Pet ownership, feelings of loneliness, and mood in people affected by the first COVID-19 lockdown

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ABSTRACT

The outbreak of the COVID-19 pandemic has caused dramatic changes to our lifestyle, particularly affecting our ability to interact "in person" with our social network. These changes have had a detrimental effect on the mental welfare of the global population. The international questionnaire "Pets in Lockdown" was designed to investigate whether feelings of loneliness were affecting the mood of people during the COVID-19 lockdown and whether pet ownership may have had a positive influence on both loneliness and general mood. As expected, higher loneliness scores were associated with higher negative and lower positive affective states. In addition, lower loneliness scores were associated with pet ownership and living with other people, but not with more frequent interactions with people from outside the household, suggesting that physical and close contact has an important role in decreasing feelings of loneliness. Besides the effects on the loneliness score, pet ownership was not associated with positive or negative affective states. The strength of the attachment to animals, measured as the amount of comfort that people obtain from their pets, was stronger in people with potentially limited access to affiliative physical human contact and was associated with both higher positive and negative affective states. Additionally, people obtained significantly more comfort from dogs and horses compared with other pet species. The results suggest that during the confinement period, pets may have benefited people with smaller social networks by alleviating loneliness and offering comfort and embodied close contact.

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Introduction

At the end of 2019, a novel coronavirus (SARS-CoV-2) that causes pneumonia with symptoms ranging from a mild cough to acute respiratory failure and death (Chen et al., 2020) was detected in the region of Wuhan (China). The disease caused by this virus, COVID-19, spread quickly around the world, and on March 11, 2020, the World Health Organization declared COVID-19 a pandemic (World Health Organisation, 2020). As part of the efforts to contain the spread of the virus, most countries took a series of measures including social distancing and lockdowns of different durations and severity that were likely to be detrimental to the mental health of the population. A meta-analysis of the early literature published by Cooke et al. (2020) estimated that 1 in 4 adults was suffering moderate to severe stress symptoms during the pandemic and would need mental health support (Qiu et al., 2020; Taylor et al., 2020). In addition to stress caused by fear of contagion, information overload, and lack of physical activity, one of the main factors leading to this loss of quality of life was the increase of feelings of loneliness due to the restriction of social contact (Killgore et al., 2020). Loneliness has been defined as an unpleasant subjective feeling of lacking enough (quality) relationships, either because of an insufficient number of social relationships, that is, a small social network, or because the desired intimacy cannot be reached (de Jong Gierveld and van Tilburg, 2016). It has been

widely associated with detrimental consequences for physical and mental health (de Jong Gierveld and van Tilburg, 2016). An adequate social network, defined as the number of social contacts that a person has (Smith and Christakis, 2008), is essential to alleviate feelings of loneliness (de Jong Gierveld and van Tilburg, 2016). In normal circumstances, living alone does not imply having a limited social network, since people often have frequent social interactions outside their households (Dykstra, 2009). Nevertheless, a lockdown limits access to social networks and increases social isolation. Most people will then resort to alternative ways of feeling connected. While there are numerous methods of long-distance communication, it has been suggested that they cannot completely replace the positive effects of close physical contact (Gallace and Spence, 2010). Affective physical interactions are likely to reinforce social bonds and provide extra comfort (Field, 2010). In times like the COVID-19 pandemic, where physical contact between people must be avoided, alternative sources of support, such as companion animals, could be beneficial.

An increasing number of households in the Western world (over 50%) contain companion animals, which are often considered part of the family (Janssens et al., 2020) and could act as a support against lockdown loneliness. Pet can have a positive effect on the quality of life of its owners, for example, by acting as an attachment figure, offering social support, or having a calming and anxiolytic effect on the owners (Enders-Slegers, 2000; Friedman and Krause-Parello, 2018). During the COVID-19 global crisis, pets could act as a safe haven from the news and negative thoughts, and provide social support and their calming effect could decrease the amount of COVID-19-related stress. Several studies have already shown that pet owners believe that their pets were helping them to cope with the COVID-19 crisis (Bowen et al., 2020; Ratschen et al., 2020). In addition, it has been proposed that pets may help mitigate feelings of loneliness, although the evidence is inconclusive (Gilbey and Tani, 2015).

This study aimed to investigate the feelings of loneliness affecting pet owners and people without pets living in areas where lockdown was in place. It focused on the factors that may be associated with lower or greater self-assessed loneliness, paying special attention to the size of social network and the presence of a pet. In addition, the participants' general mood was explored, and whether subjective feelings of loneliness, social network, and pet ownership could predict that mood. The authors hypothesize that feelings of loneliness will be an important factor associated with a mood during lockdown and therefore, people whose social network has decreased or who may be feeling lonely due to the lockdown may find comfort in the company of their pets. Finally, the amount of comfort that people obtain from their animals and whether it is associated with higher or lower feelings of loneliness and positive or negative mood will be explored.

Materials and Method

International Questionnaire Design

In March 2020, an international questionnaire was designed using Survey Monkey (See Appendix 1). It was initially designed in English and to maximize the number of participants from different backgrounds living in confinement, it was translated into Dutch, French, German, Italian, Portuguese, and Spanish. The questionnaire was available from the April 2,-May 29, when most of the lockdown measures were being lifted.

In order to access the questionnaire, the participants were presented with a participant information sheet and a digital informed consent form. The questionnaire was anonymous and directed at people with and without pets who were older than 18 and, at the moment of taking the questionnaire, lived in a "lockdown situation". Lockdown was defined as a situation where "you are restricted or not allowed to go outside and that you should keep your distance from people who don't live in your house". Respondents that did not fulfill those conditions were excluded from the study. Information about the questionnaire was distributed through social media, Ghent University resources, and the researchers' own networks using the snowball sampling technique.

Demographics, Social Network, and Loneliness

The first part of the questionnaire included questions about the respondents' demographics. In addition, a question regarding how long the respondents had been in lockdown at the time of participation was added.

In order to assess the size of each participant's social network during the lockdown and observe whether it affected self-perceived loneliness, 2 measures were used: number of people living with the respondent in the same household (children and adults) and the frequency of social contact with people outside the household.

In addition, to measure the respondents' subjective feelings of loneliness, they were asked to rate on a scale from 1 (not lonely at all) to 5 (extremely lonely) how lonely they were feeling during the lockdown period. A similar approach has been used by several authors in the past (See Gilbey and Tani, 2015 for an overview).

Measuring the Mood: The Positive and Negative Affect Schedule (PANAS)

To investigate the general mood of the population during the lockdown, the PANAS questionnaire (Watson et al., 1988) was included. This validated questionnaire is used to assess positive and negative emotions, 2 mood factors that Watson et al. considered relatively independent from each other. The 2 subscales that constitute the PANAS, that is, the Positive affect (PA) and the Negative affect (NA) scale, consisting of 10 items each. The items are descriptors of affective states, such as "upset" or "enthusiastic", that the respondents must rate from 1 (very slightly or not at all) to 5 (extremely). The final PA and NA scores are obtained by adding the 10-item's scores.

The PA scale measures to what extent the respondent feels enthusiastic, energetic, active, and alert. Low PA scores indicate sadness and lethargy and have been associated with depression. The NA scale measures distress and unpleasant feelings like anger, fear or disgust. High NA scores have been associated with anxiety-related feelings (Crawford and Henry, 2004; Watson et al., 1988). Validated translations into Dutch (Engelen et al., 2006), French (Gaudreau et al., 2006), German (Krohne et al., 1996), Portuguese (Galinha and Pais-Ribeiro, 2005), and Spanish (Díaz-García et al., 2020) of the PANAS questionnaire were used.

Measuring the Human-Animal Bond: The Comfort from Companion Animals Scale (CCAS)

Pet owners were asked to complete several questions, including the number of companion animals, the species, and the CCAS. The respondents were given the opportunity to fill in this part of the questionnaire for a maximum of 4 pets, but only the first one, defined as the one to which the participant felt emotionally closest, was included in the present study.

The CCAS was developed and validated by Zasloff (1996) and originally included 13 items to measure attachment to animals, one of the features of the Human-Animal Bond. The items are statements such as "My pet provides me with companionship". The

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respondents must rate each one of the items using a Likert scale from 1 (strongly disagree) to 4 (strongly agree). Those 13 items were later reduced to 11 (Zasloff, 1996), eliminating the 2 issues that were only applicable to dogs, making the scale suitable to be used with other pet species. The final score is calculated by adding the 11 items' scores.

The CCAS was translated from English to Dutch, French, German, Italian, Portuguese, and Spanish by native speakers and translators from Ghent University.

Data Analysis

Descriptive Statistics

An exploratory descriptive analysis was performed using IBM SPSS statistics 27. Response frequencies (in percentage) for each question were examined, with the total number of responses (N) representing the number of participants that answered each question.

Associative Analysis

A Kolmogorov–Smirnov test was used to assess distribution normality and to select appropriate statistical tests. Potential associations were explored between social network (described by the number of people living with the respondent and the frequency of social interactions outside the household), pet ownership and the loneliness score, the PA and NA scores and, in the case of pet owners, the CCAS score.

The Self-Perceived Loneliness Score

Due to the absence of proportional odds, it was not possible to build an ordinal logistic regression to explore the factors associated with self-reported loneliness. Instead, the loneliness score (rated 1-5) was transformed, prior to the analysis and exclusively for this model, into a binomial variable with 2 outcomes: lower loneliness score (score 1-3) or a higher loneliness score (score 4-5). The cut was decided by calculating the 95th percentile of the loneliness score (4) (Wang and Chen, 2012). Regarding the frequency of social interactions outside the household, the 3 categories "voice", "text" and "in person (keeping social distance)" were merged, as the 3 referred to interactions where physical affiliative contact was not possible. For this new variable, the answer with a higher frequency of interactions between the 3 previous variables was chosen. Additionally, due to the low number of respondents with less than weekly social interactions outside the household, the categories were recoded into 2 groups: "daily" and "weekly or less".

A multivariate binary logistic regression model was built with pet ownership, composition of the household, and frequency of social interactions outside the household as predictors, controlling for demographic information and time spent in lockdown. Subsequently, all non-significant variables were removed from the model at the same time.

The PANAS Score

Two different generalized linear models (GLM) were built to explore the variables associated with the PA and the NA scores. The potential association between these scores and pet ownership, self-reported loneliness, and social network were explored adjusting for age, gender, country of residence, employment status, and time since the lockdown had started.

The models were then built again including only the responses from 1) all pet owners, and 2) pet owners living alone. Pet species and the CCAS scores were included as additional predictors of The CCAS.

Using a GLM, the factors potentially associated with the CCAS score were examined to investigate whether loneliness, social network, and pet species were associated with lower or higher CCAS scores. The demographic information and time spent in lockdown were added as covariates to control for confounding factors.

Results

Demographic Information

6772 people from 53 countries participated in the questionnaire (Appendix 2). Countries representing less than 1% of the total number of respondents were excluded from the analysis to avoid excessive variation caused by cultural differences and distinct lockdown styles. 6520 respondents from 8 countries were ultimately included in the analysis (Table 1).

Social Network and Perceived Loneliness

A summary of the information obtained in this section of the survey can be found in Table 2.

A total number of 5791 pet owners and non-pet owners rated their subjective feelings of loneliness, with 18.81% of the respondents (n = 1047) rating it as high. The multi-variate model was significant (Omnibus Tests of Model Coefficients $\chi2$ (18) = 128.09; $P < 0.001$), explained 3.8% of the variance (Nagelkerke R^2), and correctly classified 81.4% of cases. The complete output can be found in Table 3. When all the other variables remained constant the chances of scoring high were 1.219 times lower for each extra family member ($P < 0.001$). Additionally, non-pet owners were 1.275 times more likely to have higher loneliness scores than pet owners ($P = 0.009$). The frequency of social interactions with people outside the household was not associated with the loneliness score (B = -0.024, $P = 0.795$)

The PANAS Score

Positive Affect Score

The PA score ranged from 10 to 50 (Mean = 29.6; median = 30.00; SD = 7.2; N = 6331). Pet ownership was not significantly associated to the PA score ($\chi2$ (25) = 0.644; $P = 0.422$), nor was the number of family members ($\chi2$ (22) = 0.43; $P = 0.836$). Contrarily, the frequency of social interactions with people outside the household was positively associated with the PA score ($\chi2$ (1) = 14.152; $P < 0.001$). When all the other variables remained constant, people that had daily communications with people outside the household scored 0.902 points higher in the PA score than people with weekly or less frequent communications. In addition, the loneliness score had a strong negative association with the PA score. The PA score decreased by 1.910 points for each extra loneliness point when the rest of the variables remained constant.

The final multivariate model output after the removal of the non-significant variables (Omnibus Test of Model Coefficients: $\chi2$ (19) = 1254.86, $P < 0.001$) can be found in Table 4.

Negative Affect Score

The NA score ranged from 10 to 50 (Mean = 20.58; median = 19.00; SD = 7.17; N = 6331). The initial GLM again showed no association between being a pet owner and the NA ($\chi2$ (25) = 0.44; $P = 0.505$). Similarly, no significant association was found between the NA score and the frequency of social interactions outside the household ($\chi2$ (1) = 2.098; $P = 0.147$). The final multivariate model output after the removal of the non-significant variables (Omnibus Test of Model Coefficients: $\chi2$ (23) = 1278.37, $P < 0.001$) can be found in Table 5

Table 1

Respondent demographic information. N = Total number of people that answered the question, n = number of people who chose a particular answer. * = Total number of responses from the 8 countries included in the analysis.

Questionnaire item and possible answer options		Percentage and number (n) of respondents	
Country (N = 6,772)	Belgium	65.6%	(4441)
	Brazil	1.1%	(74)
	Germany	1.6%	(112)
	France	12.3%	(831)
	The Netherlands	6.0%	(406)
	Spain	4.6%	(310)
	UK	3.4%	(232)
	US	1.7%	(114)
	Other (Not in the analysis)	3.7%	(252)
Gender* (N = 6,486)	Female	86.7%	(5,623)
	Male	13.1%	(850)
	Other	0.2%	(13)
Age* (N = 6,510)	18-25	14.5%	(942)
	26-35	24.4%	(1,589)
	36-45	20.0%	(1,300)
	46-55	19.6%	(1,278)
	56-65	15.3%	(997)
	Older than 65	6.2%	(404)
Employment Status* (N = 6,438)	Full time	41.4%	(2,668)
	Part-time	15.3%	(985)
	Homemaker	3.0%	(193)
	Retired	10.3%	(662)
	Self-employed	9.8%	(630)
	Student	11.0%	(707)
	Unable to work	5.0%	(323)
	Unemployed	4.2%	(270)
Time in lockdown* (N = 6,417)	1 week or less	0.1%	(6)
	Between 1 and 2 weeks	5.5%	(353)
	Between 2 and 3 weeks	39.4%	(2,531)
	Between 3 and 4 weeks	30.4%	(1,950)
	More than 4 weeks	24.6%	(1,577)
Pet owners* (N = 6,520)	Yes	83.7%	(5,454)
	No	16.3%	(1,066)

Table 2

Information collected about respondent social network. N = Total number of people that answered the question, n = number of people who chose a particular answer.

Question		Percentage and number (n) of respondents	
Number of adults in the household (N = 6,418)	None	18.2 %	(1,175)
	1	50.0%	(3,228)
	2	19.0%	(1,230)
	3	9.0%	(582)
	4	2.6%	(167)
	5 or more	1.2%	(75)
Number of children in the household (N = 6,488)	None	77.2%	(5,006)
	1	12.1%	(785)
	2	8.2%	(538)
	3	1.9%	(124)
	4	0.5%	(30)
	5 or more	0.1%	(5)
Respondents living alone (N = 6,475)		16.1%	(1,041)
Frequency of communication with people outside the household (N = 6,028)	Daily	84.0%	(5,071)
	Weekly	15.6%	(939)
	Less frequent than weekly	0.4%	(26)
Loneliness score (N = 5,791)	1	26,66%	(1,484)
	2	31,74%	(1,767)
	3	26,06%	(1,451)
	4	14,42%	(803)
	5	5,14%	(286)

The number of family members was positively associated with the NA score ($\chi2$ (1) = 10.393; $P = 0.001$). When every other variable remained constant, the NA score increased by 0.239 points for each extra family member.

The NA score was also very strongly associated with the loneliness score ($\chi2$ (1) = 1018.857; $P < 0.001$) and increased by 2.514 points for each extra loneliness point when all the co-variables remained constant.

CCAS and the PANAS Scores

The CCAS Score

A GLM was built with the CCAS score (Mean = 36.95; median = 40.00; SD = 7.94; N = 5446) as dependent variable ($\chi2$ (27) = 364.23, $P < 0.001$). Both number of family members ($\chi2$ (1) = 58.21, $P < 0.001$) and frequency of social interactions outside the household ($\chi2$ (1) = 14.58, $P < 0.001$) were significantly asso-

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Table 3
Binary logistic regression for the loneliness binary score (1-3 vs 3-5). B = Log-odds, S.E. = Standard error, df = degrees of freedom, Exp(B) = Odds Ratio.

Variables		B	S.E.	Wald Chi-square	df	Sig.	Exp(B)	95% CI	
Age		-0.072	0.034	4.473	1	0.034	0.93	0.87	0.995
Country (Compared to Belgium)				33.459	7	<0.001			
	United States	-0.146	0.287	0.259	1	0.611	0.864	0.659	2.034
	Brazil	0.162	0.319	0.259	1	0.611	1.176	0.592	3.132
	France	0.222	0.11	4.062	1	0.044	1.248	0.794	2.628
	Germany	-0.926	0.356	6.758	1	0.009	0.396	0.189	1.116
	The Netherlands	-0.55	0.185	8.837	1	0.003	0.577	0.346	1.289
	Spain	-0.691	0.21	10.808	1	0.001	0.501	0.292	1.154
	United Kingdom	-0.337	0.218	2.392	1	0.122	0.714	0.415	1.648
Employment status (Compared to Unemployed)				19.779	7	0.006			
	Employed Full time	-0.356	0.17	4.41	1	0.036	0.7	0.502	0.977
	Employed Part time	-0.341	0.188	3.299	1	0.069	0.711	0.492	1.027
	Self-employed	-0.427	0.204	4.41	1	0.036	0.652	0.438	0.972
	Student	-0.036	0.2	0.032	1	0.858	0.965	0.652	1.427
	Homemaker	-0.243	0.276	0.778	1	0.378	0.784	0.457	1.346
	Retired	-0.293	0.214	1.878	1	0.171	0.746	0.49	1.134
	Unable to work	0.127	0.216	0.343	1	0.558	1.135	0.743	1.735
Number of family members in the same household		-0.199	0.031	40.305	1	<0.001	0.820	0.771	0.872
Time in lockdown		0.097	0.045	4.713	1	0.03	1.102	1.009	1.203
Not Pet owner vs. Pet owner		0.243	0.093	6.822	1	0.009	1.275	1.062	1.53

Table 4
Positive Affect score model output with only significant factors. B: Coefficient, S.E.: Standard error, df: degrees of freedom.

Variables		B	S.E.	95% CI		Wald Chi-Square	df	Sig.
Age		1.176	0.0837	1.011	1.340	196.021	1	<0.001
Country (Compared to Belgium)						291.87	7	<0.001
	United States	-3.949	0.6653	-5.253	-2.645	35.22	1	<0.001
	Brazil	-3.988	0.7965	-5.549	-2.427	25.072	1	<0.001
	France	0.374	0.2724	-0.159	0.908	1.889	1	0.169
	Germany	-2.356	0.6781	-3.685	-1.027	12.067	1	0.001
	The Netherlands	1.086	0.3776	0.346	1.826	8.274	1	0.004
	Spain	-4.19	0.4209	-5.015	-3.365	99.106	1	<0.001
	United Kingdom	-5.11	0.4671	-6.025	-4.194	119.682	1	<0.001
Employment status (Compared to Unemployed)						56.139	7	<0.001
	Employed Full time	1.623	0.443	0.755	2.491	13.424	1	<0.001
	Employed Part time	1.058	0.4788	0.119	1.996	4.880	1	0.027
	Self-employed	1.536	0.5107	0.534	2.537	9.039	1	0.003
	Student	0.809	0.5162	-0.203	1.821	2.455	1	0.117
	Homemaker	0.505	0.6646	-0.798	1.808	0.577	1	0.447
	Retired	0.387	0.5458	-0.683	1.457	0.502	1	0.478
	Unable to work	-0.872	0.5742	-1.997	0.254	2.305	1	0.129
Frequency of social interactions outside the household: Daily vs. weekly		0.902	0.2398	0.432	1.372	14.152	1	<0.001
Loneliness Score		-1.91	0.0771	-2.061	-1.759	613.366	1	<0.001

Table 5
Negative Affect model output built with only significant factors. B: Coefficient, S.E.: Standard error, df: degrees of freedom.

Variables		B	S.E.	95% CI		Wald Chi-Square	df	Sig
Age		-0.644	0.0854	-0.809	-0.474	56.844	1	<0.001
Gender (Compared to male)						41.996	2	<0.001
	Female	1.679	0.2753	1.115	2.193	37.207	1	<0.001
	Other	5.713	1.954	1.857	9.518	8.553	1	0.003
Country (Compared to Belgium)						77.631	7	<0.001
	United States	0.660	0.671	-0.501	2.108	0.967	1	0.326
	Brazil	0.970	0.8071	-0.602	2.559	1.445	1	0.229
	France	-0.550	0.2986	-1.033	0.124	3.393	1	0.065
	Germany	0.886	0.6896	-0.427	2.276	1.652	1	0.199
	The Netherlands	-1.079	0.3894	-1.843	-0.317	7.678	1	0.006
	Spain	3.211	0.4257	2.413	4.08	56.89	1	<0.001
	United Kingdom	0.119	0.5118	-0.65	1.264	0.054	1	0.816
Employment status (Compared to Unemployed)						50.299	7	<0.001
	Employed Full time	-0.828	0.4525	-1.726	0.048	3.351	1	0.067
	Employed Part-time	0.281	0.4892	-0.682	1.236	0.329	1	0.566
	Self-employed	0.148	0.5196	-0.869	1.169	0.081	1	0.776
	Student	-0.113	0.5323	-1.107	0.979	0.045	1	0.832
	Homemaker	1.076	0.6793	-0.256	2.408	2.509	1	0.113
	Retired	-0.057	0.5552	-1.133	1.044	0.010	1	0.918
	Unable to work	1.590	0.5872	0.429	2.732	7.330	1	0.007
Time in lockdown		0.257	0.1107	0.04	0.474	5.374	1	0.02
Number of family members		0.239	0.074	0.094	0.384	10.393	1	0.001
Loneliness Score		2.514	0.0788	2.36	2.669	1.018.857	1	<0.001

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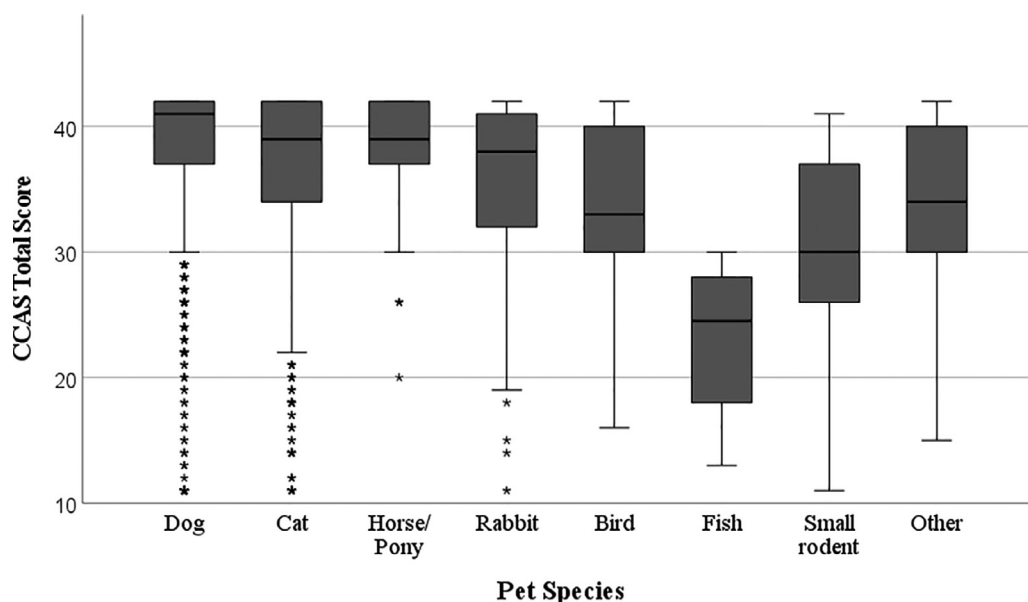

Figure 1. Representation of the Comfort from Companion Animals Scale (CCAS) score for each species included in the study. (*=Outliers).

ciated with the CCAS score but the loneliness score was not ($\chi 2$ (1) = 0.068, P = 0.794). When all the remaining variables, including the demographic information, stayed constant, the CCAS score decreased by 0.655 points for each extra person living in the same household. Contrarily, the CCAS score was 1.046 points higher for people with daily social communications outside their household when all the other variables remained constant.

The CCAS score was also dependent on the pet species ($\chi 2$ (5) = 125.41, P < 0.001). An ANOVA with Games-Howell post hoc analysis revealed that respondents with dogs scored significantly higher than respondents with cats, rabbits, birds, fish, and others (P < 0.001). Horse owners scored significantly higher than the owners of rabbits, birds, fish, and other species (P < 0.05). Cat owners scored significantly higher than the owners of rabbits, birds, fish, and other species (P < 0.05) (Figure 1).

PA score of Pet Owners

The GLM (Omnibus Test of Model Coefficients: $\chi 2$ (23) = 984.85; P < 0.001) revealed a significant positive association between the CCAS and the PA scores. (B = 0.060; $\chi 2$ (1) = 16.06, P < 0.001). When all the other variables remain constant, an increase of 1 point in the CCAS score involves a 0.06 increase in the PA score. Pet species was also a predictor of the PA score ($\chi 2$ (6) = 14.79, P = 0.023). Specifically, having horses was associated with higher PA score compared with having dogs (B = 2.330; $\chi 2$ (1) = 7.12, P = 0.009), cats (B = 2.534; $\chi 2$ (1) = 8.26, P = 0.004), rabbits (B = 3.781; $\chi 2$ (1) = 10.146, P = 0.001) and birds (B = 3.781; $\chi 2$ (1) = 10.146, P = 0.001).

This analysis was then repeated including only the pet owners that lived alone. The model (Omnibus Test of Model Coefficients: $\chi 2$ (27) = 173.331; P < 0.001) showed that the significant association between the CCAS and the PA scores was stronger (B = 0.134; $\chi 2$ (1) = 10.905, P = 0.001). In this case, an increase of 1 point in the CCAS score was associated with a 0.134 increase in the PA score. In this sub-population, the species was not associated with the PA score ($\chi 2$ (6) = 11.202, P = 0.082).

NA Score of Pet Owners

The GLM (Omnibus Test of Model Coefficients: $\chi 2$ (27) = 971.93; P < 0.001) showed that the CCAS score was also weakly associated with the NA score (B = 0.049; $\chi 2$ (1) = 10.938, P = 0.001), 1

extra point in the CCAS score would translate in a 0.049 increase in the NA score. Species was not associated with the NA score ($\chi 2$ (6) = 10.768, P = 0.096).

For the pet owners living alone, the model (Omnibus Test of Model Coefficients: $\chi 2$ (27) = 229.815; P < 0.001) revealed that the association between CCAS and NA scores (B = 0.083; $\chi 2$ (1) = 4.684, P = 0.030) was also stronger than in the general population of pet owners. An increase of 1 point in the CCAS score was predicted and an increase of 0.083 points in the NA score.

Discussion

This study was designed to explore whether loneliness, size of social network, and the Human-Animal Bond predicted the mood of people during the COVID-19 confinement in the spring of 2020. Most studies that look at the effect of pet ownership on loneliness have focused on specific populations, most commonly those in vulnerable circumstances, such as the elderly or the chronically ill. The COVID-19 pandemic affected the global population, to a greater or lesser extent, making this a unique opportunity to explore the "pet effect" by focusing on the self-reported loneliness and social network of participants from different demographics who were subjected to similar challenging circumstances.

Demographic Factors Predicting the Feeling of Loneliness and Mood

As expected, people who were feeling lonelier scored higher on the NA scale and lower on the PA scale. Indeed, loneliness has previously been associated with higher negative and lower positive affective states and is considered a risk factor for depression and other mental health issues (Ernst and Cacioppo, 1999; Krause-Parello et al., 2019).

Almost one-fifth of respondents described their level of loneliness as high. Since women have been shown to report higher levels of loneliness (de Jong Gierveld and van Tilburg, 2016; Pikhartova et al., 2014), this could be explained by the high percentage of female respondents in the study. However, no association between gender and the loneliness score was found. This could suggest that, in the unprecedented circumstances in which this study was performed, gender was not a significant factor af-

fecting how lonely people felt. On the other hand, female respondents tended to score higher on the NA scale, suggesting higher levels of anxiety. Women have already been reported to show higher levels of stress, depression, and anxiety (Salari et al., 2020) during the COVID-19 crisis. However, women have also been previously reported to score higher on the NA scale during nonpandemic conditions (Crawford and Henry, 2004).

Age has also been previously associated with loneliness. In a summary from previous literature, Dykstra (2009) showed that the prevalence of loneliness is particularly high in both people aged 15-24 years and people older than 80. Conversely, the present study found that the self-reported loneliness during the lockdown was higher in the youngest group (18-25) and decreased with age. This finding could also be specific to the COVID-19 lockdown since younger groups have a greater need for social connection, as was already reported in a study about the consequences of the lockdown in adolescents (Ellis et al., 2020). In addition, younger people reported lower positive and higher negative emotions, independently of their loneliness scores. This suggests that the consequences of a lockdown could be more harmful for the mental health of the younger population. Young people have been reported to be especially worried about their studies or work prospects in the economic recession that is likely to follow the pandemic (Ellis et al., 2020; Ozamiz-Etxebarria et al., 2020; Salari et al., 2020).

Country of residence was another factor influencing respondents' mood and feelings of loneliness. Although loneliness is an experience common to all humans (Rokach et al., 2000), there are differences between countries that have previously been attributed to population characteristics (such as culture, age, or the percentage of people living alone) or to national differences (such as life satisfaction and income per capita) or to an interaction of both (Dykstra, 2009; Rokach et al., 2000), (Dykstra, 2009; Rokach et al., 2000). It could be argued that different styles of lockdown at the time of data collection may also have influenced the results; some countries, such as Belgium or the Netherlands, did allow people to leave the house and meet others outside (while maintaining social distance), whereas others like Spain or France did not allow any non-essential activity outside the house. In other countries like Brazil, Germany, and the US the legislation varied between regions.

Finally, unemployment was also a risk factor for higher loneliness and negative emotions. It is likely that unemployed people in the present study suffered higher levels of anxiety due to the added economic uncertainty and the effects of the pandemic on their prospects of finding a job, as was suggested by Taylor et al. (2020).

Social Network Size as a Predictor of Loneliness and Mood

Unsurprisingly, participants living alone tended to rate their loneliness as high more often than those living with other people. In addition, the higher the number of people in the household, the lower the chances were of those respondents scoring high in loneliness. Despite this, a higher number of family members was also associated with higher negative emotions. A similar finding was reported in a study conducted in Wuhan during the lockdown, where being married was associated with higher anxiety levels than being single (Fu et al., 2020). Fu and colleagues hypothesized that married people, often with children, worry more about their family's health and the consequences of economic uncertainty. Additional negative consequences of living with others during the pandemic can include having less personal space or struggling to work remotely while attending to home schooled children (Spinelli et al., 2020). However, living alone was not associated with decreased negative feelings during lockdown since people living alone re-

ported higher loneliness, which was associated with higher negative emotions.

The frequency of interactions with people outside the household was not associated with the loneliness score. This suggests that virtual meetings, calls, texting apps, or even in-person conversations without the opportunity for physical interaction did not influence how lonely people were feeling. Affiliative physical contact has been shown to have an important role in human relationships, decreasing stress-induced physical symptoms and stimulating oxytocin release, a mechanism to reinforce social bonds (Gallace and Spence, 2010; Nummenmaa et al., 2016). It could, therefore, be argued that communication via video, audio, text or even brief face-to-face encounters are not a full substitute for physical intimacy as a means of connecting people with their social network (Gallace and Spence, 2010).

People that had daily communication tended to have higher PA scores, independently of their loneliness. This could indicate that having more frequent social communication can stimulate positive affective states. But this association could also mean that people feeling fewer positive emotions, and therefore more likely to be depressed, may have felt less inclined to engage in social interactions (Ingram, 2016).

Human-Animal Bond as Predictor of Loneliness and Mood

In this study, after controlling for all the included confounding variables, being a pet owner was associated with lower self-reported loneliness. Numerous studies have proposed that pet ownership may alleviate feelings of loneliness, especially in vulnerable populations such as older adults living alone (Stanley et al., 2014) or homeless young people (Brooks et al., 2018; Pikhartova et al., 2014; Rew, 1996). However, as reflected in a review from Gilbey and Tani, (2015), some of the evidence supporting this effect is flawed. In addition, several studies have not been able to find any effect or association between pet ownership and loneliness. In a recent study, Gilbey and Tani (2020) identify some methodology issues that may have affected the results of some of these previous studies. For example, they suggest that one of the most frequently used tools to measure loneliness, the UCLA-Loneliness Scale revised (Russell et al., 1980), may not be adequate to identify a potential effect of pet ownership on loneliness as most of its items are specifically focused on measuring deprivation of human social contact. The present study used a different approach, with a single item question designed to investigate the respondents' self-perception of their own loneliness.

The results presented in this study are consistent with previous reports. For example people living alone during the first lockdown in the UK (Clements et al., 2021; Holland et al., 2021) and the US (Bussolari et al., 2021) believed that their pets, in this case, dogs were helping them feel less lonely. Additionally, Bowen et al. (2021) suggested that dogs had an important social support role during the first Spanish lockdown. Contrarily, in a retrospective study by Clements et al. (2021), they found no association between pet ownership and loneliness in a population of UK adults.

Besides the association between pet ownership and lower self-reported loneliness, there was no additional association between having a pet and either the NA or the PA scores. It is possible that a positive association between pet ownership and mood exists but only due to the potential loneliness alleviation, which would have been masked by the link between loneliness and mood.

The lack of association between pet ownership and the NA scale is consistent with a review by Friedman and Krause-Parello (2018), who did not find studies reporting differences in the general anxiety levels between people with and without pets, but did find several studies linking the presence of a friendly animal to

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lower stress indicators during a stressful event (Allen et al., 2001; Friedmann et al., 2007; Tsai et al., 2010). This suggests that contact with a friendly animal may have a calming effect in specific situations but may not always have a buffering effect on the general negative feelings elicited by a more chronic state. Another factor to consider is that the effect of pets on the mood of their owner may be dependent on the proximity of the pet at the moment of assessment. In their study, Janssens et al. (2020) asked pet owners to complete the PANAS at random times during the day, showing that the participants had lower NA scores when they completed the assignment with their animal present. They also presented higher PA scores when answering while interacting with their pet. Finally, the positive effects of pet ownership on mood may be counteracted by the extra stress associated with owning a pet during lockdown. For example, several studies (Parry, 2020; Ratschen et al., 2020; Vincent et al., 2020) have described concerns regarding not having enough access to proper veterinarian care or enough exercise/walks, fear of the owner that they will become ill, and, consequently, that they would be unable to take care of their animals, worries about cross-species virus transmission or financial concerns.

The "quality" of the Human-Animal Bond has also been suggested to modulate the potentially positive effects of pet ownership (Brooks et al., 2018; Hill et al., 2020). The CCAS was used as a measure of attachment strength from the point of view of the owner, but the results did not show an association between stronger bonds and lower or higher loneliness scores. Nevertheless, it is important to remark that the CCAS measures the "comfort obtained from the animal", an attachment-related aspect of the Human-Animal Bond and that there are other dimensions, such as social support value, that the CCAS does not measure (Ratschen et al., 2020).

The CCAS score was positively, although very weakly, associated with both PA and NA scales, which may seem contradictory. This could be explained by some respondents' bias toward more extreme answers to scale-type questions. Nevertheless, the fact that the effect was stronger when analyzing the population of pet owners living alone may suggest a different explanation. The association between attachment strength and negative emotions for pet owners was twice as strong for those who lived alone, suggesting a link between higher negative emotions and stronger attachment to pets in people with limited access to physical emotional support from other people. These results support the findings of Antonacopoulos and Pychyl (2010), who reported that, among pet owners with a reduced social network, a stronger attachment to their pets could be a predictor of depression. This association was also found by Clements et al. (2021), who reported that increased interactions with companion animals were associated with poorer mental health during the first UK COVID-19 lockdown. Accordingly, the third explanation could be that people with higher levels of anxiety may have stronger attachments to their pets and look for comfort in the soothing effects of pet ownership, especially if they have a reduced social network. This theory is supported by previous publications that reported stronger bonds between animals and people in a situation of vulnerability or suffering from mental health issues (Clements et al., 2021; Peacock et al., 2012; Ratschen et al., 2020). In order to further understand the results, the potential factors that may influence people's attachment to their companion animals were explored. Respondents living alone or with a smaller social network obtained more comfort from their pets than those living with more people. This finding could be linked to the previously mentioned association between access to affiliative physical contact and loneliness, suggesting that comfort from pets can substitute the comfort obtained by physically interacting with people. Humans and companion animals often communicate

with each other via physical contact (Siniscalchi et al., 2018). Physical interaction with pet dogs has been shown to induce the release of oxytocin, in a similar way to physical contact between 2 people linked by an affective bond (Handlin et al., 2011; Odendaal and Meintjes, 2003). For example, in a population of elderly pet owners, Enders-Slegers (2000) showed that emotional attachment, specifically through physical contact, was the most important social provision that their pets offered them. During lockdown, companion animals may have offered comfort by being physically close to people, offering a safe haven from COVID-related stress and helping reduce their feelings of loneliness. This would explain why, during lockdown, having pets seems more effective against loneliness than having frequent communication with people outside the household. This theory is supported by the study from Bowen et al. (2021), who also highlighted the importance of dogs as sources of social support mainly thanks to affiliative physical contact during the first Spanish COVID-19 lockdown.

Species seems to be another factor that modulates the strength of the attachment. The CCAS score of owners of dogs and horses was higher than other species, followed by the scores of cats and rabbits. These results align with the study by Ratschen et al. (2020), who also looked at the CCAS during the COVID-19 lockdown and who also found that owners of birds, fish, small animals and reptiles had a significantly lower CCAS score compared with the owners of dogs and horses. The fact that the highest scoring species were those that are more prone to elicit physical interactions further supports the importance of physical proximity to offer comfort.

Finally, pet species was not only a predictor of the CCAS score but also seemed to have an additional influence on the PA scales. Specifically, horse owners scored both higher than the owners of other species in PA. In addition to the positive effects that horses may have on their owners, this could be partly explained by the demographics of horse owners. As an example, horse owners in Australia were reported to be wealthier than the general population and to live in more rural areas (Smyth and Dagley, 2015). Although Australia was not included in the study, it is not unreasonable to assume that being a horse owner entails relatively frequent access to open spaces, fresh air and exercise, all factors that may help alleviate the chronic stress related to the confinement (Burtscher et al., 2020).

Limitations of the Study

The special circumstances surrounding the study, for example, the unpredictability of the situation including the uncertainty about the evolution of the pandemic and the duration of the lockdown measures, made it impossible to compare respondent mood and loneliness with a baseline, that is, the mood before the corona crisis or after the end of the lockdown. The authors acknowledge the limitations of cross-sectional studies but decided not to include questions about past feelings to avoid recall bias.

Although the questionnaire received a high number of responses, the results are not representative of the global population. As often happens in questionnaire-based studies, female respondents and pet owners are over-represented. This could be due to the snowball distribution method used to reach participants, as pet owners may have been more interested in the study and more willing to participate and share the questionnaire (Wilson and Barker, 2003). In addition, the number of participants for each country varied considerably. Most participants were Belgian residents, where the lockdown was less strict than in other countries like Spain but stricter than in the US or the UK. Nevertheless, living in a place where new rules to encourage social distancing were in place was a prerequisite to participate and most participants indi-

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cated that they had already been in lockdown for 2 weeks or more. It has been previously suggested that even confinement shorter than 2 weeks has been associated with decreased psychological well-being (Bowen et al., 2020). In addition, the high number of responses allowed us to control for potentially confounding variables including gender and country of residence.

Conclusion

Our results suggest that, during the first COVID-19 lockdown, pets may have filled in a void in the life of people with a decreased social network by providing social support and by acting as attachment figures. Both living with other people and living with companion animals were associated with lower self-reported loneliness which, in turn, was strongly associated with higher positive and lower negative emotions. Besides the association with loneliness, no association between pet ownership and mood was found, further supporting the theory of companion animals acting as sources of emotional support when there is a deficit due to reduced social network. Having frequent communication with people outside the household did not influence the loneliness score, suggesting that physical contact, either with other people or with companion animals, may be important in alleviating feelings of isolation. In addition, the results suggest that pets may have, at least partly, functioned as non-human attachment figures, as the strength of attachment to companion animals was negatively correlated with the number of people available for affiliative physical interactions. Species of animals that facilitate physical interactions were also the ones that provided more comfort to their owners.

This study was performed in the first months of the pandemic. The psychological effects are therefore likely to have continued and become chronic. Further research is needed to understand the evolution of the associations between pet ownership and mood, and the perceived loneliness of the population during the following waves and the years to come.

Ethical Considerations

This research did not involve the use of live animals nor did it involve the acquisition of identifiable private information about human subjects and so required no ethical approval.

Authorship Statement

The idea for the paper was conceived by A. Martos Martinez-Caja, V. De Herdt, M.J. Enders-Slegers and C.P.H. Moons. The experiments were performed by A. Martos Martinez-Caja. The data were analyzed by A. Martos Martinez-Caja. The paper was written by A. Martos Martinez-Caja, V. De Herdt, M.J. Enders-Slegers and C.P.H. Moons.

Conflict of Interest

The authors have no conflict of interest to declare.

Acknowledgments

Appendix 1. Questionnaire

Effect of Coronavirus Measures on Households With and Without Pets

How are you feeling?

These days we are all facing a difficult situation. Because of coronavirus pandemic, governments all over the world are taking a series of measures to limit the spreading of the virus. These measures can have consequences, not only directly by affecting our health, way of life and social relationships but they also may be affecting our mental well-being.

To learn about how people are coping with this unprecedented situation and how this might be different for households with and without pets, researchers from Gent University have developed this questionnaire.

By clicking on the button "Next" below, you give permission to use the collected information strictly for research purposes. Therefore, please read the text below carefully.

There is no obligation for you to participate in this research and you can end your participation at any time. All provided information will be used solely for the purpose of this research, including any publications that may come from them. Personal information is strictly confidential and anonymous. If this research is presented or published, no individual information will be given.

The survey is administered by the Ethology and Animal Welfare Research Group of Ghent University and information is collected using third party software (SurveyMonkey), which has its own privacy policy: https://nl.surveymonkey.com/mp/legal/privacy-policy/. When data collection has finished, data will be transferred to secure servers of Ghent University. The answers to the questionnaire are completely anonymous and the database of information will be kept for the required duration of the research.

It is possible to leave the questionnaire and return later. Your answers will be saved and you will be able to continue from the point where you left it automatically. Since the questionnaires are anonymous, once you submit the questionnaire it will not be possible to change your answers.

We are at your disposal to provide further information (ana.martos@ugent.be).

Are you 18 years old or older

- Yes (continue)
- No (end of the questionnaire)

Are strict corona measures currently being enforced in your area of residence? By strict measures we mean that you *are restricted or not allowed to go outside and that you should keep your distance from people who don't live in your house (social distancing).*

- Yes (continue)
- No (end of questionnaire)

1. What is your age?

- 18-25
- 26-35
- 36-45
- 46 -55
- 56-65
- Older than 65
- I prefer not to say

2. What gender do you most identify with?

- Female
- Male
- Other (Specify) (Open question)
- I prefer not to say

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3. Where do you currently live (country of residence)?
(List of countries)
4. What is your current employment status?

- Employed full time (40 or more hours per week)
- Employed part time (up to 39 hours per week)
- Unemployed and currently looking for work
- Unemployed and not currently looking for work
- Student
- Retired
- Homemaker
- Self-employed
- Unable to work

5. Which of the following best describes your current occupation?
(list of occupations)
6. How many adults (18 years or older) live with you (excluding yourself)? Please answer only with a number:___ (Open question)
7. How many children (younger than 18) live with you (excluding yourself)? Please answer only with a number:__ (Open question)
8. For how long have the strict coronavirus measures been in place in your area of residence?

- < 1 week
- Between 1 and 2 weeks
- Between 2 and 3 weeks
- Between 3 and 4 weeks
- ≥ 4 weeks
- I don't know

9. How often do you speak to friends or family members, other than those who live with you, by using live audio and/or video?(phone, video calls, online videogame video or audio chat, etc.)

- Several times/day
- Once a day
- Several times/week
- Once a week
- Less than once a week
- I don't know
- Other (please specify)

10. How often do you exchange written messages with friends or family members, other than those who live with you? (for example via WhatsApp text messages, phone text messages, Facebook messages, written chat during online videogames, etc.)?

- Several times/day
- Once a day
- Several times/week
- Once a week
- Less than once a week
- I don't know
- Other (please specify)

11. When outside, how often do you talk in person to people other than those who live with you (respecting the safety distance)

- Several times/day
- Once a day
- Several times/week
- Once a week
- Less than once a week
- I don't know
- Other (please specify)

12. On a scale from 1 (not lonely at all) to 5 (extremely lonely) how lonely are you feeling during this period of isolation?
13. Below is a list of 20 words that describe feelings and emotions. Please rate from 1 (very slightly or not at all) to 5 (extremely) how accurately these words describe how are you currently feeling.

- interested
- distressed
- excited
- upset
- strong
- guilty
- scared
- hostile
- enthusiastic
- proud
- irritable
- alert
- ashamed
- inspired
- nervous
- determined
- attentive
- jittery
- active
- afraid

14. Do you currently live with pets?

- Yes (continue)
- No (End of the questionnaire)

15. Please, indicate which type of pet and the number of animals that you live with
1   2   4   more than 4

Dog
Cat
Rabbit
Hamster
Guinea pig
Rat
Ferret
Bird
Fish
Reptile
Other (specify)

16. Rate each of the pets you live with in terms of how much you agree on a scale between 1 and 4, where 1 is not at all and 4 is a lot. If you live with more than 1 animal, you can fill in this part of the questionnaire up to 4 times. Please start with the pet to which you are more attached.
My pet is a:

Cat
Dog
Rabbit
Hamster
Guinea pig
Rat
Ferret
Bird
Fish
Reptile
Other (specify)

17. On a scale between 1 and 4, where 1 is not at all and 4 is a lot, how much you agree with these statements.

- My pet provides me with companionship
- Having a pet gives me something to care for
- My pet provides me with pleasurable activity
- My pet is a source of constancy in my life

- My pet makes me feel needed
- My pet makes me feel safe
- My pet makes me play and laugh
- Having a pet gives me something to love
- I get more exercise because of my pet
- I get comfort from touching my pet
- I enjoy watching my pet
- My pet makes me feel loved
- My pet makes me feel trusted

Please select the most appropriate option

18. Now that strict coronavirus measures are in place, the care for my pet (feeding, cleaning, brushing, etc.) has been...

- Easier now than before ()
- The same as before
- More difficult now than before

19. Now that strict coronavirus measures are in place, I enjoy spending time with my pet (petting, playing, walking...)

- Less now than before
- The same now than before
- More now than before

20. Now that strict coronavirus measures are in place, my pet comforts me...

- More now than before
- The same as than before
- Less now than before

21. Now that strict coronavirus measures are in place, I spend time with my pet (playing, walking, petting...)

- More now than before
- The same as before
- Less now than before

22. Now that strict coronavirus measures are in place, the time that my pet can rest undisturbed...

- Has increased
- Has remained the same
- Has decreased

23. Since the start of the strict coronavirus measures, my pet has shown behavioral changes (in general, towards people in the household or towards other animals in the household)

- No.
- Yes. Please specify which behaviors have you noticed

24. Do you want to fill in this part for a different pet?

- Yes
- No

25. Do you have any comments regarding this research, or the questions asked? (Open question)

Thank you very much for your time. This completes the survey for you.

End

Appendix 2. Total number of initial participants per country (N = 6772). The countries included in the study are presented in bold

Country	n	%	Country	n	%
Afghanistan	1	0,01%	Ireland	3	0,04%
Argentina	8	0,12%	Italy	41	0,61%
Australia	23	0,34%	Luxemburg	8	0,12%
Austria	2	0,03%	Malaysia	1	0,01%
Belgium	**4441**	**65,58%**	Mexico	10	0,15%
Belize	7	0,10%	Morocco	1	0,01%
Benin	1	0,01%	**The Netherlands**	**406**	**6,00%**
Bhutan	1	0,01%	New Zealand	5	0,07%
Bolivia	1	0,01%	Pakistan	2	0,03%
Brazil	**74**	**1,09%**	Paraguay	1	0,01%
Bulgaria	1	0,01%	Peru	1	0,01%
Cabo verde	2	0,03%	Poland	1	0,01%
Canada	20	0,30%	Portugal	10	0,15%
Chile	12	0,18%	Romania	3	0,04%
Chypre	1	0,01%	Russia	6	0,09%
Colombia	8	0,12%	Slovenia	1	0,01%
Congo	2	0,03%	South Africa	2	0,03%
Costa Rica	33	0,49%	**Spain**	**310**	**4,58%**
Croatia	2	0,03%	Sweden	1	0,01%
Denmark	3	0,04%	Switzerland	14	0,21%
Finland	1	0,01%	Thailand	1	0,01%
France	**831**	**12,27%**	Turkey	1	0,01%
Gabon	1	0,01%	**UK**	**232**	**3,43%**
Germany	**112**	**1,65%**	**USA**	**114**	**1,68%**
India	3	0,04%	Uruguay	2	0,03%
Indian Ocean	1	0,01%	Venezuela	1	0,01%
			Vietnam	2	0,03%

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