



# Impacts of the COVID-19 pandemic on animal behaviour and welfare researchers<sup>\*</sup>

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## ABSTRACT

The COVID-19 pandemic has resulted in many changes in the way research is conducted. Some specific groups (e.g. women) and activities (e.g. teaching) may have been disproportionately affected. Our aim was to assess the impact of the COVID-19 pandemic on animal behaviour and welfare researchers' work experience and productivity, focussing on gender, care role, career stage and teaching load. An online survey asked researchers about childcare, research and teaching load and associated changes due to the pandemic, among others, and included the Perceived Stress Scale (PSS) and the Inventory of Socially Supportive Behaviours (ISSB). From June–July 2020, 117 completed responses were received from 28 countries. Time available for writing papers and grants either increased (36 %), decreased (31 %) or these tasks were halted completely (12 %). Perceived productivity was significantly lower for caregivers ( $P < 0.001$ ) and for men as compared to women ( $P < 0.001$ ); and low productivity was associated with more stress (higher PSS:  $P < 0.001$ ). Respondents' experience of the pandemic related to the PSS ( $b = -0.03 \pm 0.02$ ;  $P = 0.03$ ) and to self-assessed personality traits ( $P = 0.01$ ). The average PSS of  $21 \pm 6.5$  was greater than the reference value of 15, and was higher when respondents had low job security ( $P < 0.001$ ) and when they more strongly characterised themselves as perfectionists, hard-working, empathetic and worried ( $P = 0.02$ ). Respondents who had an intense care role received most social support ( $P = 0.04$ ). Teaching load increased for 25 % of the respondents but did not significantly relate to any of the response variables. Overall, caregivers and early career researchers faced the most difficulties, and personality traits had a major impact on the ability to cope with the changes caused by the pandemic.

## 1. Introduction

It is clear that the COVID-19 pandemic has affected many areas of research, with disciplines that rely on laboratories and time-sensitive experiments being more affected than other disciplines (Myers et al., 2020). Restrictions to control the COVID-19 pandemic have included, in most countries, a complete lock-down including the temporary closure of research facilities. Many researchers have been forced to work from home for two to three months or longer. This has resulted in many changes in work circumstances and research progress, with many facets that go beyond what we can address in just one paper.

Researchers faced suspension of animal trials and restrictions on entering laboratory and animal facilities. This affected the planning and

execution of many trials and their related funding. Projects that depend on specific timing, for example seasonal data collection such as trials on newborn animals in spring, may have been suspended for a whole year or cancelled completely. At the time of writing, there is still great uncertainty about the feasibility of planning research projects, as waves of COVID-19 infections, and thus related restrictions, are foreseen (Kaxiras and Neofotistos, 2020). This will affect nearly all researchers in animal behaviour sciences, and especially those who rely heavily on data collection in a limited time frame, such as PhD students. Consequently, there may be gaps in researchers' curriculum vitae, which may impact their future career progression.

It is common for researchers to face high levels of stress (Shin and Jung, 2014) and to have uncertainty about their job position (Castellacci

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and Viñas-Bardolet, 2020). The pandemic may have resulted in (additional) mental health challenges and reduced life satisfaction (Ammar et al., 2020), in particularly for those who had to stop working (Zhang et al., 2020) and thus had reduced job security. Psychological resilience to stress is an important trait to cope with the situations that arise during the COVID-19 pandemic (Paredes et al., 2021), and is related to other personality traits, such as extraversion and conscientiousness (Campbell-Sills et al., 2006). The ability to cope with stressful events can be increased by receiving social support (Ye et al., 2020; Qi et al., 2020). Job security, personality and social support are some of the factors which can affect researchers' response to the situation.

Some groups may have been affected more strongly than others. Women particularly may face hardship during the pandemic for multiple reasons, including being more often the primary caregivers, having less financial security and being more often victims of domestic violence than men (e.g. Connor et al., 2020; Fortier, 2020; Gausman and Langer, 2020). The gendered knock-on effects of the pandemic also pervade into academic careers (Gabster et al., 2020; Malisch et al., 2020; Myers et al., 2020). For example, during the first months of the pandemic relatively fewer manuscripts were submitted by female than by male researchers (Gabster et al., 2020). The pandemic may therefore exacerbate gender inequality, which is already an important concern in academia (European Commission, 2019). As our discipline has mostly female researchers (European Commission, 2019; Tang-Martínez, 2020), especially at the level of PhD students and Early Career Researchers (ECR, those up to seven years after obtaining their PhD), there is concern as to how the pandemic will affect our research field in the long term. For parents, the closure of kindergartens and schools during the pandemic led to increased childcare needs, especially for working women (Staniscuaski et al., 2020). Researchers with children or other care duties had to adapt their working schedule to family care. For many, this meant temporary suspension of work duties, as employers requested parents to take up their holidays or take special leave in order to fulfill their care role. During and after the pandemic, ECR may experience increased difficulties in obtaining or keeping a job (Forsythe et al., 2020). Researchers with young children are also more likely to be ECR; which is already a vulnerable group. Lecturers had to move their classes online and alter content and design to a form that was suitable for virtual learning (Crawford et al., 2020). For those with a lot of teaching hours this may have come at the cost of their other professional tasks and their private life (Rapanta et al., 2020). These groups require extra attention in current COVID-19 response strategies and in the development of the post-pandemic research landscape (Corbera et al., 2020; Gibson et al., 2020).

The aim of this study was to assess the impact of the pandemic on animal behaviour and welfare researchers' work experience and productivity. For this purpose, we looked at how certain groups perceived the pandemic as compared to others. We hypothesised that especially women, caregivers, ECR and those with a high teaching load would face most challenges during the pandemic. We further predicted that job security, personality and social support would influence the experience of the pandemic as well as work productivity. Although this study is not directly concerning applied (non-human) animal behaviour science, the findings are likely to impact the associated research, and we therefore consider this journal the best place to raise awareness of this subject.

## 2. Methods

### 2.1. Survey

A survey was developed to ask animal behaviour and welfare researchers about their experience during the pandemic in relation to their work. The survey was anonymous, and respondents had to agree to give their consent before continuing to the questions. The survey was approved by the Social Science Ethics committee of Scotland's Rural College, where the survey was hosted. The target population was animal

behaviour and welfare researchers of any gender. Participants had to be at least 18 years of age and had to be enrolled as a PhD student or holding a PhD degree.

An online survey was created using SurveyMonkey. The shareable link to the survey was distributed by email and by advertising the link at various relevant forums, including the Animal Welfare Slack forum, the Animal Welfare Research Network newsletter, the website of the International Society for Applied Ethology (ISAE) and the ISAE newsletter of July 2020. The full survey is provided in the Supplementary Files (Table S1). The survey consisted of four parts. The first part included nine questions on demographics, including questions on country of residence, gender, age, children, care roles and a Likert scale of questions related to personality and life satisfaction. The questions on personality were added to get a glimpse of the personality of the respondents without making the online survey unnecessarily long. The questions were chosen from existing questionnaires (Satisfaction with Life Scale: Diener et al., 1985; Big Five Inventory: John et al., 1991; The Toronto Empathy Questionnaire: Spreng et al., 2009) and selected based on traits that are common for researchers, such as conscientiousness (Chamorro-Premuzic and Furnham, 2003; De Feyter et al., 2012) and those related to the pandemic, such as neuroticism (Moldersitzki et al., 2020). The second part was related to research work, and included questions on research field, role (i.e. research position), type of institution (e.g. university, research institute, industry, independent, etc.), job security (on a sliding scale corresponding to an 8-point Likert scale), working hours, percentage of time spent on research and education, changes due to the pandemic, and an open question to reflect upon the impact of the pandemic on their career. The third part was the 10-item Perceived Stress Scale (PSS; Cohen et al., 1983), which is a well-established psychological instrument for measuring the perception of stress (Cohen and Janicki-Deverts, 2012). The PSS contains ten fixed questions that can be answered on a 5-point scale ranging from 0=Never to 4=Very Often. To calculate individual PSS scores, responses to the four positively stated questions (items 4, 5, 7, and 8) were reversed, after which all ten scores were summed. The PSS has an average reference value of 15 to which other groups can be compared (Cohen and Janicki-Deverts, 2012). The fourth part of the survey was optional (i.e. it was not compulsory to answer in order to proceed with the next questions) to decrease dropout rates and included the short form of the Inventory of Socially Supportive Behaviours (ISSB; Barrera et al., 1981; Stokes and Wilson, 1984). The ISSB short form consists of 19 questions related to social support (during the past four weeks) that can be answered on a 5-point scale ranging from 1='Not at all' to 5='About every day' (Supplementary file, Table S4). To obtain the overall score of a respondent, their 19 answers were averaged. The survey concluded with an open question, giving the option to add further comments on personal experiences of the lockdown. Upon submitting the survey, participants were provided with two links to information on mental support during the COVID-19 pandemic. Data from one respondent was removed from the analyses as the person had indicated to be an MSc student. Three surveys were removed mainly due to incomplete answers, resulting in a final sample of 117 responses (out of 121 responses received).

### 2.2. Data preparation

In order to facilitate data analyses, four new variables were constructed out of the responses. Three of these variables were 'principal components' (PC) obtained through a Principal Component Analysis (PCA). A PCA reduces the number of variables by combining correlated variables into a few principal components through the use of a matrix (Wold et al., 1987). The PCA's were performed using SAS software (version 9.4, SAS Institute Inc., Cary, NC, USA) without matrix rotation. The subsequent analyses of these new variables are provided in Section 2.3.

To create the PC variable 'Work productivity', all responses to

questions related to work output during the pandemic were combined in a PCA, after verifying that the questions were significantly correlated. Variables were maintained in the PCA factors irrespective of their loading. One factor had an Eigenvalue of  $>1$  (1.50) and was retained. The factor loaded positively on research output (0.80) and 'Working from home has positively influenced my productivity' (0.61), and loaded negatively on 'My caring commitments have made it challenging to complete my workload' ( $-0.69$ ). A higher PCA factor score therefore related to a more positive outlook on own productivity. To create the PC variable 'Pandemic experience', responses to questions on work-related changes and opinions during the pandemic were set to numerical scales and combined in a PCA. One factor best explained the pandemic work experience, with an Eigenvalue of 1.58. All variables loaded moderately positive (0.50 – 0.70) on the factor pattern (change in working hours 0.71; change in time spent on education 0.66; preference to remain working from home 0.62; and competence in online tools 0.50), except for 'change in research time' ( $-0.07$ ). A higher factor score therefore related to increased working and teaching hours combined with a preference to remain working from home.

The seven responses to the question 'How would you describe yourself?' (Supplementary file, Table S1), that were scored on a Likert scale, were combined in a PCA. One factor best explained the combination of variables, with an Eigenvalue of 2.15, and is hereafter called 'Self-description'. All variables loaded moderately positive (0.50 – 0.70) on the factor pattern except for life satisfaction ( $-0.16$ ) and multitasking (0.36). A high factor score thus describes researchers who characterise themselves as being perfectionists, hard-working, empathetic and having a tendency to worry a lot.

To analyse the effect of care duties, responses related to care roles were combined into the variable 'Care role' with three levels: no (59 %), moderately involved (24 %), and intensely involved (17 %) in caregiving. 'No' was when the respondent had no children and was not taking care of a family member. 'Moderately involved' was when the respondent either took care of a family member, or had one or two children but indicated not to be the main caregiver. 'Intensely involved' was when the respondent was either the main caregiver of the child (ren), had more than two children, or took care of a family member alongside childcare.

### 2.3. Quantitative data analysis

Data were analysed using SAS software, version 9.4 (SAS Institute Inc., Cary, NC, USA). Data are presented as percentages of the number of respondents, and as means with standard deviation (SD) unless stated otherwise. Fluctuating sample sizes are due to missing responses as none of the questions were compulsory. Descriptive statistics were assessed by Chi-square tests for categorical variables, t-tests and Pearson correlations.

Four response variables were analysed: 'Pandemic experience', 'Work productivity', PSS (stress scale) and ISSB (social support). All were continuous variables and were analysed in General Linear Models using the GLMSELECT procedure with automatic 'Stepwise' selection method

**Table 1**

Job profile of the respondents ( $n = 117$ ) in percentage and number of respondents according to type of research institution, research field and career stage, separately. The column for institution exceeds 100 % as some respondents had functions in multiple institutions.

Institution	% (n)	Research field	% (n)	Career stage	% (n)
University	77.8 (91)	Animal welfare	71.6 (83)	PhD student	31.9 (37)
Research institute	15.4 (18)	Animal behaviour	25.0 (29)	ECR	35.3 (41)
Research college	7.7 (9)	Animal production	1.7 (2)	Established <sup>1</sup>	15.5 (18)
NGO	6.8 (8)	Veterinary research	1.7 (2)	Senior <sup>2</sup>	17.2 (20)
Government	6.8 (8)				
Independent	2.6 (3)				

<sup>1</sup> 'Established researcher' includes independent researchers, lecturers and assistant professors.

<sup>2</sup> 'Senior researcher' includes associate researchers and (university and full) professors.

based on the lowest Corrected Akaike Information Criterion (AICC) statistic, with steps treated competitively, and no constraints on the significance level. The predictor variables were gender (male / female), career stage (PhD student / ECR / established researcher / senior), care role (no / moderate / intense), the interaction between gender and care role, institution (university / other), usual working hours per week (6 levels), working over-hours or overtime (yes / no), job security (8-point Likert scale), percentage of time spent on student education, age and self-description. Mental stress and social support can affect mood and work productivity and vice versa; therefore, for the models on 'pandemic experience' and 'work productivity', the PSS and ISSB were added as covariates, and vice versa for the models on PSS and ISSB.

### 2.4. Qualitative data analysis

Responses to the two open-ended questions, which asked participants to describe their experiences of lockdown, were entered into MaxQDA (version 18.2.4) for analysis. They were analysed thematically following the approach of Braun and Clarke (2006) by one of the authors (BV) and final interpretation of the findings was based on this analysis. This involved reading through the responses and looking for points of meaning and coding (i.e. categorising) them according to their topic or theme. For example, a sentence such as "Staying home has let me have more time for practicing sports" would have been coded as 'more time for activities / hobbies', and then further grouped according to an overarching theme, in this case, 'Personal life' (see Table 4). This was repeated systematically across all responses until a range of codes emerged. These codes were then grouped into super-ordinate (e.g. positive) and sub-ordinate themes (e.g. personal life) resulting in a table of key thematic findings and the codes or 'meaning units' relating to them (see Table 4). Grouping codes according to overarching or super-ordinate themes helped determine connections between different codes (e.g. 'more time for activities/hobbies' and 'quality time with family' would connect via a 'personal life' theme).

## 3. Results

### 3.1. Respondents

The survey was completed by 117 researchers from 28 different countries. Almost 60 % of the respondents were based in Europe (34.2 %,  $n = 40$ ) and the United Kingdom (counted separate from Europe: 25.6 %,  $n = 30$ ). North America (21.4 %,  $n = 25$ ) and South America (7.7 %,  $n = 9$ ) accounted for almost 30 %, and the remaining 10 % of respondents were living in Australia (6.0 %,  $n = 7$ ), Africa (2.6 %,  $n = 3$ ) or south-west Asia (2.6 %,  $n = 3$ ). Most respondents were women (82.5 %,  $n = 94$ ). Respondents predominantly worked at universities on the topic of animal welfare and were doing their PhD studies or were at an early career stage after their PhD (Table 1). The average age of respondents was  $38.9 \pm 9.79$  years. Age increased linearly with career stage: PhD students  $31 \pm 4.8$  years of age; ECR  $38 \pm 6.1$  years; established researchers  $44 \pm 8.2$  years; and senior researchers  $51 \pm 9.6$  years. Female

respondents occupied relatively fewer senior positions than male respondents, and instead were mostly PhD students or ECR ( $\chi = 8.462$ ;  $P = 0.04$ ). At the time of completing the survey, 57.7 % ( $n = 64$ ) of the respondents were in lockdown working from home; 4.5 % ( $n = 5$ ) were in lockdown but partly in the office; with the rest not being in lockdown but working from home (29.7 %,  $n = 33$ ) or in the office (8.1 %,  $n = 9$ ).

Regarding personality, the large majority agreed that they were good at multi-tasking, perfectionists, working more than is demanded from them, and tended to worry a lot (Table 2). They responded similarly to the questions related to empathy, indicating to have a strong urge to help others and to get emotionally affected. Regarding life satisfaction, 43.6 % indicated ‘somewhat agree’. Notably, 12.8 % indicated disagreeing with this statement (Table 2).

### 3.2. Care roles

The majority of the respondents (61.5 %,  $n = 72$ ) did not take care of children. Most respondents with child-care responsibilities had two children (21.4 % of all respondents,  $n = 25$ ), and the most common child-age category was 1–5 years (17.1 % of all respondents,  $n = 20$ ; Supplementary files, Table S2). A higher percentage of the male respondents had children (65 %,  $n = 13$ ) as compared to the female respondents (34.1 %,  $n = 32$ ;  $\chi = 12.499$ ;  $P = 0.002$ ; Supplementary Files, Table S2). However, when looking at respondents with care responsibility, none of the men indicated to be the main caregiver, whereas 14 of the 32 (43.7 %) women caregivers did. Men responded that the care was equal between the two partners (84.6 %,  $n = 11$ ) or the main care was with the partner ( $n = 1$ ) or family ( $n = 1$ ). Half of the women responded that they shared the childcare equally with their partner (50 %,  $n = 16$ ) or that the care was allocated to a nanny ( $n = 1$ ). Seven women and three men took care of a family member during the pandemic. Childcare was increased during the pandemic both for women (for 81.3 % of those with children,  $n = 26$ ) and men (for 76.9 % of those with children,  $n = 10$ ).

### 3.3. Work pressure

On a scale from 0 to 7, with seven as most secure, respondents rated the financial security of their job as  $4.6 \pm 2.24$  (range 0–7). Respondents’ usual working hours (outside the pandemic) are given in Fig. 1A. For the respondents who were halted in their work during the pandemic (Fig. 1B), 8.6 % had to stop temporarily, 8.6 % had to take up holiday during the pandemic, 3.4 % had to take special leave, and 1.7 % were furloughed by their employer. Three-quarters of the respondents (76.7 %,  $n = 89$ ) indicated working more hours than they were paid for

(i.e. unpaid overtime). Respondents spent on average  $27.6 \% \pm 24.79\%$  of their working time on education and teaching and  $64.6 \% \pm 26.34\%$  on research. The percentage spent on education increased for 25.2 % ( $n = 28$ ) of the respondents and decreased for 18.9 % ( $n = 21$ ). The percentage spent on research increased for 7.2 % ( $n = 8$ ) and decreased for 41.4 % ( $n = 46$ ) of the respondents.

### 3.4. Work productivity

Of 111 respondents, 29.7 % ( $n = 33$ ) were less able to work on grant proposals and publications during the pandemic, with 13.5 % ( $n = 15$ ) indicating to have no time at all for it. For 36 % ( $n = 40$ ) the time spent writing grant proposals and publications increased.

Respondents were divided on whether working from home increased their productivity, with 45.9 % ( $n = 43$ ) disagreeing and 35.7 % ( $n = 33$ ) agreeing with the statement (Table 3). Similarly, the preference to remain working from home was divided with 39.1 % ( $n = 35$ ) disagreeing and 50 % agreeing ( $n = 55$ ). For the majority, care commitments made it challenging to complete work. However, almost all felt competent in using online tools. The majority (76.4 %,  $n = 69$ ) had the impression that female researchers were more disadvantaged during the lockdown than male researchers; but it were the female respondents who indicated this more than the male respondents ( $F_{1,107} = 4.24$ ,  $P = 0.04$ ).

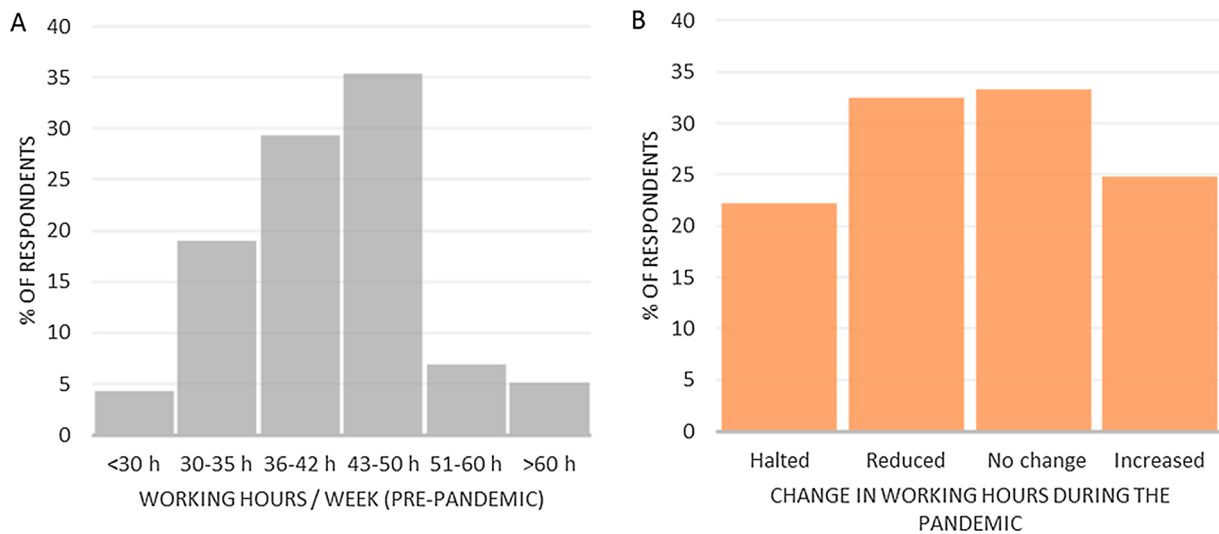
Perceived work productivity during the pandemic was significantly lower for those who had a care role as compared to those who did not have a care role ( $F_{2,73} = 7.87$ ;  $P < 0.001$ ), irrespective of the level of involvement in the care (Fig. 2: no care role vs. involved  $P < 0.001$ , no care role vs. intense  $P = 0.003$ , involved vs. intense  $P = 0.95$ ). Perceived work productivity was also lower for men as compared to women ( $F_{1,73} = 13.81$ ;  $P < 0.001$ ); and for those who were working at universities as compared to those working in other types of institutions ( $F_{1,73} = 13.99$ ;  $P < 0.001$ ; Fig. 2). The higher productivity for women was partly related to a relatively lower percentage of women being caretakers than men in this sample. The highest productivity was seen in women without a care role, with an average factor score of  $0.67 \pm 0.769$  (range -0.77 – 2.03), while the factor scores for all other groups were negative, i.e. less than zero. The factor scores for productivity tended to be lower depending on career stage ( $F_{3,73} = 2.28$ ;  $P = 0.09$ ), with a significant post-hoc difference for ECR as compared to senior researchers (Fig. 2). A higher perceived productivity was related to a lower Perceived Stress Scale (PSS, estimate  $\pm$  SEM:  $b = -0.05 \pm 0.01$ ;  $F_{1,73} = 12.11$ ;  $P < 0.001$ ).

**Table 2**

Heat map of the Likert scales on questions related to personality and life satisfaction, showing the percentage of respondents (out of  $n = 117$ ) indicating their answer to a 7-point\* Likert scale. The darker the colour the higher the percentage of respondents.

How would you describe yourself?	Likert scale*						
	1	2	3	4	5	6	7
I am good at multi-tasking	0.9	7.7	6.0	6.0	37.6	29.1	12.8
I consider myself a perfectionist	1.7	6.8	6.0	11.1	23.9	26.5	23.9
I tend to work more than what is demanded from me	0.0	6.8	3.4	9.4	29.1	20.5	30.8
I tend to worry a lot	0.9	6.0	4.3	8.6	31.6	21.4	27.4
I get a strong urge to help when I see someone who is upset	1.7	6.0	1.7	5.1	29.1	28.2	28.2
I easily get emotionally affected by others’ situation	1.7	10.3	6.0	6.8	31.6	26.5	17.1
I am satisfied with my life	0.0	12.8	4.3	6.8	43.6	21.4	11.1

\* Likert scale: 1: completely disagree; 2: disagree; 3: somewhat disagree; 4: neither agree nor disagree; 5: somewhat agree; 6: agree; and 7: completely agree.



**Fig. 1.** a) The distribution of the average number of working hours per week prior to the pandemic; and b) the change in working hours during the pandemic.

**Table 3**

Heat map of the Likert scales on questions related to work during the pandemic. The table shows the percentage of respondents indicating their answer to an 8-point Likert scale\*. The darker the colour the higher the percentage of respondents.

To what extent do you agree with the following statements?	Likert scale*							
	n/a	1	2	3	4	5	6	7
Working from home has positively influenced my productivity (n = 108)	0.9	18.4	17.4	10.1	17.4	12.8	17.4	5.5
My caring commitments have made it challenging to complete my workload (n = 77)	5.2	9.1	3.9	11.7	18.2	10.4	13.0	28.6
I would prefer to remain working from home (n = 110)	0.9	11.8	11.8	15.5	10.0	16.4	21.8	11.8
I feel competent to use online tools for virtual meetings (n = 109)	0.0	0.9	3.7	0.9	6.4	36.7	17.4	33.9
I have the feeling that female researchers have faced more challenges during the lock-down than male researchers (n = 110)	0.0	5.5	1.8	1.8	14.6	33.6	15.5	27.3

\* Likert scale: n/a: not applicable; 1: completely disagree; 2: disagree; 3: somewhat disagree; 4: neither agree nor disagree; 5: somewhat agree; 6: agree; and 7: completely agree.

**3.5. Experience of working (from home) during the pandemic**

The factor score for ‘pandemic experience’, which loaded positively on increased working and teaching hours and a preference to remain working from home, was associated with a lower PSS, i.e. less stress as described in Section 3.6 (estimate ± SEM:  $b = -0.03 \pm 0.02$ ;  $F_{1,104} = 4.91$ ;  $P = 0.03$ ). ‘Pandemic experience’ related positively to the variable ‘self-description’ (estimate ± SEM:  $b = 0.27 \pm 0.11$ ;  $F_{1,104} = 6.47$ ;  $P = 0.01$ ), thus showing higher factor scores for researchers who described themselves as being perfectionists, hard-working, empathetic and having a tendency to worry a lot. The factor scores for ‘pandemic experience’ tended to be higher for women (means ± SEM:  $0.10 \pm 0.10$ ) than for men ( $-0.36 \pm 0.23$ ;  $F_{1,104} = 3.16$ ;  $P = 0.08$ ).

**3.6. Perceived Stress Scale (PSS)**

The average score on perceived stress, based on 110 responses, was

$21.3 \pm 6.33$  (SD) (range 7–35), with the possible range being 0–40. The average of the study population was significantly higher than the reference value of 15 (Cohen and Janicki-Deverts, 2012) ( $df = 109$ ,  $t = 10.36$ ,  $P < 0.001$ ). The separate scores for each of the ten questions of the PSS are provided in the Supplementary files, Table S3. Thirty percent of the variation in the final model of PSS was explained by financial security, work productivity and the respondents’ self-description. The PSS was higher when researchers had lower financial job security (estimate ± SEM:  $b = -0.95 \pm 0.27$ ;  $F_{1,74} = 12.45$ ;  $P < 0.001$ ) and lower productivity ( $-1.73 \pm 0.59$ ;  $F_{1,74} = 8.36$ ;  $P = 0.005$ ). Women respondents tended to have lower job security than the male respondents (LSmeans ± SEM:  $F 4.42$ ,  $M 5.35$ ;  $t = -1.69$ ;  $P = 0.09$ ). The PSS was higher when respondents had a higher factor score for self-description, relating to perfectionism, hard work, empathy and worrying ( $1.40 \pm 0.59$ ;  $F_{1,74} = 5.55$ ;  $P = 0.02$ ). ‘Productivity’ related significantly to and provided a better model fit than both career stage and working at a university (described in Section 3.5). However, it is worth mentioning

**Table 4**  
Qualitative thematic analysis of participants' experiences of the COVID-19 pandemic and lockdown.

Themes and sub-themes	Codes	Illustrative quote	
<b>Positive</b>			
Personal life	Quality time with friends/family	"It was great to spend so much time with my family which I am truly grateful for"	
	More time for activities / hobbies	"Staying home has let me have more time for practicing sports, which I enjoy"	
	Work-life and Career	Opportunity to write	"Inability to carry out practical work... gave me extra time to refocus my attention on writing publications, which allowed me to catch up on this aspect to a great extent"
		Opportunity to develop skills	"I could focus more on my working and I increased my competence on my research field"
	Opportunities from moving online	"I enjoyed that many events [...] became available online. This meant that in some ways I felt more connected to other researchers"	
	Working from home	"Less time spent commuting has meant more time for work"	
Health	Physical health benefits	"I haven't had any respiratory diseases compared to other autumn semesters"	
<b>Negative</b>			
Personal life	Lack of routine	"Working from home affected daily routine"	
	Travel restrictions	"[...] the embassy is closed, so I'm stuck in a country that is not my home country"	
Physical health	At desk all day	"I'm at my desk exclusively all day which I feel is negatively affecting my health."	
Mental health	Lack of exercise	"Insufficient exercise"	
	Stress		"Increased workload in terms of teaching, PT support, getting course, exams, assessments, etc online has been very stressful"
		Uncertainty	"Not knowing when I might go back to my lab/office (if am not fired before) is frightening...I am highly afraid of the future"
		Anxiety / Worry	"General anxiety about the situation and loved ones has made it difficult to concentrate at times, and lockdown in general has not been good for my mental health"
	Guilt	"I feel guilty that my daughter is not learning at the level she should be"	
	Loneliness / isolation	"I didn't expect to feel lonely as well"	
Fatigue / exhaustion	"My mental health has suffered, never switching off from work, having to make up time in the evenings when the kids are asleep and feeling torn between helping them and working in the day"		
	Overwhelm	"Lack of childcare and need to do home schooling has meant I have been meeting myself coming backwards and feeling exhausted and overwhelmed with all the different aspects of life until my children returned to school"	
Negative Home and family-life	Interpersonal conflict	"Working from home all the time has increased interpersonal conflict with my family members"	
	Impact on productivity	"More traffic/noise in the house (at times it feels like there is constantly someone video-chatting out loud with family members who are in lockdown elsewhere)"	
Child-care responsibilities	Impact on career	"Childcare duties put me behind my PhD colleagues without children, to a much greater extent than during normal times"	

**Table 4 (continued)**

Themes and sub-themes	Codes	Illustrative quote
	Home-schooling	"I do not like having to simultaneously work, care for children and ensure home schooling happens. That is 3 jobs at once, and I can't think straight or do any of them well under these conditions"
Work-life and career	Impact on planned research	"The effects of not being able to be in the office have pushed back my trial dates which has greatly impacted my overall plans for this year and next year as well as creating an uncertainty with respects to the pay-out of my funding"
		"Isolation from my peers has definitely affected my productivity negatively"
	Employment uncertainty	"My current position ends July 31. The uncertainty related to the next school year for my two primary school children mean I cannot search for a 'traditional' job. I will have gaps in my CV as a result and fear the long term negative implications"
	Increased demands	"Remote teaching has required me to take on more hours with not a comparable amount of pay"
	Challenges of home working	"I did notice that it was/is difficult to set work-home boundaries. Often I would work until quite late"
	Concern for students	"I worry about my international students who are separated from family, it has put more stress on them which has reduced their efforts/outputs"
	Impact on industry relationships	"Perception amongst producers, who pay the levy which pays my wages, that I am not doing anything for them"

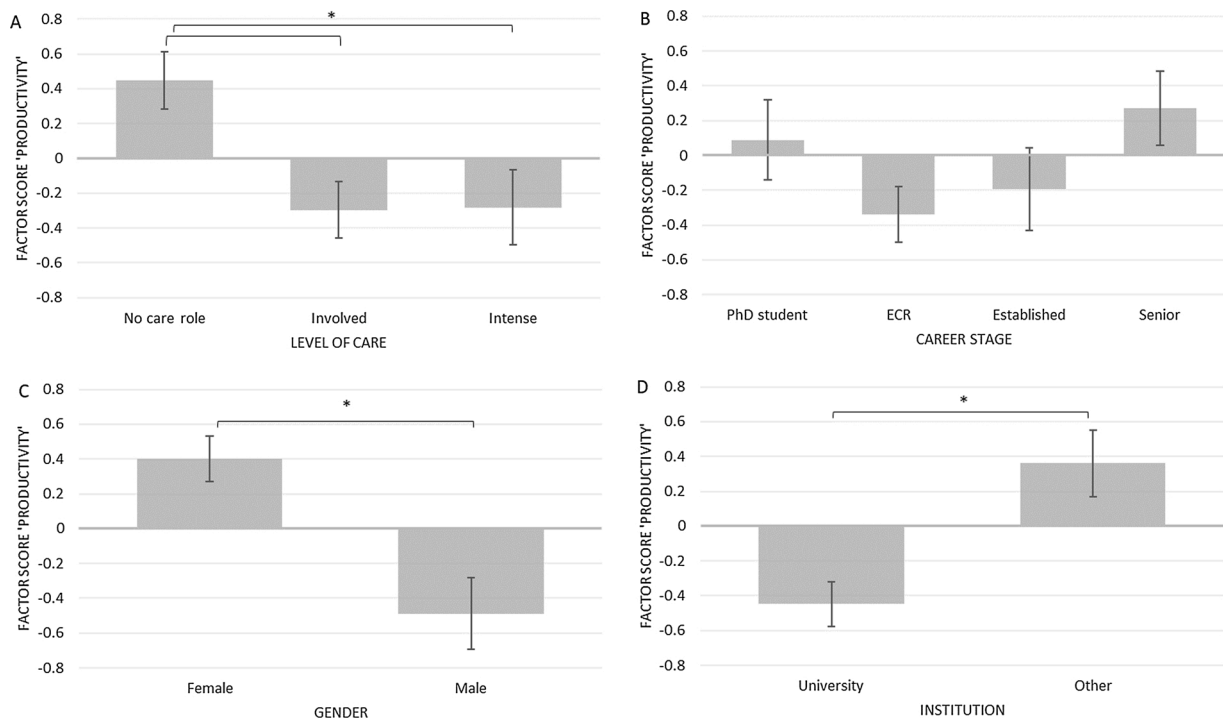
that PhD students had the highest PSS (means ± SEM: 26.2 ± 1.35), followed by ECR (21.0 ± 0.96), established researchers (19.3 ± 1.35) and senior researchers (18.3 ± 1.38), showing a decline in PSS with advancement in the research career.

### 3.7. Inventory of Socially Supportive Behaviours (ISSB)

The average score for the ISSB, i.e. how much support the respondent received, was 2.10 ± 0.56 (SD) (range 1.11–3.79), with a possible range of 1–5. The ISSB did not correlate with the PSS (n = 109, r = -0.01, P = 0.93). The separate scores for the ISSB questions are provided in the Supplementary files, Table S4. Twenty-one percent of the variation in the ISSB could be explained by the respondent's age, care role, financial security, self-description and productivity. A higher ISSB was associated with a lower age (estimate ± SEM: b = -0.02 ± 0.007; F<sub>1,73</sub> = 4.23; P = 0.04) and a higher factor score on 'self-description' (0.15 ± 0.061; F<sub>1,73</sub> = 5.92; P = 0.02). Social support was related to care role (F<sub>1,73</sub> = 3.42; P = 0.04), with a significantly higher ISSB for respondents who were classified as having an intense care role (mean ± SEM: 2.28 ± 0.129), as compared to those who did not have a care role (1.93 ± 0.105) or who were moderately involved in caretaking activities (1.87 ± 0.113). The latter two did not significantly differ from each other. Financial security (P = 0.20) and productivity (P = 0.10) were not significantly related to the ISSB but did contribute to the overall model fit.

### 3.8. Qualitative findings

The qualitative findings provide a deeper insight into participants' experiences of the COVID-19 pandemic and what factors may underlie some of the quantitative findings. The outputs of the thematic analysis, as presented in Table 4, indicated that participants' experiences of the pandemic and its impact on them could be grouped super-ordinately as being either positive or negative, and sub-ordinately according to how it



**Fig. 2.** The effects of a) care role, b) career stage, c) gender, and d) type of work institution on the perceived work productivity during the pandemic. The axes across the panels are set to the same scale. \*indicates a significant difference between the categories.

impacted: a) their personal life; b) their health; c) their home and family-life and; d) their work-life and career. Personal life was separated from home and family-life to enable a distinction between factors relating to ‘the self’ e.g. personal hobbies and activities, and those relating to ‘the others’ i.e. the other individuals in the household and the nature of those interactions and relationships.

Several participants recounted positive impacts on personal life, including being able to spend more quality time with family or friends and having more time to engage in personal activities (e.g. sports) and hobbies (e.g. gardening). The predominant perception on careers and work-life balance was of the pandemic providing new work-related opportunities, including greater opportunities to write and work on papers, and opportunities to up-skill or develop new skills. Interestingly, many highlighted how the move to more ‘online’ working offered opportunities to increase international engagement with other researchers and the possibility to attend more conferences as many had moved to a virtual format. Responses concerning working from home related to the time-saving benefit of ‘no commute’ and the positive impact of home-working on productivity due to ‘less distractions’ from colleagues or a busy office environment. One participant also described a positive impact on physical health.

Despite these positive experiences, the predominant view was that the COVID-19 pandemic had a negative impact on personal life, health, home and family-life, and work-life and career. Negative impacts on personal life included factors such as a lack of routine, and travel restrictions which left individuals feeling isolated due to being unable to visit family or friends. The latter was highlighted by some as being particularly pertinent to the research community where many had moved abroad, away from family and home communities, to pursue their careers. Regarding physical and mental health, participants recounted experiencing increased stress, uncertainty, anxiety, worry, guilt, loneliness and isolation, fatigue and exhaustion, and feelings of being overwhelmed, contributing to poorer mental health. There were several interconnected reasons given, such as having to ‘juggle too many jobs’ (e.g. child-care, home-schooling, increased teaching, having to move teaching online, learning new ways of working), social isolation

(e.g. not able to see friends), a lack of social support (primarily from not being able to engage with colleagues), work-related uncertainty (e.g. future funding, whether contract would be renewed, whether PhD could be completed), not switching off from work (due to working from home) and working longer hours (due to increased workload or having to work around caring commitments). In terms of negative impacts on physical health, participants described negative effects of ‘being at the desk all day’ attributed to the working day no longer being broken up when working from home and a ‘lack of exercise’.

The negative impact of the pandemic on home and family-life was primarily due to more people having to work and live in the home simultaneously, which resulted in issues such as increased ‘interpersonal conflict’ and ‘more distractions’. In line with the quantitative results, participants with children reported the most negative impacts within this theme, describing numerous challenges related to home-schooling as an ‘extra job’. Some recounted how home-schooling had directly impacted their career prospects, where they had to take time off work or post-poned looking for a new job role until they could be sure their children could return to school.

The negative impact of the pandemic on participants’ work-life and career was the most widely mentioned and common theme within participants’ qualitative responses. Specifically, the negative impact lockdown had on planned research, whereby experiments and field-work had to be indefinitely postponed and the potential knock-on effects of this on funding, was most commonly mentioned. PhD students and ECR highlighted this as being particularly detrimental, with PhD students experiencing uncertainty regarding completion of planned PhD work and ECR highlighting the potential negative effects on career progression. Other themes were reduced productivity, motivation and focus. Many stated this was due to the negative impacts of the lockdown on their mental health, the aforementioned challenges of home-working and reduced interaction with colleagues to help motivate or ‘problem-solve’. Several participants ( $n = 11$ ) also described an increase in employment uncertainty. Many had work contracts which would end soon, and they were unsure whether contracts would be extended or whether they would be able to find a new job. Respondents also

described how the lockdown had resulted in increased work-related demands, including increased teaching, more meetings and the need to provide more student support. Several mentioned difficulties with creating ‘boundaries’ between work and personal time, a lack of proper equipment (e.g. desk, chair) and difficulties in transitioning to working online. Five participants raised concerns over how the lockdown had impacted their students (e.g. PhD and MSc level) and a perceived need to try to provide them with more support but an uncertainty about what they could feasibly do. In sum, it is evident that respondents had wide-ranging and varied experiences of the lockdown, describing numerous different ways in which it had both positively and negatively impacted their personal, home and family life, work-life and career as well as their health

#### 4. Discussion

The quantitative and qualitative study of the experience of animal behaviour and welfare (ABW) researchers during the COVID-19 pandemic shows that many have been, mainly negatively, affected by the changes. Although around one-third of the respondents saw opportunities to focus on research work and increase their productivity, for the majority of respondents research tasks competed with an increased teaching load and increased child care. In this study, extra emphasis was given to women, caregivers, PhD students, ECR and those with a high teaching load. The negative impact of the pandemic especially hit PhD students and ECR, as well as researchers who had an intense care role in their family. Gender differences were present, but overall female ABW researchers were not more disadvantaged than male researchers in the current results.

##### 4.1. Changes in work during the pandemic

Half of the respondents indicated that they would prefer to remain working from home, which is also found across occupations (Beck et al., 2020), and most felt that it increased their work productivity. Some indicated reduced productivity but still preferred to remain working from home, which may be related to an improved work-life balance (Crosbie and Moore, 2004; Chung and van der Lippe, 2020). Universities and companies have now had to make the necessary adjustments to facilitate home working, and this may open up new opportunities for more workplace flexibility in the future (Kramer and Kramer, 2020). At the start of the lockdown, however, difficulties such as having no desk space, suitable computer or an ergonomic set-up, may have been common issues, as was indeed found for 47 % of the respondents in the survey by Kappel and colleagues (*this Special Issue*). Additional issues existed with limited or no access to folders, servers, hardcopy files and books; and problems with internet access and broadband speed at home. Internet access may have been especially problematic in developing countries, thereby contributing to increased inequality (Niner et al., 2020). Although it was not addressed here, we should be considerate of the consequences of the pandemic on BAME (Black, Asian, and minority ethnic) communities (Bentley, 2020; Kirby, 2020).

##### 4.2. Work productivity

Time required for teaching and student supervision mostly increased during the pandemic, and researchers indicated they had less time for research. Myers et al. (2020), in their sample of 4535 respondents, reported a 24 % reduction in research time across disciplines, and a decline between 30–40 % for biological and agricultural sciences. Indeed, over 43 % of our respondents were less able, or not able at all, to work on manuscripts and grant proposals. Perceived work productivity appeared to be partly determined by whether or not the respondent had students (and thus lectures and supervision), rather than the number of hours spent on student education. The reduced productivity at universities may also be in part explained by the reduced productivity of PhD

students, who were one of the most affected groups during the pandemic and typically are employed at a university. A low perceived work productivity (i.e. job performance) was associated with more stress (i.e. a higher Perceived Stress Scale score, PSS). However, stress and job performance are not always related (Topić et al., 2016), and not necessarily linear (AbuAlRub, 2004).

Perceived productivity was lower for researchers with children, as also found by Myers et al. (2020), which is a natural consequence of the immensely increased unpaid worktime and attention needed from parents to home-school and take care of their children during the pandemic (Craig and Churchill, 2020). Those who had an intense care role received more social support from their surroundings (in the month prior to the survey) than those without care roles or those who were not a main caregiver. For those without children, productivity may have increased as the self-isolation during lockdown reduced social activities, and thus freed up time to complete work tasks. Perceived productivity was highest for women without children, and higher for women than for men, which is in contrast to Myers et al. (2020). The lower productivity for men in our survey might be related to a relatively greater proportion of men having children although none of them was a main child caregiver. Women are still the main child-caregivers in industrialised countries, even when both parents are working (Power, 2020).

##### 4.3. Gender differences

The majority of the respondents were women, which is in line with the gender distribution in this discipline (Tang-Martínez, 2020) and its main scientific society (ISAE; Supplementary file Figure S1). Most respondents believed that female researchers may have suffered more from the pandemic than male researchers, although this was mostly indicated by women themselves. This mirrors the global concerns on the disproportional burden on women during the pandemic (Fortier, 2020; Gausman and Langer, 2020), including in academia (Malisch et al., 2020; Myers et al., 2020). This survey and the one from Kappel et al. (2021) from within biological sciences show, however, no significant gender effects on the main parameters, suggesting that in ABW research there is less gender inequality when it comes to dealing with the pandemic. Europe has set strong goals to reduce gender inequality in research (European Commission, 2019), but for most other parts of the world gender inequality is a prominent and persistent problem in academia (Conesa Carpintero and González Ramos, 2018; Malisch et al., 2020). In the current data, where more than 80 % of the respondents were from industrialised countries, women did have fewer senior positions and tended to perceive their job as less secure than did men.

##### 4.4. Difficulties for early career researchers (ECR)

PhD students and ECR (those up to seven years after obtaining their PhD degree), had a lower perceived productivity than senior researchers and the highest levels of perceived stress. The high PSS scores emphasize the vulnerability of this group to stress-related mental and physical problems (Gibson et al., 2020). However, younger researchers did receive more social support, which is an important factor in reducing the risk of a burnout (Jacobs and Dodd, 2003). With the COVID-19 recession, it may be harder to find a job for those who are, or soon would be, on the job market (Forsythe et al., 2020). This is especially problematic for those who graduate during a recession (Oreopoulos et al., 2012). A larger gap may appear between young staff members with children and those without (i.e. the ‘family gap’, Antecol et al., 2018; Conesa Carpintero and González Ramos, 2018), whereby those with children may see a more drastic impact on their work productivity (Malisch et al., 2020). The current results indeed support this hypothesis. This may leave a gap in the CV of ECR with children, thus increasing inequality unless funders and employers adjust to such an involuntary ‘career-break’, or assess research output relative to the actual opportunity to work (Klocker and Drozdowski, 2012). Respondents did mention, as a



positive aspect of the pandemic, the increased networking opportunities due to the surge in online meetings and conferences. Virtual conferences provided new opportunities for networking, especially for PhD students and ECR who often have limited financial capacity (Niner et al., 2020).

#### 4.5. The typical personality of researchers

Respondents quite uniformly indicated their agreement with the statements on working more than is expected from them, being a perfectionist, being good at multi-tasking, having a tendency to worry a lot, and scoring high on empathy. Higher empathy is associated with a positive attitude towards animals (Furnham et al., 2003; Taylor and Signal, 2005; Apostol et al., 2013) and is higher in self-reports of women as compared to men (Baez et al., 2017). The responses show that the sample population scored high on conscientiousness, which is positively related to academic achievement (Chamorro-Premuzic and Furnham, 2003; MacCann et al., 2009; De Feyter et al., 2012). High conscientiousness however also makes scientific staff more vulnerable to a burn-out (Ghorpade et al., 2007). The combined PCA score for these selected traits was indicative of how respondents perceived the pandemic, including their perceived stress. It is thus relevant to include questions on personality in surveys that aim to address researchers' perception. The small selection of questions here does, however, not cover the full spectrum of personality, and including more questions, for example using the full Big Five inventory (De Feyter et al., 2012), would be worthwhile in future surveys.

#### 4.6. Increased workload and a high perceived stress

Prior to the pandemic, respondents already worked many hours per week, as is characteristic for academics (Sang et al., 2015). The pandemic contributed to many participants working longer hours, often in their own personal time, as indicated in the open answers. This is in contrast to the survey of Myers and collaborators (2020), who reported a reduction in working hours from 61 h pre-pandemic to 54 h per week in April 2020. The average PSS in the present study was higher than the reference values provided for the PSS (on average 15), which are based on 4387 US respondents (Cohen and Janicki-Deverts, 2012). The moderately high PSS found here (21) is in accordance with studies addressing the high work pressure and competitiveness in academia (Sang et al., 2015) and may be higher than normal due to the pandemic. Academics should therefore be attentive to a potential need for (professional) organisational and mental health support among employees, colleagues and students (Cao et al., 2020; Malisch et al., 2020).

#### 4.7. Future perspective

Research institutes, departments and groups will have to consider how to deal with the multitude of changes due to the COVID-19 pandemic that are either happening now (e.g. mental distress, teaching load) or that are expected to appear in the future (e.g. career gaps; Corbera et al., 2020; Gibson et al., 2020). For example, a substantial part of the curriculum is now adapted to online teaching which makes it likely that online teaching will be more widespread in future (Corbera et al., 2020), although this will vary widely among countries (Crawford et al., 2020). Malisch et al. (2020) provide a diagram laying out required changes in teaching, research and services related to the pandemic in order to facilitate a structured evaluation of research staff. Such schemes can be instrumental in, for example, reassessing performance. Corbera et al. (2020) emphasize that post-COVID-19 academia should foster a culture of care to make academia more sustainable. The main findings from the current and related surveys (Kappel et al., 2021; Myers et al., 2020) indicate that the experiences of individual researchers vary widely. We thus urge funders, supervisors, colleagues and heads of faculty to be considerate of the stark contrast in experiences, and to take into account that many researchers may need (professional) support.

Therefore, adjust research targets to what is feasible for the personal circumstances of individuals, especially those with care roles. This study addressed just a few of the major initial issues that are related to the COVID-19 pandemic within the field of animal behaviour and welfare research. This survey was conducted within half a year of the start of the pandemic, and we strongly encourage more work on this topic to be carried out as the pandemic unfolds and – hopefully – recedes.

#### Author declaration

We wish to confirm that there are no known conflicts of interest associated with this publication and there has been no financial support for this work that could have influenced its outcome.

#### Declaration of Competing Interest

The authors report no declarations of interest.

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#### Appendix A. Supplementary data

Supplementary material related to this article can be found, in the online version, at doi:<https://doi.org/10.1016/j.applanim.2021.105255>.

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