first time that the defensive function of IPS encoding is studied when other people are seen as a potential threat regardless of their willingness to harm, as possible virus spreaders. This confirms that the defensive function of the IPS is alerted by a potential threat. This early alert allows us to prepare appropriate behavioural reactions to protect our physical and psychological well-being.

References

- Adams, J. (1995). *Risk* (Vol. 20, Issue 1). Press, UCL.
<https://doi.org/https://doi.org/10.1177/030913259602000110>
- Addolorato, G., Ancona, C., Capristo, E., Graziosetto, R., Di Rienzo, L., Maurizi, M., & Gasbarrini, G. (1999). State and trait anxiety in women affected by allergic and vasomotor rhinitis. *Journal of psychosomatic research*, 46(3), 283-289. [https://doi.org/10.1016/S0022-3999\(98\)00109-3](https://doi.org/10.1016/S0022-3999(98)00109-3)
- Adhanom Ghebreyesus, T. (2020). Addressing mental health needs: an integral part of COVID-19 response. In *World Psychiatry*, 19, 129. <https://doi.org/10.1002/wps.20768>
- Argyle, M., & Dean, J. (1965). Eye-contact, distance and affiliation. *Sociometry*, 28, 289–304. <https://doi.org/10.2307/2786027>.
- Arslan, G., Yildirim, M., Tanhan, A., Buluş, M., & Allen, K. A. (2020). Coronavirus Stress, Optimism-Pessimism, Psychological Inflexibility, and Psychological Health: Psychometric Properties of the Coronavirus Stress Measure. *International Journal of Mental Health and Addiction*, 4, 1–17. <https://doi.org/10.1007/s11469-020-00337-6>
- Bavel, J. J. V., Baicker, K., Boggio, P. S., Capraro, V., Cichocka, A., Cikara, M., Crockett, M. J., Crum, A. J., Douglas, K. M., Druckman, J. N., Drury, J., Dube, O., Ellemers, N., Finkel, E. J., Fowler, J. H., Gelfand, M., Han, S., Haslam, S. A., Jetten, J., ... Willer, R. (2020). Using social and behavioural science to support COVID-19 pandemic response. *Nature Human Behaviour*, 4, 460–471. <https://doi.org/10.1038/s41562-020-0884-z>
- Becker, M. H., & Janz, N. K. (1987). Behavioral science perspectives on health hazard/health risk appraisal. *Health services research*, 22(4), 537–551.
- Bell, P. A., Greene, T. C., Fisher, J. D., & Baum, A. S. (2005). *Environmental psychology (Fifth ed.)*. Harcourt College.
- Bish, A., & Michie, S. (2010). Demographic and attitudinal determinants of protective behaviours during a pandemic: A review. *British Journal of Health Psychology*, 15(Pt 4), 797–824. <https://doi.org/10.1348/135910710X485826>
- Brady, A. T., & Walker, M. B. (1978). Interpersonal distance as a function of situationally induced anxiety. *British Journal of Social and Clinical Psychology*, 17(2), 127–133. <https://doi.org/10.1111/j.2044-8260.1978.tb00254.x>

- Brooks, S. K., Webster, R. K., Smith, L. E., Woodland, L., Wessely, S., Greenberg, N., & Rubin, G. J. (2020). The psychological impact of quarantine and how to reduce it: rapid review of the evidence. In *The Lancet*, 395(10227), 912-920. [https://doi.org/10.1016/S0140-6736\(20\)30460-8](https://doi.org/10.1016/S0140-6736(20)30460-8)
- Camperio, C. A., & Malaman, M. (2002). Where to sit in a waiting room: density, age and gender effects on proxemic choices. *Human Evolution*, 17(3-4), 175-185. <https://doi.org/10.1007/bf02436369>
- Chu, D. K., Akl, E. A., Duda, S., Solo, K., Yaacoub, S., Schünemann, H. J., El-harakeh, A., Bognanni, A., Lotfi, T., Loeb, M., Hajizadeh, A., Bak, A., Izcovich, A., Cuello-Garcia, C. A., Chen, C., Harris, D. J., Borowiack, E., Chamseddine, F., Schünemann, F., ... Reinap, M. (2020). Physical distancing, face masks, and eye protection to prevent person-to-person transmission of SARS-CoV-2 and COVID-19: a systematic review and meta-analysis. *The Lancet*, 395(10242), 1973–1978. [https://doi.org/10.1016/S0140-6736\(20\)31142-9](https://doi.org/10.1016/S0140-6736(20)31142-9)
- Cohen, D. (2020). *Surviving Lockdown Human Nature in Social Isolation* (1st editio). Routledge.
- Cohen, S., Kamarck, T., & Mermelstein, R. (1983). A global measure of perceived stress. *Journal of Health and Social Behavior*. <https://doi.org/10.2307/2136404>
- Cohen, S. (1988). Perceived stress in a probability sample of the United States. In S. Spacapan & S. Oskamp (Eds.), *The Claremont Symposium on Applied Social Psychology. The social psychology of health* (p. 31–67). Sage Publications, Inc.
- Dosey, M. A., & Meisels, M. (1969). Personal space and self-protection. *Journal of Personality and Social Psychology*, 11(2), 93. <https://doi.org/10.1037/h0027040>
- Duke, M. P., & Nowicki, S. (1972). A new measure and social learning model for interpersonal distance. *J.Exp.Res.Personality*, 6, 2–3, 119–132.
- Fossati, A. (2010). *Traduzione Italiana della scala per lo stress percepito [Italian translation of the Perceived Stress Scale]*. Università Vita-Salute San Raffaele.
- Gifford, R. (1997). *Environmental psychology: principles and practice*. Allyn & Bacon.
- Gifford, R., Scannell, L., Kormos, C., Smolova, L., Biel, A., Boncu, S., Corral, V., Güntherf, H., Hanyu, K., Hine, D.W., Kaiser, F., Korpela, K., Lima, L., Mertig, A., Mira, R., Moser, G., Passafaro, P., Pinheiro, J., Saini, S., Sako, T., Sautkina, E., Savina, Y., Schmuck, P., Schultz, W., Sobeck, K., Sundblad, E., & Uzzell, D. (2009). Temporal pessimism and spatial optimism

in environmental assessments: An 18-nation study. *Journal of Environmental Psychology*, 29(1), 1-12.

Gioiella, E. C. (1977). The relationships between slowness of response, state anxiety, social isolation and self-esteem, and preferred personal space in the elderly. *Journal of Gerontological Nursing*, 4(1), 40–43. <https://doi.org/10.3928/0098-9134-19780101-10>

Götz, F. M., Gvirtz, A., Galinsky, A. D., & Jachimowicz, J. M. (2020). How personality and policy predict pandemic behavior: Understanding sheltering-in-place in 55 countries at the onset of COVID-19. *American Psychologist*.

Graziano, M. S. A. (2017). The Space Between Us. A Story of Neuroscience, Evolution, and Human Nature. In *Journal of Chemical Information and Modeling*. <https://doi.org/10.1017/CBO9781107415324.004>

Hall, E. T. (1966). *The hidden dimension*. New York: Doubleday.

Harper, C. A., Satchell, L. P., Fido, D., & Latzman, R. D. (2020). Functional Fear Predicts Public Health Compliance in the COVID-19 Pandemic. *International journal of mental health and addiction*, 1–14. Advance online publication. <https://doi.org/10.1007/s11469-020-00281-5>

Hayduk, L. A. (1983). Personal space: Where we now stand. *Psychological Bulletin*, 94(2), 293–335. <https://doi.org/10.1037/0033-2909.94.2.293>

Holt, D. J., Cassidy, B. S., Yue, X., Rauch, S. L., Boeke, E. A., Nasr, S., Tootell, R. B. H., & Coombs, G. (2014). Neural correlates of personal space intrusion. *Journal of Neuroscience*, 34(12), 4123–4134. <https://doi.org/10.1523/JNEUROSCI.0686-13.2014>

Horowitz, M. J., Duff, D. F., & Stratton, L. O. (1964). Body-Buffer Zone: Exploration of Personal Space. *Archives of general psychiatry*, 11, 651–656. <https://doi.org/10.1001/archpsyc.1964.01720300081010>

Iachini, T., Coello, Y., Frassinetti, F., Senese, V. P., Galante, F., & Ruggiero, G. (2016). Peripersonal and interpersonal space in virtual and real environments: Effects of gender and age. *Journal of Environmental Psychology*, 45, 154–164. <https://doi.org/10.1016/j.jenvp.2016.01.004>

Iachini, T., Pagliaro, S., & Ruggiero, G. (2015). Near or far? It depends on my impression: Moral information and spatial behavior in virtual interactions. *Acta Psychologica*, 161, 131–136. <https://doi.org/10.1016/j.actpsy.2015.09.003>

- Julian, L. J. (2011). Measures of Anxiety. *Arthritis care & research*, 63 Suppl 11(0 11), S467–S472.
<https://doi.org/10.1002/acr.20561>.Measures
- Kaitz, M., Bar-Haim, Y., Lehrer, M., & Grossman, E. (2004). Adult attachment style and interpersonal distance. *Attachment and Human Development*, 6(3), 285–304.
<https://doi.org/10.1080/14616730412331281520>
- Kappers, A. M. L., Çetinkaya, A. Ö. R., & Tan, G. S. (2018). Parallel Behind Your Head. *I-Perception*, 9(3), 1–6. <https://doi.org/10.1177/2041669518781141>
- Kazak, A. E. (2020). Psychology is an essential science: American Psychologist highlights the role of psychology in understanding and addressing COVID-19. *American Psychologist*, 75(5), 605.
- Kennedy, D. P., Gläscher, J., Tyszka, J. M., & Adolphs, R. (2009). Personal space regulation by the human amygdala. *Nature Neuroscience*, 12(10), 1226–1227. <https://doi.org/10.1038/nn.2381>
- Kim, S. H., & Utz, S. (2019). Effectiveness of a Social Media-Based, Health Literacy-Sensitive Diabetes Self-Management Intervention: A Randomized Controlled Trial. *Journal of nursing scholarship : an official publication of Sigma Theta Tau International Honor Society of Nursing*, 51(6), 661–669. <https://doi.org/10.1111/jnu.12521>
- Knight, R. G., Waal-Manning, H. J., & Spears, G. F. (1983). Some norms and reliability data for the State-Trait Anxiety Inventory and the Zung Self-Rating Depression scale. *British Journal of Clinical Psychology*, 22(4), 245-249.
- Kvaal, K., Ulstein, I., Nordhus, I. H., & Engedal, K. (2005). The Spielberger State-Trait Anxiety Inventory (STAI): The state scale in detecting mental disorders in geriatric patients. *International Journal of Geriatric Psychiatry*, 20(7), 629–634.
<https://doi.org/10.1002/gps.1330>
- Latta, R. M. (1978). Relation of Status Incongruence to Personal Space. *Personality and Social Psychology Bulletin*, 4(1), 143–146. <https://doi.org/10.1177/014616727800400131>
- Layden, E. A., Cacioppo, J. T., & Cacioppo, S. (2018). Loneliness predicts a preference for larger interpersonal distance within intimate space. *PLoS ONE*, 13(9), e0203491.
<https://doi.org/10.1371/journal.pone.0203491>
- Lewnard, J. A., & Lo, N. C. (2020). Scientific and ethical basis for social-distancing interventions against COVID-19. *The Lancet Infectious Diseases*, 20(6), 631–633.

[https://doi.org/10.1016/S1473-3099\(20\)30190-0](https://doi.org/10.1016/S1473-3099(20)30190-0)

- Lloyd, D. M. (2009). The space between us: A neurophilosophical framework for the investigation of human interpersonal space. *Neuroscience and Biobehavioral Reviews*, 33(3), 297–304. <https://doi.org/10.1016/j.neubiorev.2008.09.007>
- López, L., & Rodó, X. (2020). The end of social confinement and COVID-19 re-emergence risk. *Nature Human Behaviour*, 4(7), 746–755. <https://doi.org/10.1038/s41562-020-0908-8>
- Lourenco, S. F., Longo, M. R., & Pathman, T. (2011). Near space and its relation to claustrophobic fear. *Cognition*, 119(3), 448–453. <https://doi.org/10.1016/j.cognition.2011.02.009>
- McDonald, R. I., Chai, H. Y., & Newell, B. R. (2015). Personal experience and the ‘psychological distance’ of climate change: An integrative review. *Journal of Environmental Psychology*, 44, 109–118. <https://doi.org/10.1016/j.jenvp.2015.10.003>
- Mishara, B. L., Brawley, P., Cheevers, M., Kitover, R. M., Knowles, A. M., Rautiala, P., & Suvajian, A. (1974). Encroachments upon the body buffer zones of the young and old woman: a naturalistic study. *International Journal of Aging and Human Development*, 5(1), 3–5. <https://doi.org/10.2190/PGL7-TAQ3-XHBW-C36X>
- Pedersen, D. M. (1973). Development of a Personal Space Measure. *Psychological Reports*, 32(2), 527–535. <https://doi.org/10.2466/pr0.1973.32.2.527>
- Remland, M. S., Jones, T. S., & Brinkman, H. (1995). Interpersonal distance, body orientation, and touch: Effects of culture, gender, and age. *The Journal of Social Psychology*, 135(3), 281–297. <https://doi.org/10.1080/00224545.1995.9713958>
- Ruggiero, G., Frassinetti, F., Coello, Y., Rapuano, M., di Cola, A. S., & Iachini, T. (2017). The effect of facial expressions on peripersonal and interpersonal spaces. *Psychological Research*, 81(6), 1232–1240. <https://doi.org/10.1007/s00426-016-0806-x>
- Sawada, Y. (2003). Blood pressure and heart rate responses to an intrusion on personal space. *Japanese Psychological Research*, 45(2), 115–121. <https://doi.org/10.1111/1468-5884.t01-2-00039>
- Schultz, P. W., Gouveia, V. V., Cameron, L. D., Tankha, G., Schmuck, P., & Franěk, M. (2005). Values and their Relationship to Environmental Concern and Conservation Behavior. *Journal of Cross-Cultural Psychology*, 36(4), 457–475. <https://doi.org/10.1177/0022022105275962>
- Sjöberg, L. (2000). Factors in Risk Perception. *Risk Analysis*, 20(1), 1–12.

<https://doi.org/10.1111/0272-4332.00001>

Sommer, R. (2002). From personal space to cyberspace. In R. B. Bechtel & A. Churchman (Ed.), *Handbook of environmental psychology*, 647–660. John Wiley & Sons.

Spence, A., Poortinga, W., & Pidgeon, N. (2012). The psychological distance of climate change. *Risk analysis : an official publication of the Society for Risk Analysis*, 32(6), 957–972.
<https://doi.org/10.1111/j.1539-6924.2011.01695.x>

Spielberger, C. (2010). State-Trait Anxiety Inventory for Adults - Manual, Instrument and Scoring Guide. 1983 Consulting Psychologists Press, Inc. Mind Garden, Inc.
<https://doi.org/10.1037/t06496-000>

Stoet G. (2010). PsyToolkit: a software package for programming psychological experiments using Linux. *Behavior research methods*, 42(4), 1096–1104. <https://doi.org/10.3758/BRM.42.4.1096>

Stoet, G. (2017). PsyToolkit: A novel web-based method for running online questionnaires and reaction-time experiments. *Teaching of Psychology*, 44(1), 24–31.
<https://doi.org/10.1177/0098628316677643>

Taylor, S. E. (2006). Tend and Befriend: Biobehavioral Bases of Affiliation Under Stress. *Current Directions in Psychological Science*, 15(6), 273–277. <https://doi.org/10.1111/j.1467-8721.2006.00451.x>

Taylor, S. E. (2009). Social Support: A Review. In *The Oxford Handbook of Health Psychology*. Howard S. Friedman. <https://doi.org/10.1093/oxfordhb/9780195342819.013.0009>

Taylor, S. E. (2011). How psychosocial resources enhance health and well-being. In S. I. Donaldson, M. Csikszentmihalyi, & J. Nakamura (Eds.), *Series in applied psychology. Applied positive psychology: Improving everyday life, health, schools, work, and society* (p. 65–77). Routledge/Taylor & Francis Group.

Uzzell, D., & Horne, N. (2006). The influence of biological sex, sexuality and gender role on interpersonal distance. *British Journal of Social Psychology*, 45(3), 579–597.
<https://doi.org/10.1348/014466605X58384>

Winogrand, I. R. (1981). A comparison of interpersonal distancing behaviour in young and elderly adults. *International Journal of Aging and Human Development*, 13(1), 53–60.
<https://doi.org/10.2190/TT33-D5JK-N23N-6YMT>

Wise, T., Zbozinek, T. D., Michelini, G., Hagan, C. C., & Mobbs, D. (2020). Changes in risk

perception and self-reported protective behaviour during the first week of the COVID-19 pandemic in the United States. *Royal Society Open Science*, 7(9).
<https://doi.org/10.1098/rsos.200742>

World Health Organization. (2020). Mental Health and Psychosocial Considerations During COVID-19 Outbreak. *World Health Organization*.

World Health Organization. (2020). Rational use of personal protective equipment for coronavirus disease 2019 (COVID-19). *World Health Organization*.

World Medical Association declaration of Helsinki: Ethical principles for medical research involving human subjects. (2013). *Journal of the American Medical Association*.
<https://doi.org/10.1001/jama.2013.281053>

APPENDIX 1

Standardized tests and ad hoc questionnaires used for the online survey

1. **IVAS.** The IVAS combines projective measurement features of classical proxemics such as the Comfortable Interaction Distance Scale (CIDS, Duke & Nowicki, 1972) and the Pedersen Personal Space Measure (PPSM, Pedersen, 1973). The test has been used in a previous study that compared classic behavioural proxemics tasks in virtual and actual settings, i.e. in the interaction with avatars and actual confederates, with this projective measure. The results showed similar effects with both behavioural and projective measures: shorter distance from females than males, shorter distance from children than young and elderly adults (Iachini et al., 2016). In the present version, the test represented two different characters on opposite sides of a line: one character (male or female) for the participant (Self), the other for another person (Confederate) for whom the preferred interpersonal distance had to be determined. Six types of confederates were shown, by crossing their gender and age range: a male or female child about 8-10 years old (relative height =24 mm), an elderly male or female about 65-70 years old (relative height =32 mm), a young male or female about 30 years old (relative height =32 mm). The confederates were represented in front, behind or on the sides (right and left) with respect to the Self (see Figure 2). The combination of the various factors (participants' gender, the four positions and the confederate type) gave rise to 48 different images, of which 24 were used for male participants (i.e. the images with the male Self) and 24 for female participants (i.e. the images with the female Self). The initial distance between the Self and the Confederate was 100 mm. Participants were presented with IVAS images one at a time on the screen. They had to imagine that they were the person standing on the line indicated by the word "You" while the confederate walked towards them from the four positions. Participants had to indicate, by moving a slider, their preferred interpersonal distance from the confederates. Scores could vary from 100 (max distance) to 0 (no distance).

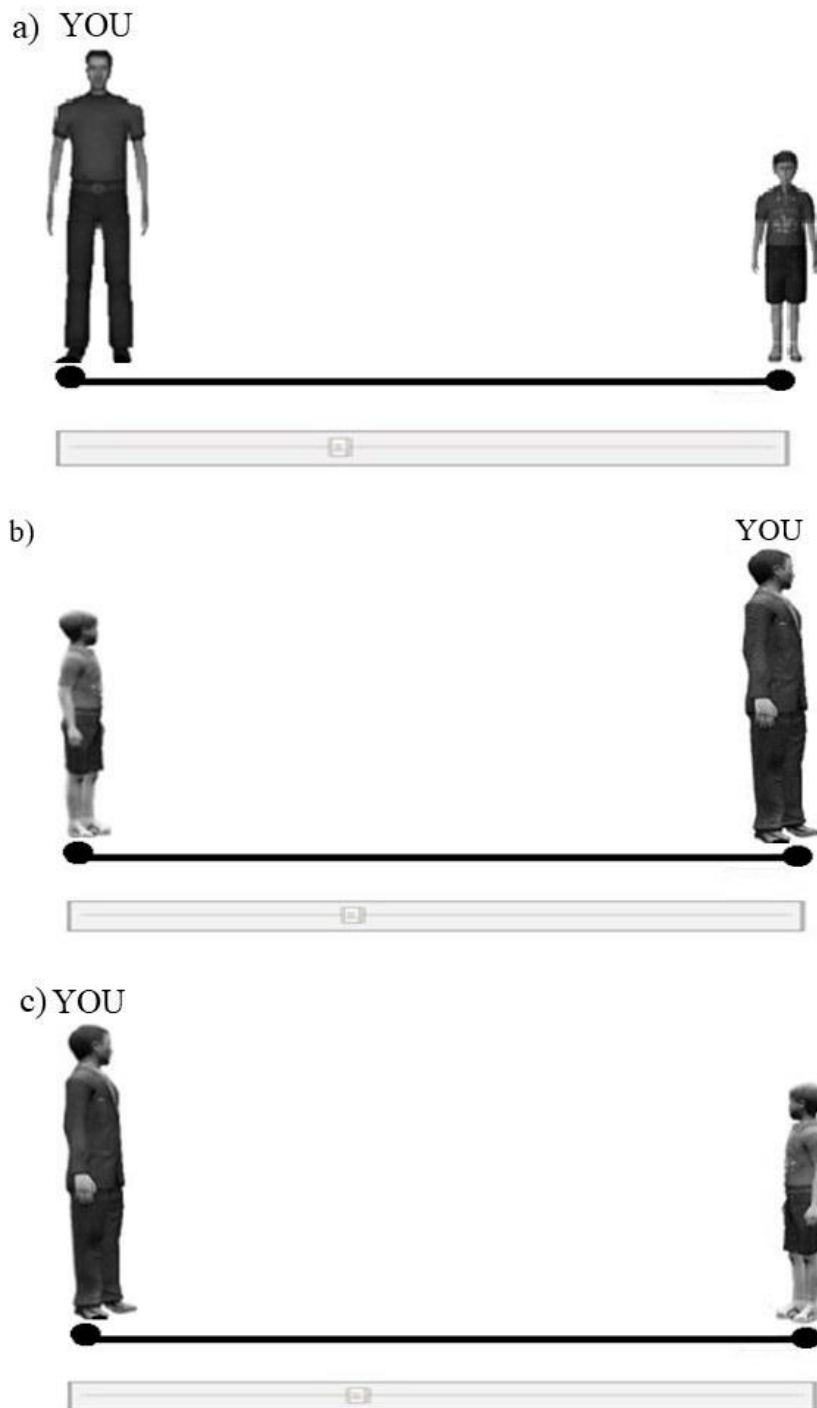


Figure 2. The figure depicts three examples of images displayed to a male participant in the (a) lateral, (b) back, and (c) frontal condition approach. The participants is indicated by “YOU”, the other character depicts the confederate. The slider is represented by the grey bar below the image. The “YOU” character could appear on the left (50% of the trials, see panels a; c) or on the right (b) of the slider.

2. **Interpersonal distance with or without face-mask.** Participants had to indicate what was the distance from others that made them feel comfortable with or without face-mask. For this measure, two items were used: 1) “With mask”; 2) “Without mask”. Participants had to indicate the distance on an 8-point Likert scale, ranging from 1 = “0.50 meter” to 8 = “4 meters”.

3. Perceived risk

Four questions investigated how risky people perceived the COVID-19 virus:

- a) How dangerous do you consider the coronavirus in general in the present?
- b) How dangerous do you consider the coronavirus in general in the future?
- c) How dangerous do you consider the coronavirus in the area where you live in the present?
- d) How dangerous do you consider the coronavirus in the area where you live in the future?

Participants had to indicate, by moving a slider, their degree of risk perception. Scores could vary from 100 (max risk) to 0 (no risk).

4. Psychological factors

STAI. The State-Trait Anxiety Inventory (STAI, Spielberger, 2010; see also Julian, 2011) is a self-report inventory based on a 4-point Likert scale to measure the presence and severity of current symptoms of anxiety and a generalized propensity to be anxious. More specifically, State anxiety (S-Anxiety) regards our feeling about an event, and Trait anxiety (T-Anxiety) is concerned with a personal characteristic. The S-Anxiety scale consists of twenty items that assess the current state of anxiety by asking how participants feel “right now, at this moment”, using items that measure feelings of apprehension, tension, nervousness, worry and so forth. The T-Anxiety scale assesses relatively stable aspects of “anxiety proneness,” such as general calmness, confidence and security. It has proven useful for identifying persons with high levels of neurotic anxiety. Each STAI item is given a weighted score of 1 to 4. Range of scores for each sub-scale is 20–80, the higher score indicating higher anxiety. A cut-off of 39-40 is indicated to detect clinically significant symptoms on the S-Anxiety scale (Addolorato et al., 1999; Knight et al., 1983). Some studies with elderly subjects suggested a higher cut-off of 54-55 (Kvaal et al., 2005).

Perceived Stress Scale. Perceived stress was assessed using the Italian version of the Perceived Stress Scale (PSS), the most widely used psychological instrument for measuring the perception of stress (Cohen et al., 1983; Cohen, 1988) (Italian translation Fossati, 2010). The instrument was developed to measure the degree to which situations in one’s life are perceived as stressful. Psychological stress can be defined as the extent to which persons perceive that their demands exceed their ability to cope. The PSS consists of 10 items rated on a 5-point Likert scale, ranging from 0 = “never” to 4 = “very frequently”. These items are related to one’s feelings and thoughts during the last month and participants have to indicate how often they felt or thought a certain way. Individual scores can range from 0 to 40 with higher scores indicating higher perceived stress in response to stressful situations: scores ranging 0-13 would indicate low stress, scores ranging 14-26 moderate stress, scores ranging 27-40 high perceived stress.

Psychological reactions to lockdown. With regard to the psychological reactions to the experience of lockdown, an ad hoc self-report questionnaire was devised with a five-point Likert-type scale (1= not at all, 5= very much). The questions were:

- a) How isolated do you feel?
- b) How safe do you feel at home?
- c) How safe do you feel outside home?)

5. Situational factors

As regards the living situation during the lockdown, participants had to indicate their marital status (without or with a partner), having or not children, the context of residence (city, village, countryside), the number of cohabitants and the number of rooms in their house. The latter were asked by two open-ended questions:

- a) "How many people live in your home, including you?"

b) "How many rooms in your home (excluding services)?".

Moreover, they had to indicate how many days they had been locked up at home until the date of filling in the survey and how many times they had left home. To this aim two questions were asked:

c) "How many days were you confined at home following the restrictions introduced by Government Decrees?" (open answer);

d) "How many times, on average, have you left home from the implementation of Government Decrees?": never, rarely (twice a month), sometimes (once a week), often (several times a week), always (almost every day).

APPENDIX 2

Descriptive statistics

INTERPERSONAL SPACE IPS						
GENDER OF PARTICIPANTS	AGE OF CONFEDERATES	<i>M</i>	<i>SD</i>	-95%	+95%	<i>N</i>
MALE	CHILDREN	51.77	19.20	49.98	53.57	439
MALE	YOUNG	52.89	17.43	51.26	54.52	439
MALE	ELDERLY	55.93	19.28	54.13	57.74	439
FEMALE	CHILDREN	57.00	19.20	55.72	58.29	854
FEMALE	YOUNG	59.80	17.43	58.63	60.97	854
FEMALE	ELDERLY	61.91	19.28	60.62	63.20	854

Table 8. The Table reports the preferred average interpersonal distance (IPS) of the participants measured through the IVAS according to the gender of the participants and the age of the confederates. *M*= mean; *SD*= standard deviation; +/- 95% CI= confidence interval; *N*= number of participants.

INTERPERSONAL SPACE IPS						
AGE OF CONFEDERATES	GENDER OF CONFEDERATES	<i>M</i>	<i>SD</i>	-95,00%	+95,00%	<i>N</i>
CHILDREN	MALE	54.48	20.65	53.35	55.60	1293
CHILDREN	FEMALE	54.30	20.38	53.19	55.41	1293
YOUNG	MALE	56.87	18.69	55.85	57.88	1293
YOUNG	FEMALE	55.83	18.78	54.80	56.85	1293
ELDERLY	MALE	59.17	20.36	58.06	60.28	1293
ELDERLY	FEMALE	58.67	20.88	57.53	59.81	1293

Table 9. The Table reports the preferred average interpersonal distance (IPS) of the participants measured through the IVAS according to the gender of the confederates and the age of the confederates. *M*= mean; *SD*= standard deviation; +/- 95% CI= confidence interval; *N*= number of participants.

INTERPERSONAL SPACE IPS in the six regions					
<i>REGIONS</i>	<i>M</i>	<i>SD</i>	-95,00%	+95,00%	<i>N</i>
LOMBARDY	57.06	17.79	54.70	59.43	218
EMILIA-ROMAGNA	54.09	17.79	51.69	56.49	211
VENETO	54.63	17.79	52.06	57.20	184
CAMPANIA	57.86	17.79	55.89	59.83	314
APULIA	61.19	17.79	58.78	63.59	210
SARDINIA	60.59	17.79	57.80	63.38	156

Table 10. The table reports the average IPS as a function of the different regions in which participants lived at the time of the survey. *M*= mean; *SD*= standard deviation; +/- 95% CI= confidence interval; *N*= number of participants.