

## Cat-human related activities associated with human well-being

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Besides inconsistent evidence relating to the mental health benefits of pet ownership, there is a specific lack of data in relation to cat ownership. Research in this field frequently fails to consider the effect of specific cat-human relationships or activities that might impact owner well-being. This study aimed to identify and address this gap by examining the activities associated with owning a cat that were perceived by owners to impact on their well-being. Twenty cat owners (18 to 74 years old) were interviewed remotely, and their audio transcripts thematically analysed. 67 activities were reported by cat owners to cause changes in their hedonic or eudaimonic well-being or life satisfaction. Most activities were reported to improve well-being, for example, “providing for the cat” increased feelings of enjoyment and enhanced owner’s reported purpose in life. However, some activities were predominantly associated with negative outcomes, such as veterinary visits and cat behaviour problems. This study presents an operationally-defined framework that lays the groundwork for further research in the field of human-cat interaction and human well-being. It highlights the importance of focusing on specific activities associated with cat ownership, rather than just assessing “ownership” per se, as if it is a homogenous phenomenon.

*Keywords:* cat ownership, eudaimonia, feline, hedonia, human-animal interaction, human well-being, life satisfaction, pet.

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**Conflict of interest:** the authors declare no potential conflicts of interest concerning this study.

**Data availability statement:** The data that support the findings of this study are available from the corresponding author upon reasonable request.

**Acknowledgements:** The authors would like to thank all cat owners involved in the study.

Pet ownership has been claimed to have mental health benefits such as reduction in stress (Allen et al., 2001; Allen, 2003); a sense of purpose and meaning to life (Raina et al., 1999; Brooks et al., 2016); management of emotions and increased ability to cope with difficult life situations (Brooks et al., 2012; Byström and Persson, 2015); and a reduced risk to older adults developing mental health disorders associated with loneliness and depression (Hui Gan et al., 2019). Children with autism spectrum disorder were said to exhibit calmer behaviours with affectionate cats, which in turn provided comfort for the parents, creating a rewarding relationship for both parent and child (Hart et al., 2018). Although much published research proposes pet ownership benefits mental health, there is also evidence to suggest no effect or detriment to mental health due to increased responsibility, financial burden and emotional attachments resulting in depressive symptoms (Enders-Slegers and Hediger, 2019; Gilbey et al., 2007; Needell and Mehta-Naik, 2016). Müllersdorf et al. (2009) hypothesize that pet owners may report poorer mental health, as people who have a predisposition for mental health conditions, such as depression, may be more likely to acquire a pet. Mueller et al. (2018) were unable to determine the directionality between depression and pet ownership, and they conclude that having the pet may alleviate depressive symptoms, but the loss of previous pets may exacerbate them. Therefore, it is not surprising that the findings are inconsistent as to whether pet ownership in general is beneficial or not to human well-being and mental health.

When considering the impact of pet ownership and human well-being many studies simply compare ‘pet owners’ and ‘non-pet owners’, without specifically addressing how pet ownership might change well-being (Bao and Schreer, 2016). “Direct activities” associated with ownership require the presence of the pet, and include things like petting, and being licked by the pet; but there are also “indirect activities” which occur without the pet being present for example, buying toys and food, talking about, or managing the pet’s social media account. Understanding the specific activities that owners engage in is vital to gain better insight into how they impact on well-being (Barcelos et al., 2020).

Barcelos et al. (2020) recently addressed this issue in relation to dog ownership, by undertaking a thematic analysis of focus groups of dog owners. This identified 58 dog-human related activities which could be organized into 15 themes believed to impact on hedonic well-being, life satisfaction and eudaimonic well-being. Hedonia refers to the maximization of pleasure (positive affect) and minimization of pain (negative affect) (Deci and Ryan, 2008; Neil et al., 2019), which is often associated with life satisfaction to form subjective well-being (Keyes et al., 2002). Life satisfaction is typically depicted as less emotionally powered and more cognitively driven, referring to a global evaluation of an individual’s quality of life (Peterson et al., 2005; Singh and Jha, 2008). In contrast eudaimonia, also known as psychological well-being, refers to elements of a fulfilling life, and is often viewed as comprising of six elements; (1) autonomy and independence -, a sense of self-determination, not looking for the approval of others, freedom to express oneself, (2) self-acceptance -, acceptance of past and present self along with good and bad qualities, (3) environmental mastery or demands of life -, one’s ability to cope with their surrounding world and adapt to changes in environment, (4) personal growth -, development as a person and continued growth to reach individual potential, (5) positive relations with others -, trusting and intimate relationships with others, capable of empathy and affection towards others and generating meaningful friendships, (6) purpose in life -, a sense of meaning to life, a sense of direction with goals and intentions (Ryff, 1989; Ryff and Keyes, 1995).

To date, research regarding cat ownership and well-being has also typically failed to consider specific activities and simply related any emotional responses or mood changes to ‘interactions’ with the cat (Turner et al., 2003; Turner, 2017). For example, Turner et al. (2003) found that the presence of owners interacting with their own cats improved anxiety, depression,

and fear, yet failed to relate this to any specific type of interaction. Cats differ markedly from dogs in what they need and how owners interact with them, and so it is reasonable to assume that the activities performed by cat owners which might impact on their well-being outcomes might also differ. Both Howell et al. (2017) and Zasloff (1996), when developing owner relationship scales, recognized the important difference in the type of interactions owners engage with a cat compared to a dog. Indeed, Zasloff (1996) removed two items ("I get more exercise because of my pet" and "My pet makes me feel safe") from the Comfort from Companion Animals Scale because dog owners were scoring much higher than cat owners simply because of these species-specific activities. Indeed, exercising with the dog, is one of the most widely mentioned features of dog ownership (Barcelos et al., (2020); and several studies have indicated this important for owner mental health (Campbell et al., 2016; Hui Gan et al., 2019). Although walking cats in a harness occurs, it is not the norm (Howell et al., 2017) and therefore the primary benefits cat ownership might be different. Therefore, the current study aimed to adapt the approach Barcelos et al. (2020) used for dog-human related activities to focus on cat human related activities (direct and indirect) and their perceived impact on the owner's well-being (hedonia, life satisfaction and eudaimonia). With the adapted approach, it is expected that there will be cat-human activities that both positively and negatively impact on owner's well-being, as with Barcelos et al.'s (2020) findings. It is also expected that there will be more activities resulting in positive well-being outcomes rather than detrimental ones. However, it is assumed that the specific activities will differ slightly to that of Barcelos et al. (2020) due to species-specific activities.

## Methods

### Participants

This study was approved by the delegated authority of the University of Lincoln ethical review committee (reference number: 2020-CAB-002) and methods were conducted according to the University's Research Ethics Policy and the BPS Code of Ethics and Conduct. A recruitment survey was used to identify suitable interviewees, who were met individually and virtually due to contact restrictions associated with COVID-19.

Nonprobability sampling methods (convenience, snowball and voluntary) were used to recruit interested participants through social media from a range of ages, genders, and locations across the United Kingdom. A total of 65 respondents completed an online recruitment form, of whom 20 were selected through purpose sampling to produce a diverse sample. Priority of participation was given in the order of gender, age, and level of animal expertise. Information regarding the breed, age of cat(s), number of years owning the cat(s), the amount of time the cat(s) spent outdoors, and the lifetime number of years the owner had spent living with cats, were collected in the registration survey.

The final 20 interviewees for the study comprised of 12 females (60%), five participants aged 18-24, four 25-34, two 35-44, three 45-54, three 55-64 and three 65-74. Over half of the owners (55%) had lived with cats for over 20 years across their lifetime, with the time of the remaining owners (45%) ranging from between 1-3 years to 16-18 years. Regarding animal expertise, 16 participants were considered only cat owners (80%), two were also veterinary professionals (10%), and two had expertise in animal behaviour (10%). The cats' ages and ownership ranged from less than 5 months old to over 15 years old (median 7-9 years old). Three owners stated that their cats were exclusively indoor cats; for the remaining cats, time spent outdoors ranged from 2-3 hours to over 12 hours outside (median 4-5 hours).

All participants provided electronically signed informed consent before the formal interview. They were asked to attend a single remote interview with the first author, conducted through Blackboard Collaborate.

Allocation of interviews was finalized as a result of participant availability. Inductive thematic saturation, i.e., no new themes emerging (Saunders et al., 2018), was used to determine if further respondents were required, as analysis was performed immediately after each interview a reserve list was created with consenting respondents. Saturation was achieved, with no new themes emerging after interview 17, so no reserve participants were required.

### **Interviews**

Semi-structured interviews were used allowing the interviewees to elaborate on information important to them (Gill et al., 2008). As in-person interviews were not feasible during the time of data collection (due to COVID-19 restrictions), video conferencing for qualitative one to one interviews was used, allowing the researcher and the participant to visually see each other and build a rapport (Irani, 2018). The sessions were audio recorded simultaneously using Blackboard Collaborate, a KINOEE Digital Audio Recorder and an iPhone SE 2020 (Apple). The interview duration varied from 15-56 minutes (mean 28.8 minutes). Using a semi-structured moderator guide, owners were introduced to the concept of direct and indirect activities. A PowerPoint presentation with examples of activities and well-being was shown to all participants to facilitate understanding of concepts. They were then introduced to the concepts of hedonic well-being and life satisfaction, limiting examples so as to minimize interviewer influence on participant answers. Hedonic well-being was described as feelings, emotions, and moods for easier understanding. Each participant was asked to think of important cat human related activities they experience, and the associated changes in hedonic well-being and life satisfaction. Participants were able to talk freely about the activities, with the interviewer prompting for specific emotional responses or life satisfaction outcomes relating to the activities, as necessary. Once the participant had reached the end of the relevant activities they could think of in this regard, the interview moved on to consider eudaimonic well-being. Participants were introduced to the six aspects of eudaimonic well-being described above (autonomy and independence, self-acceptance, environmental mastery or demands of life, personal growth, positive relations with others and personal growth) and asked to relate some activities to these aspects. Participants were provided with the example of “playing with my cat gives me confidence” which corresponded to the element “self-acceptance” as a guide. The six aspects of eudaimonia were presented on the PowerPoint prompt as a reminder for participants. The interviewer asked participants to elaborate any vague points using probes and prompts to clarify and gather more information from the participant as necessary.

### **Transcription and data analysis**

Microsoft Word was used for word-for-word transcription of the audio files and data analysis was performed using the program NVivo 11 (release 1.0). Thematic analysis of each transcript was then undertaken by coding activities and the corresponding well-being outcome as either hedonic, life satisfaction-related or eudaimonic. All similar activities were then grouped to create themes. For example, “taking pictures of the cat” and “sharing pictures of the cat” were grouped into the theme “picture related”. Life satisfaction was divided into increasing or decreasing. Hedonic elements were then placed into groups of affect derived from Panskepp et al.’s (2002) affective circumplex model, using positive or negative valence and arousal level (positive feeling, high arousal (PvHa); positive feeling, low arousal (PvLa); negative feeling, high arousal (NvHa); negative feeling, low arousal (NvLa)). Emotion and mood codes were placed into each of the groups in accordance with existing dimensional models (Russell, 1983; Scherer, 2005). Eudaimonic well-being elements were separated according to the six elements. The final themes and codes were discussed with the second author until a consensus was reached. All themes and activities were then linked with the corresponding well-being outcomes using

NVivo's matrix coding tool. This included calculation of the number of times a theme or activity was mentioned in relation to each of the well-being outcomes.

## Results

### Cat human related activities and human well-being outcomes

A total of 67 activities were reported to be important to participant well-being, the activities were grouped into 15 themes (Figure 1). The most frequently mentioned theme was 'providing for the cat' with 68 references, with the highest mentioned activity within this theme being 'feeding the cat', which was referenced 23 times. This was closely followed by the theme 'tactile interactions' with 63 mentions and 'petting and fussing the cat' being the most mentioned activity within this theme with 15 references. Other commonly reported themes included 'social interactions' mentioned 44 times, 'unwanted behaviour' mentioned 39 times and 'shared activities in the house' mentioned 37 times. Frequently mentioned activities included 'playing with the cat' mentioned as a theme and an activity 24 times, 'presence of the cat without touch' referred to 23 times and 'talking about the cat' mentioned a total of 22 times.

There was a total of 16 well-being outcome themes (Figure 1). The most common was an increase in 'positive valence, high arousal' affect, mentioned a total of 100 times. This theme included an increase in feelings and emotions such as 'excitement', and 'joy' (Figure 2). The next most common hedonic theme was an increase in 'negative valence, high arousal' state, mentioned a total of 61 times. This included feelings such as 'stressed', and 'frustrated' (Figure 2). In terms of eudaimonia, the most commonly mentioned well-being outcome was an increase in 'positive relations with others', examples included an increase in communication and sense of community, associated with activities a total of 44 times. The themes that increased 'self-acceptance' and 'personal growth' were also frequently mentioned, a total of 31 times each. Details of all of the activity themes along with the well-being outcomes can be seen in the heat map (Figure 1). The percentages used within the Results section should not be used for quantitative analysis and should be interpreted only as a description of the generated data.

### 'Positive valence, high arousal' and cat human activities

Mentioned 100 times by participants, this theme was the most popular outcome, including the feelings mentioned above, along with 'pleasure', 'happiness' and 'enjoyment'. Frequently mentioned activities said to increase this were 'buying toys, beds, and scratching posts', 'feeding the cat', and 'talking to the cat'. Participant 14:

*"I find myself talking to them (the cats) like with children. Yes, I think I get as much enjoyment out of it as they do, probably more".*

Other activities described as increasing this sort of feeling included 'taking videos and pictures of the cat', 'playing with the cat', and 'watching the cat perform daily activities'. The latter involved watching the cat play with other cats or toys, witnessing the cat watching a bird feeder and watching the cat using its scratching post.

No activity was reported to lower these feelings/moods.

**Figure 1**  
*Heat Map of All Cat Human Related Activities and Associated Well-Being Outcome*

All themes and activities	Hedonia						Eudaimonia						Life Satisfaction			
	Increase in			Decrease in			Increase in			Decrease in			Increase in	Decrease in		
	NvHa	NvLa	PvHa	PvLa	NvHa	NvLa	Aut	Sel	Dem	Per	Poa	Pur	Aut	Sel	LS	LS
<b>1: Activities performed because of the cat</b>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Creating business dedicated to cat																
Giving money to help cat charities																
<b>2: Failing to meet cats demands, expectations, restricting the cat</b>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Leaving cat when going away																
Putting cat into carrier																
Restricting the cat to indoors																
Stopping cat from visiting others properties																
<b>3: Learning about cats</b>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Learning about cats eg. behaviour																
Reading books about cats																
Researching about cats																
Watching TV programmes about cats																
Watching YouTube videos about cats																
<b>4: Unwanted behaviour</b>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Attention seeking by cat																
Cat being aggressive																
Cat meowing when travelling																
Failed recall																
Interruption by cat																
Rescuing cat from neighbors property																
Running away from owner																
Waking owner up from sleep																
Cat engaging in fighting with other cats																
<b>5: Listening to cat purr (theme and activity)</b>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<b>6: Picture related</b>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sharing photos of the cat with family and friends																
Taking photos and videos of the cat																
Taking photos with the cat																
<b>7: Playing with cat (theme and activity)</b>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<b>8: Prey related activities</b>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cat bringing home prey																
Cat failing to catch bugs																
Rescuing prey																
<b>9: Providing for cat</b>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Being present for the cat																
Buying food for cat																
Buying toys, beds and scratching posts																
Caretaking other cats																
Feeding the cat																
Grooming the cat																
Non-specific routine																
<b>10: Shared activities in the house</b>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cat recognising owner																
Dressing cat in costumes																
Followed by cat in house																
Presence of cat without touch																
Slow blinking with cat																
Training the cat																
Watching TV with the cat																
<b>11: Shared activities outside of the house</b>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cat waiting to be let indoors																
Following owner outside of home																
Gardening with cat																
Recall when out of the house																
Travelling with cat																
<b>12: Social interactions</b>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Joining cat owner Facebook groups																
Social media about cat																
Talking about cat																
Talking to the cat																
Telling cat off																
<b>13: Tactile touch</b>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cat joining owner on bed																
Cat kneading owner																
Cuddling with cat																
General handling cat																
Non-specific touching the cat																
Petting and fussing the cat																
Sitting on lap																
Sleeping with cat																
Cat standing on owner's head																
<b>14: Cat's health</b>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Veterinary visits																
Giving cat medication																
<b>15: Watching cat behaviour</b>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cat choosing other family member																
Cat refusing food or play																
Watching the cat perform daily activities, play, scratch ect.																

0% 0.1 - 2.5% 2.6-5% 5.1-7.5% 7.6-10% 10.1- 12.5% 12.6 - 15% 15.1 - 17.5% 17.6 - 20% 20.1 - 22.5% 22.6 - 25% 25.1 - 27.5% 27.5 - 30% >30%

*Note:* The darker the cell the more frequently mentioned that activity (row) was in relation to the well-being outcome (column). E.g., ‘talking about the cat’ (dark cell) was more frequently mentioned to increase ‘positive relations with others’ than ‘sharing photos of the cat with family and friends’ (light cell). **NvHa** (negative valence, high arousal), **NvLa** (negative valence, low arousal), **PvHa** (positive valence, high arousal), **PvLa** (positive valence, low arousal), **Aut** (autonomy), **Sel** (self-acceptance), **Per** (personal growth), **Dem** (demands of life) **Pos** (positive relations with others), **Pur** (purpose in life), **LS** (life satisfaction).

### **‘Positive valence, low arousal’ and cat human activities**

This theme included feelings of increased ‘calmness’ and ‘relaxation’, often brought about by tactile interactions. Particularly ‘petting and fussing the cat’ including ‘stroking the cat’ and ‘sitting on the owner’s lap’, also the theme and activity ‘listening to the cat purr’. Participant 7 stated:

*“Having the cat sitting next to me purring is always quite calming”.*

Some other activities that were mentioned to increase ‘PvLa’ feelings were ‘sharing photos of the cat with family and friends’, ‘presence of the cat without touch’, and ‘social media about the cat’ including having or managing social media relating to the cat.

There was no report of activities lowering this aspect of well-being.

### **‘Negative valence, high arousal’ and cat human related activities**

This well-being outcome was frequently mentioned. Participants reported feelings of an increase in ‘frustration’, ‘annoyance’, and ‘stress’. These outcomes were associated with unwanted behaviours, specifically ‘attention seeking’, ‘waking owner up at night’, and ‘veterinary visits’. For example, Participant 4:

*“She’ll (the cat) come in and meow at me so it can be a bit frustrating sometimes, not all the time, but occasionally when it is constant it does get a little bit frustrating”.*

The activity ‘cat sitting on lap’ was consistently described as counteracting feelings in the quadrant ‘NvHa’. Participant 15 explains how this activity had an anti-anxiety effect:

*“I think she (the cat) has improved my mental well-being through lots of different acts throughout the day, she relaxes me, I do get anxious a bit and she does bring my anxiety down when she comes and sits with me. she mostly helps when she comes in and sits on me”.*

### **‘Negative valence, low arousal’ and cat human related activities**

This well-being outcome was the least mentioned theme by the participants (33 mentions). This theme included feelings of ‘guilt’, ‘sadness’ and ‘unhappy’. These outcomes were paired with activities such as ‘attention seeking’, ‘cat being aggressive’, and ‘rescuing cat from a neighbour’s property’. Participant 12 said the following in relation to the activity ‘grooming the cat’:

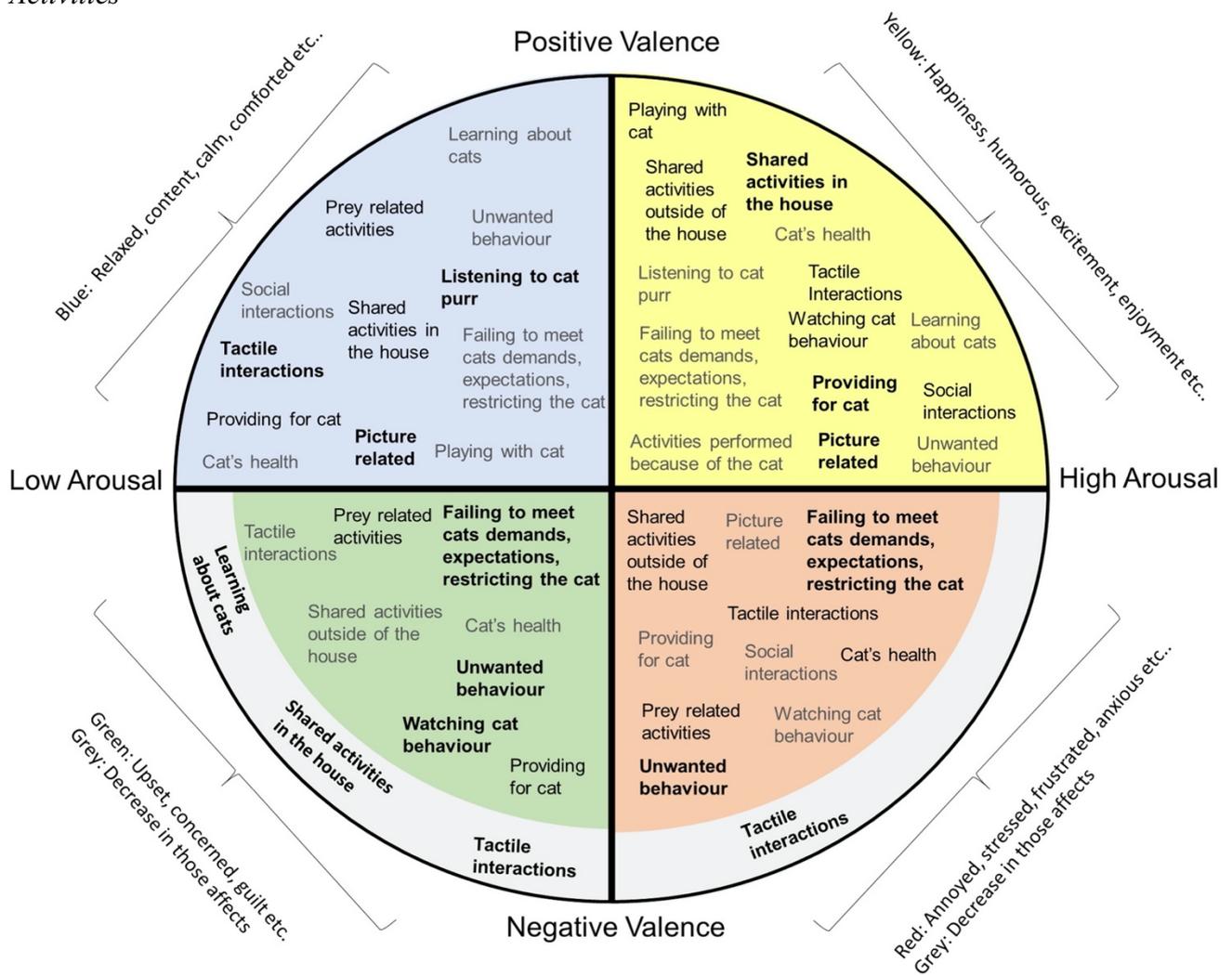
*“We’ve got different brushes, we’ve got different gloves we’ve got so many things in our cupboard, we have tried everything, but he (the cat) just hates all of it. So, I just feel really guilty when doing it”.*

Some participants explained how feelings of sadness were reduced by ‘researching about cats’, ‘presence of the cat without touch’ and ‘cat joining owner on bed’. Participant 3 described how the cat’s presence eases feelings of unhappiness:

*“I’ve always had that sense of when you’re unhappy, they’ll (the cat) come to like comfort you and it does make me feel better. Even if there is like my partner next to me whenever the cat comes in that’s an extra thing”.*

2. The hedonic well-being outcomes and corresponding themes are summarized in Figure 2.

**Figure 2**  
 Model for Hedonic Affect (Valence and Arousal) for All Themes of Cat Human Related Activities



*Note:* Blue, yellow, green, and orange quadrants contain themes of activities that increase that aspect of affect. Themes in grey borders were reported to reduce that aspect of affect. Themes in **bold** had a high frequency of mentions in that element of well-being (≥10%). Black themes were moderately mentioned (5% - 9.9%) and grey themes low frequency of mentions (0.1% – 4.9%). The spatial position of themes is not correlated with intensity or frequency of mentions.

### **‘Life satisfaction’ and cat human related activities**

Overall, there were few mentions of activities in relation to life satisfaction. Increased life satisfaction was associated once each with ‘playing with the cat’, ‘buying toys, beds and scratching posts’, ‘feeding the cat’ (all mentioned twice), and ‘cuddling with the cat’. Participant 5 stated:

*“Coming home and playing with him (the cat) and having a bit of a rough and tumble adds to the life satisfaction”.*

In contrast, only one participant reported an activity resulting in reduced life satisfaction, this activity being ‘cat bringing prey home’. Participant 5:

*“The only thing which I do think negatively affects [life] satisfaction is hunting”.*

### **‘Positive relations with others’ and cat human related activities**

Increased positive relationships with others was the most popular eudaimonic outcome with 44 mentions. The most frequent activities mentioned were ‘talking about the cat’ and ‘presence of the cat without touch’. Some participants explained how talking about the cat increased their sociability, Participant 6:

*“One thing that is quite nice about having a cat is it gives you something directly to talk about with other people, so if someone else has a pet you immediately have a connection with them and something else to discuss so I think in that sense that can help socially”.*

Specific outcomes mentioned within this theme included an increase in the owner’s communication with others, viewing the cat as social companionship for themselves or family members, and an increased sense of community. There were no activities described that decreased this well-being outcome.

### **‘Self-acceptance’ and cat human related activities**

This element was one of the more commonly reported eudaimonic themes mentioned 31 times. Activities said to improve self-acceptance included ‘followed by cat in house’, ‘general handling of the cat’, and ‘talking about the cat’ amongst others (Figure 3). Participant 16 shared how their self-acceptance improved when they talked to their cat:

*“It doesn’t feel like you’re coming home to an empty house. It’s like waking them up from whatever they are doing, it makes you feel welcome and loved”.*

Self-acceptance was decreased in two instances in relation to ‘veterinary visits’ and ‘joining cat owners Facebook groups’, Participant 6:

*“I do sometimes worry about coming across as a crazy cat lady”.*

### **‘Personal growth’ and cat human related activities**

An increase in personal growth was another popular element with 31 mentions, with some contributing activities including ‘learning about cat behaviour’, ‘training the cat’, and ‘listening to the cat purr’. Activities within the theme ‘providing for the cat’ were commonly described for example, Participant 11:

*“Not just the playing with the cat but, feeding it, the grooming it, the having a cuddle with it, sleeping on the bed with it all that kind of stuff and treating it well, has given me a great amount of responsibility and the understanding of how to be responsible in other parts of my life”.*

No participants mentioned activities that decreased this element.

### **‘Demands of life’ and cat human related activities**

This theme was mentioned 19 times with some activities improving this element being ‘presence of the cat without touch’, ‘petting and fussing the cat’, and ‘cuddling the cat’. The activity ‘talking to the cat’ was also mentioned for example Participant 9:

*“I think you can offload stuff onto the cat and then they just respond with love and you can feel better for just doing that”.*

No participants reported activities that decreased their ability to cope with everyday demands of life.

### **‘Purpose in life’ and cat human related activities**

There were no activities reported to decrease participants’ sense of purpose in life, this theme was less frequently mentioned, referenced only 12 times. Some activities that increased owners’ sense of purpose in life included ‘feeding the cat’, ‘being present for the cat’, and ‘non-specific routines’, Participant 12:

*“With the purpose in life, having to be there and care for another thing than just myself and wanting to kind of buy and spoil this animal”.*

### **‘Autonomy’ and cat human related activities**

This was the least reported amongst the eudaimonic outcomes, being mentioned only three times. An increase in autonomy was mentioned in relation to ‘creating a business dedicated to the cat’ by Participant 1:

*“He (the cat) has had quite a big influence on everything I do at the moment. In terms of well-being I think that is very positive especially at the moment because it gives me some independence... I’m not reliant, I’m self-employed”.*

In contrast, decreased autonomy was mentioned twice, this was in relation to ‘cat standing on owner’s head’ and ‘traveling with the cat’. Participant 15 explained:

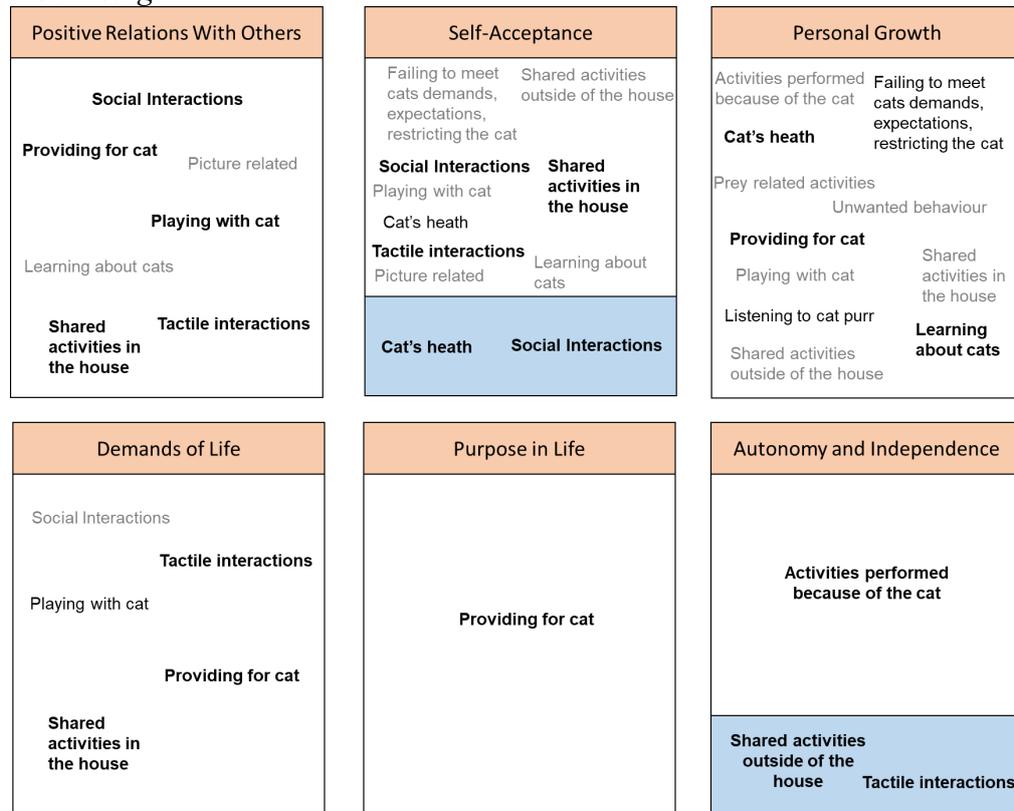
*“It has changed how we plan for meeting up with friends... whether we are going to see friends for a few days, whether there is somewhere for (cats name) to stay at the friend’s house... so I think it has limited our freedom with being able to meet up with friends”.*

The eudaimonic well-being outcomes and corresponding themes are summarized in Figure 3.

## **Discussion**

A comprehensive investigation that encompasses the nuances of each cat human relationship in relation to human well-being has been missing from the literature. The results of this study provide a framework of 67 cat human related activities, divided into 15 themes, that owners believe impact on their hedonic and eudaimonic well-being and their life satisfaction. The findings indicate that the repertoire of interactions in a cat-human dyad is diverse and that well-being outcomes vary with the activities experienced, as found for dogs (Barcelos et al. 2020). Tactile interactions with the cat and providing for the animal (e.g., feeding), for example, were predominantly reported to benefit participants’ hedonic (mood/emotions) and eudaimonic (life functioning) well-being, cat’s behaviour problems and failure to meet the cat’s needs had the converse effect (i.e., detrimental to well-being).

**Figure 3**  
*All Themes of Activities of Cat Human Related Activities Reported to Influence Eudaimonic Well-Being*



*Note:* Themes located in white boxes were described as increasing the associated well-being outcome whereas those in blue boxes were stated as reducing the associated well-being outcome. Themes in **bold** had a high frequency of mentions in that element of well-being ( $\geq 10\%$ ). Black themes were moderately mentioned (5% - 9.9%) and grey themes were low frequently mentioned (0.1% – 4.9%). The spatial position of themes is not correlated with intensity or frequency of mentions.

Despite the similarities between the cat framework and dog reported previously (Barcelos et al. 2020), there are species-related differences, some of which are clearly exclusive (e.g., cat purring, dog barking); others are largely relevant to a particular species and so, not appearing in both frameworks (e.g., cat bringing home prey, putting cat into carrier, walking the dog).

Unsurprisingly, the majority of activities were associated with positive well-being outcomes, but there are also important activities that have a negative impact. This emphasizes the limitations of simply comparing pet (or cat) owners versus non-owners or focussing on a general ‘pet effect’ (Allen, 2003; Barcelos et al., 2020; Friedman and Krause-Parello, 2018; Janssens et al., 2020) and supports Janssens et al.’s (2020) proposal that different aspects of the pet-human relationship have different impacts on human well-being.

### Negative well-being outcomes

Two major cat-related activity themes that owners reported had negative impacts on their well-being were 1) ‘failing to meet the cat’s demands, expectations and restricting the

cat', which included leaving the cat when going away and putting the cat into a carrier, and 2) 'unwanted behaviours' especially attention seeking and aggressiveness. An impact of related themes was found for dog owners (Barcelos et al. 2020). Interestingly, it has recently been reported that issues, such as excessive vocalisation, and a preoccupation with not being able to meet as cat's needs (e.g., buying food, litter) had a negative impact on the well-being of US owners during the COVID-19 pandemic (Applebaum et al. 2020).

Interestingly the hedonic quadrant 'NvHa', (e.g., frustration, stress) was frequently mentioned by cat owners, second only to 'PvHa' (e.g., excitement, happiness), this is quite different to what was found for dog owners, who tended to describe outcomes associated to positive affect and low arousal (Barcelos et al. 2020) ahead of 'NvHa'. This might explain why a few studies have found cat ownership to be less beneficial than dog ownership (e.g., Friedmann and Thomas, 1995; Oliva and Johnston, 2020; Serpell 1991). Perhaps, cats cause more stress-related emotions than dogs do, or the calming/relaxing effects of dogs is preponderant, or individuals attracted to cats are more prone to 'NvHa' states. Activities soliciting negative affect of high arousal were similarly reported by both cat and dog owners (Barcelos et al. 2020), with 'inappropriate/ unwanted behaviours' being a mutual theme. Future quantitative studies are required to evaluate the significance of this apparent difference.

### **Positive well-being outcomes**

Improvements in positive affect of high arousal was the most frequent well-being outcome reported here and in dogs by Barcelos et al. (2020). As expected, 'exercise', was not declared by cat owners and reports of walking with the cat outside seemed to be described in terms of 'following' rather than actively walking the cat. The main activities important to positive affect of high arousal related to 'providing for the cat' (Figure 2) including buying items for the cat and feeding the cat (Figure 1). This theme was also responsible for improving participants' eudaimonic well-being (Figure 3). General care of a pet has been reported to improve well-being in other studies (Brkljačić et al., 2020; Freedman et al., 2020; Glaw et al., 2017; Lal et al., 2013), and so is not surprising. Tactile interactions with the cat were also commonly mentioned (Figures 2 and 3) to improve hedonic and eudaimonic well-being. Other studies have shown touching animals reduces stress (Barker et al., 2005), anxiety (Kaminski et al., 2001), and blood pressure (Vormbrock and Grossberg, 1988) and, Franco et al. (2017) argue that well-being outcomes associated with physical touch are under-researched.

The activity 'listening to the cat purr' (Figure 1) is species-specific and was reported to increase positive affect of low arousal (i.e., relaxing, calming; Figure 2). The function of a cat's purr is not entirely understood, but it has been suggested that humans find a cat purring calming due to the vibration frequency, since the use of mechanical vibrations has been shown to enhance natural self-healing in humans (Facchin et al., 2018). More research needs to be undertaken to understand why a cat's purr may be perceived so positively by humans.

Activities important for improving eudaimonic well-being (Figure 3) included gaining education regarding cats, providing for the cat and performing activities such as creating a business because of the cat. Eudaimonic well-being is often achieved by more long-term activities (McMahan and Estes, 2011), and this could explain why these activities were more frequently associated with this type of time investment or are part of a longer-term routine (e.g., feed the cat) than activities like stroking the cat. Improvements in positive relations with others was the most common eudaimonic outcome in both the cat and dog frameworks. For cat owners, the presence of their cats and talking about them were very relevant, whereas for dog owners, this was more commonly associated with being out with them and the "social lubricant" effect of dogs (Barcelos et al. 2020). Interestingly, a recent randomised controlled

trial with autistic children (Carlisle et al., 2021) found that the acquisition of a cat can improve participants' empathy, which is an essential element to positive relations with others (Ryff and Keyes, 1995).

### **Limitations**

Life satisfaction was not greatly reported on by participants. However, this may be the product of study design, often appearing to be potentially discussed along with aspects of hedonic wellbeing, and so perhaps not fully differentiated by them. It must also be acknowledged that interviews were performed during the COVID-19 pandemic lockdown, and owners reported spending more time with their cats, potentially highlighting activities that may not normally occur. Many described their cats as providing social companionship during the pandemic, consequently leading to potential overemphasis of this. Recent research has shown that owners' feelings associated with their pets during the COVID-19 lockdown changed with the new circumstances. Applebaum et al. (2020) discussed how negative feelings such as frustration and annoyance were provoked when working from home due to unwanted behaviours from pets such as interruptions and attention seeking behaviours. This potentially led to an increase in mentions of these activities and associated well-being outcomes compared to that of the Barcelos et al. (2020) dog study which took place before the COVID-19 lockdown. By contrast, during the COVID-19 lockdown in Malaysia, it was reported that cat owners showed greater psychological well-being than dog owners, and it was suggested perhaps interactions with cats, such as petting, potentially had more of an impact regulating emotion than physical exercise with dogs as previous research would suggest (Grajfoner et al. 2021). The pandemic has also had a negative impact on people's mental health (Usher et al. 2020), and so owners may have been more inclined to report increases in negative states, however, this is a qualitative study and the relative importance of the themes needs further quantitative investigation.

### **Future research**

This framework of cat human related activities provides a solid basis for more specific hypotheses testing studies aimed at evaluating the impact of the cat human relationship on owner well-being. The greater specificity provided by a focus on ownership activities over ownership per se, is likely to increase the consistency of results across such studies, as we are now more able to determine exactly what it is about owning a cat that owners find appealing and unpleasant. The relevance of our findings to specific human populations with different characteristics (e.g., those with mental illnesses and the elderly) and in different contexts (e.g., animal-assisted interventions) also requires further evaluation. Although this research had a good representation of cat owners in terms of age and gender, and saturation of themes was achieved, it is not possible to collect information regarding every activity performed by owners from a single population such as this. Although small differences may emerge, it seems reasonable to suppose that the themes and well-being outcomes are likely to be quite consistent across studies.

### **Conclusion**

The findings of the current study evidence the diversity of cat-related activities in the lives of cat owners and the individuality of their well-being outcomes, this, can help to alleviate inconsistencies surrounding the relationship between cat (and potentially more general 'pet') ownership and mental health. The links between activities and well-being outcomes identified here may also support future studies looking into treatment plans for animal assisted

interventions or help cat owners better understand how living with their cat impacts their well-being.

### References

- Allen, K., Shykoff, B. E., Izzo, Jr. J. L. (2001). Pet ownership, but not ace inhibitor therapy, blunts home blood pressure responses to mental stress. *Hypertension*, 38(4), 815-820. <https://doi.org/10.1161/hyp.38.4.815>
- Allen, K. (2003). Are pets a healthy pleasure? The influence of pets on blood pressure. *Current Directions in Psychological Science*, 12(6), 236-239. <https://doi.org/10.1046/j.0963-7214.2003.01269.x>
- Applebaum, J. W., Tomlinson, C. A., Matijczak, A., McDonald, S. E., Zsembik, B. A. (2020). The concerns, difficulties, and stressors of caring for pets during COVID-19: results from a large survey of US pet owners. *Animals*, 10(10), 1882. <https://doi.org/10.3390/ani10101882>
- Bao, K. J., & Schreer, G. (2016). Pets and happiness: examining the association between pet ownership and wellbeing. *Anthrozoös*, 29(2), 283-296. <https://doi.org/10.1080/08927936.2016.1152721>
- Barcelos, A. M., Kargas, N., Maltby, J., Hall, S., Mills, D. S. (2020). A framework for understanding how activities associated with dog ownership relate to human well-being. *Scientific Reports*, 10(11363), 1-12. <https://doi.org/10.1038/s41598-020-68446-9>
- Barker, S. B., Knisley, N. L., McCain, N. L., Best, A. M. (2005). Measuring stress and immune response in healthcare professionals following interaction with a therapy dog: a pilot study. *Psychological Reports*, 96(3), 713-729. <https://doi.org/10.2466/pr0.96.3.713-729>
- Blue Cross (2012). How to put your cat into a carrier. Available from: <https://www.bluecross.org.uk/pet-advice/how-to-put-your-cat-into-a-carrier> (Accessed: 30 April 2021)
- Brkljačić, T., Sučić, I., Lučić, L., Tkalić, R. G., Lipovčan, L. K. (2020). The beginning, the end, and all the happiness in between: pet owners' wellbeing from pet acquisition to death. *Anthrozoös*, 33(1), 71-87. <https://doi.org/10.1080/08927936.2020.1694313>
- Brooks, L. H., Rogers, A., Kapadia, D., Pilgrim, J., Reeves, D., Vassilev, I. (2012). Creature comforts: Personal communities, pets and the work of managing a long-term condition. *Chronic Illness*, 9(2), 87-102. <https://doi.org/10.1177/1742395312452620>
- Brooks, H., Rushton, K., Walker, S., Lovell, K., Rogers, A. (2016). Ontological security and connectivity provided by pets: a study in the self-management of the everyday lives of people diagnosed with a long-term mental health condition. *BMC Psychiatry*, 16(409), 1-12. <https://doi.org/10.1186/s12888-016-1111-3>
- Byström, K. M., & Persson, C. A. L. (2015). The meaning of companion animals for children and adolescents with autism: the parents' perspective. *Anthrozoös*, 28(2), 263- 275. <https://doi.org/10.1080/08927936.2015.11435401>
- Campbell, K., Smith, C. M., Tumilty, S., Cameron, C., Treharne, G. J. (2016). How does dog-walking influence perceptions of health and wellbeing in healthy adults? A qualitative dog-walk along study. *Anthrozoös*, 29(2), 181-192. <https://doi.org/10.1080/08927936.2015.1082770>
- Carlisle, G. K., Johnson, R. A., Wang, Z., Bibbo, J., Cheak-Zamora, N., Lyons, L. A. (2021). Exploratory study of cat adoption in families of children with autism: impact on

- children's social skills and anxiety. *Journal of Pediatric Nursing*, 58, 28-35. <https://doi.org/10.1016/j.pedn.2020.11.011>
- Deci, E. L., & Ryan, R. M. (2008). Hedonia, eudaimonia, and well-being: an introduction. *Journal of Happiness Studies*, 9, 1-11. <https://doi.org/10.1007/s10902-006-9018-1>
- Enders-Slegers, M., & Hediger, K. (2019). Pet ownership and human-animal interaction in an aging population: Rewards and challenges. *Anthrozoös*, 32(2), 255-265. <https://doi.org/10.1080/08927936.2019.1569907>
- Facchin, F., Bianconi, E., Canaider, S., Basoli, V., Biava M., Ventura, C. (2018). Tissue regeneration without stem cell transplantation: self-healing potential from ancestral chemistry and physical energies. *Stem Cells International*, 3, 1-9. <https://doi.org/10.1155/2018/7412035>
- Franco, L. S., Shanahan, D. F., Fuller, R. A. (2017). A review of the benefits of nature experiences: more than meets the eye. *International Journal of Environmental Research and Public Health*, 14(8), 1-29. <https://doi.org/10.3390/ijerph14080864>
- Freedman, S., Paramova, P., Senior, V. (2020). 'It gives you more to life, it's something new every day': an Interpretative Phenomenological Analysis of wellbeing in older care home residents who keep a personal pet. *Ageing and Society*, 2020, 1-23. <https://doi.org/10.1017/S0144686X19001880>
- Friedman, E., & Krause-Parello, C. A. (2018). Companion animals and human health: benefits, challenges, and the road ahead for human-animal interaction. *Revue scientifique et technique*, 37(1), 71-82. <https://doi.org/10.20506/rst.37.1.2741>
- Foreman-Worsley, R., & Fanworth, M. J. (2019). A systematic review of social and environmental factors and their implications for indoor cat welfare. *Applied Animal Behaviour Science*, 220(104841), 1-10. <https://doi.org/10.1016/j.applanim.2019.104841>
- Gilbey, A., McNicholas, J., Collins, G. M. (2007). A longitudinal test of the belief that companion animal ownership can help reduce loneliness. *Anthrozoös*, 20(4), 345-353. <https://doi.org/10.2752/089279307X245473>
- Gill, P., Stewart K., Treasure, E., Chadwick, B. (2008). Methods of data collection in qualitative research: interviews and focus groups. *British Dental Journal*, 204, 291-295. <https://doi.org/10.1038/bdj.2008.192>
- Glaw, X., Kable, A., Hazelton, M., Inder, K. (2017). Meaning in life and meaning in life in mental health care: an integrative literature review. *Issues in Mental Health Nursing*, 38(3), 243-252. <https://doi.org/10.1080/01612840.2016.1253804>
- Grajfoner, D., Ke, G. N., Wong, R. M. M. (2021) The effect of pets on human mental health and wellbeing during COVID-19 lockdown in Malaysia. *Animals*, 11(2689), 1-10. <https://doi.org/10.3390/ani11092689>
- Hart, L. A., Thigpen, A. P., Willits, N. H., Lyons, L. A., Hertz-Picciotto, I., Hart, B. L. (2018). Affectionate interactions of cats with children having autism spectrum disorder. *Frontiers in Veterinary Science*, 5(39), 1-10. <https://doi.org/10.3389/fvets.2018.00039>
- Howell, T. J., Bowen, J., Fatjó, J., Calvo, P., Holloway, A., Bennett, P. C. (2017). Development of the cat-owner relationship scale (CORS). *Behavioural Processes*, 141(3), 305-315. <https://doi.org/10.1016/j.beproc.2017.02.024>
- Hui Gan, G. Z., Hill, A., Yeung, P., Keesing, S., Netto, J. A. (2019). Pet ownership and its influence on mental health in older adults. *Ageing and Mental Health*, 27, 1-8. <https://doi.org/10.1080/13607863.2019.1633620>

- Irani, E. (2018). The use of videoconferencing for qualitative interviewing: opportunities, challenges, and considerations. *Clinical Nursing Research*, 28(1), 3-8. <https://doi.org/10.1177/1054773818803170>
- Janssens, M., Eshuis, J., Peeters, S., Lataster, J., Reijnders, J., Enders-Slegers, M., Jacobs, N. (2020). The pet-effect in daily life: an experience sampling study on emotional well-being in pet owners. *Anthrozoös*, 33(4), 579-588. <https://doi.org/10.1080/08927936.2020.1771061>
- Kaminski, M., Pellino, T., Wish, J. (2002). Play and pets: the physical and emotional impact of child-life and pet therapy on hospitalized children. *Children's Health Care*, 31(4), 321-335. [https://doi.org/10.1207/S15326888CHC3104\\_5](https://doi.org/10.1207/S15326888CHC3104_5)
- Keyes, C. L. M., Shmotkin, D., Ryff, C. D. (2002). Optimizing well-being: the empirical encounter of two traditions. *Journal of Personality and Social Psychology*, 82(6), 1007-1022. <https://doi.org/10.1037//0022-3514.82.6.1007>
- Lal, S., Ungar, M., Leggo, C., Malla, A., Frankish, J., & Suto, M. J. (2013). Well-being and engagement in valued activities: experiences of young people with psychosis. *OTJR: Occupation, Participation and Health*, 33(4), 190-197. <https://doi.org/10.3928/15394492-20130912-02>
- Needell, N. J., & Mehta-Naik, N. (2016). Is pet ownership helpful in reducing the risk and severity of geriatric depression. *Geriatrics*, 1(24), 1-7. <https://doi.org/10.3390/geriatrics1040024>
- Neil, C., Gerard, J., Arbuthnott, K. D. (2019). Nature contact and mood benefits: contact duration and mood type. *The Journal of Positive Psychology*, 4(6), 756-767. <https://doi.org/10.1080/17439760.2018.1557242>
- McMahan, E. A., & Estes, D. (2011). Hedonic versus eudaimonic conceptions of well-being: evidence of differential associations with self-reported well-being. *Social Indicators Research*, 103, 93-108. <https://doi.org/10.1007/s11205-010-9698-0>
- Mendl, M., Burman, O. H. P., Paul, E. D. (2010). An integrative and functional framework for the study of animal emotion and mood. *Proceedings of Royal Society B*, 227(1696), 2895-2904. <https://doi.org/10.1098/rspb.2010.0303>
- Mental Health Task Force. (2016). The five year forward view for mental health—a report from the independent mental health taskforce to the NHS in England. Available at <https://www.england.nhs.uk/wp-content/uploads/2016/02/Mental-Health-Taskforce-FYFV-final.pdf>
- Mueller, M. K., Gee, N. R., Bures, R. M. (2018). Human-animal interaction as a social determinant of health: descriptive findings from the health and retirement study. *BMC Public Health*, 18(305), 1-7. <https://doi.org/10.1186/s12889-018-5188-0>
- Müllersdorf, M., Granström, F., Sahlqvist, L., Tillgren, P. (2009) Aspects of health, physical/leisure activities, work and socio-demographics associated with pet ownership in Sweden. *Scandinavian Journal of Public Health*, 38(1), 53-63. <https://doi.org/10.1177/1403494809344358>
- Panskepp, J., Knutson, B., Burgdorf, J. (2002). The role of brain emotional systems in addictions: a neuro-evolutionary perspective and new 'self-report' animal model. *Addiction*, 97, 459-469. <https://doi.org/10.1046/j.1360-0443.2002.00025.x>
- Peterson, C., Park, N., Seligman, M. E. P. (2005). Orientations to happiness and life satisfaction: the full life versus the empty life. *Journal of Happiness Studies*, 6, 24-41. <https://doi.org/10.1007/s10902-004-1278-z>

- Russell, J. A. (1983) Pancultural aspects of the human conceptual organization of emotions. *Journal of Personality and Social Psychology*, 45(6), 1281-1288. <https://doi.org/10.1037/0022-3514.45.6.1281>
- Raina, P., Waltner-Toews, D., Bonnett, B., Woodward, C., Abernathy, T. (1999). Influence of companion animals on the physical and psychological health of older people: An analysis of a one-year longitudinal study. *Journal of the American Geriatrics Society*, 47(3), 323-329. <https://doi.org/10.1111/j.1532-5415.1999.tb02996.x>
- Ryff, C. D. (1989). Happiness is the everything, or is it? Explorations on the meaning of psychological well-being. *Journal of Personality and Social Psychology*, 57(6), 1069-1081. <https://doi.org/10.1037/0022-3514.57.6.1069>
- Ryff, C. D., & Keyes, C. L. M. (1995). The structure of psychological well-being revisited. *Journal of Personality and Social Psychology*, 69(4), 719-727. <https://doi.org/10.1037/0022-3514.69.4.719>
- Saunders, B., Sim, J., Kingstone, T., Baker, S., Waterfield, J., Bartlam, B., Burroughs, H., Jinks, C. (2018). Saturation in qualitative research: exploring its conceptualization and operationalization. *Quality and Quantity*, 54(7), 1893-1907. <https://doi.org/10.1007/s11135-017-0574-8>
- Scherer, K. R. (2005). What are emotions? And how can they be measured? *Social Science Information*, 44(4), 695-792. <https://doi.org/10.1177/0539018405058216>
- Singh, K., & Jha, S. D. (2008). Positive and negative affect, and grit as predictors of happiness and life satisfaction. *Journal of the Indian Academy of Applied Psychology*, 34(2), 40-45.
- Steel, N., Ford, J. A., Newton, J. N., Davis, A. C. J., Vos, T., Naghavi, M., Glenn, S., Hughes, A., Dalton, A. M., Stockton, D., Humphreys, C., Dallat, M., Schmidt, J., Flowers, J., Fox, S., Abubakar, I., Aldridge, R., Baker, A., Brayne, C., ... Murray, C. J. L. (2018). Changes in health in the countries of the UK and 150 English local authority areas 1990-2016: a systematic analysis for the global burden of disease study 2016. *The Lancet*, 392(10158), 1647-1661. [https://doi.org/10.1016/S0140-6736\(18\)32207-4](https://doi.org/10.1016/S0140-6736(18)32207-4)
- Toukhsati, S. R., Young, E., Bennett, P. C., Coleman, G. J. (2012). Wandering cats: attitudes and behaviours towards cat containment in Australia. *Anthrozoös*, 25(1), 61-74. <https://doi.org/10.2752/175303712X13240472427195>
- Turner, D. C. (2017). A review of over three decades of research on cat-human and human-cat interactions and relationships. *Behavioural Processes*, 141(3), 297-304. <https://doi.org/10.1016/j.beproc.2017.01.008>
- Turner D. C., Rieger, G., Gygas, L. (2003). Spouses and cats and their effect on human mood. *Anthrozoös*, 16(3), 213-228. <https://doi.org/10.2752/089279303786992143>
- Usher, K., Bhullar, N. and Jackson, D. (2020). Life in the pandemic: social isolation and mental health. *Journal of Clinical Nursing*, 29, 2756-2757. <https://doi.org/10.1111/jocn.15290>
- Vormbrock, J. K., & Grossberg, J. M. (1988). Cardiovascular effects of human-pet dog interactions. *Journal of Behavioural Medicine*, 11(5), 509-517. <https://doi.org/10.1007/BF00844843>
- Whiteford, H. A., Degenhardt, L., Rehm, J., Baxter, A. J., Ferrari, A. J., Erskine, H. E., Charlson, F. J., Norman, R. E., Flaxman, A. D., Johns, N., Burstein, R., Murray, C. J. L., Vos, T. (2013). Global burden of disease attributable to mental and substance use disorders: findings from the Global Burden of Disease Study 2010. *The Lancet*, 382(9904), 1575-1586. [https://doi.org/10.1016/S0140-6736\(13\)61611-6](https://doi.org/10.1016/S0140-6736(13)61611-6)