The Old School, Brewhouse Hill, Wheathampstead,
Hertfordshire AL4 8AN, UK
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Public attitudes towards grief in animals

N McGrath†‡, J Walker‡, D Nilsson‡ and C Phillips*‡

† The Royal (Dick) School of Veterinary Studies, The University of Edinburgh, Easter Bush, Roslin, Midlothian EH25 9RG, UK
‡ Centre for Animal Welfare and Ethics, School of Veterinary Science, University of Queensland, Gatton 4343, QLD, Australia
* Contact for correspondence and requests for reprints: c.phillips@uq.edu.au

Abstract

Animals under human management are often separated from conspecifics, which may lead to behaviour indicative of separation distress or grief. For the purposes of this paper, grief is considered as a biological response to separation, indicated by a bi-phasic 'protest-despair' behavioural response. It is reasonable to assume that only animals which are able to form complex social bonds can experience grief. Scientific experiments have suggested that some farm and laboratory animals experience distress or grief as a result of maternal separation and social isolation. However, little is known about whether the public believe that animals are capable of grief. Therefore, we surveyed 1,000 members of the public to establish what knowledge they have about grief in animals and to compare this to what we know in science. The survey revealed that 90% of the general public believed that some or all animals can experience grief, with 23% believing that all animals can grieve. They attributed grief more to companion animals and animals with higher level cognitive abilities than to farm animals and animals that may be feared. It is concluded that public belief about grief in animals extends beyond scientific evidence, and that educating people about scientific findings and management practices connected with grief and separation distress may improve the welfare of farm and laboratory animals.

Keywords: *animals, animal welfare, emotion, grief, public attitudes, separation*

Introduction

In human management systems, animals are often abruptly separated from their mothers (Newberry & Swanson 2008; Enriquez *et al* 2011) and other conspecifics (Siebert *et al* 2011) either temporarily or permanently. Both separation and social isolation may have a negative physiological and emotional effect on animals, which could directly impact upon their welfare.

Bowlby describes grief as:

> A peculiar amalgam of anxiety, anger, and despair following the experience of what is feared to be an irretrievable loss...

and he differentiates it from separation anxiety saying:

> Anxiety is experienced when the loss is believed to be retrievable and hope remains (Bowlby 1961).

Bowlby's description relates to the human experience of grief, and predominantly the psychological aspects of this emotion, the nature of which cannot be definitively known or inferred in animals. However, as emotions act to govern behaviour in response to specific events, behavioural and physiological changes are often induced by these events. Grief is considered by Averill (1968) to be:

> A biological reaction, the evolutionary function of which is to ensure group cohesiveness in species where a social form of existence is necessary for survival...

Which also

> Comprises a stereotyped set of psychological and physiological reactions.

Humans exhibit emotional responses to loss including depression, anxiety and anger, but may also suffer from physiological symptoms, such as sleeplessness, loss of appetite, and decreased immunological resistance (Boccia *et al* 1997; Stroebe *et al* 2007). It is difficult to know for certain whether a non-human animal has a conscious emotional experience of grief similar to that of a human. Our understanding of the subjective experience of animals is limited by their communication capabilities, and the potential differences between our psychological responses to stresses and theirs. However, some of these physiological symptoms could compromise an animal's ability to cope with survival situations, impair growth and reproduction, and increase susceptibility to disease (Weary & Chua 2000).

It is reasonable to assume that only animals which are able to form complex social bonds with conspecifics can experience grief as a result of severance of these bonds. A social bond is defined by Newberry and Swanson (2001) as:

> A mutual, affectionate, emotional attachment between two individuals that is relatively long lasting and survives temporary separations.

Attachment helps govern behaviour in parent-offspring relationships (Bowlby 1958). Bowlby's early work on grief in humans outlined a bi-phasic 'protest-despair' reaction (Bowlby 1960). Experiments have demonstrated that animals go through distinct affective phases after separation, initially vocalising and exhibiting agitation (Seay *et al* 1962). These early reactions indicate distress and a desire for reunion (Hofer 1984, 2006; Topal *et al* 2005). A severe and sustained response may lead to the second phase of inactivity and withdrawal similar to the despair and depression exhibited by humans (Panksepp & Watt 2011). Prolonged separation of some animals has been shown to lead to physiological changes, such as increased heart rate, and behaviour indicative of despair, such as withdrawal (Seay *et al* 1962; Kraemer 1992) and increased self-directed behaviour (Bard & Nadler 1983). However, there can be no certainty that the psychological impact is the same as in humans.

Most scientific accounts of grief in animals, including the classic protest-despair phase, relate to primates (Seay *et al* 1962; Bard & Nadler 1983; Codner & Nadler 1984; Reite *et al* 1989; Laudenslager *et al* 1990; Cronin *et al* 2011), although anecdotal evidence suggests that elephants (*Elephas, Loxodonta* spp) and dolphins (Delphinidae) also experience grief as a result of chronic separation from conspecifics (Fertl & Schiro 1994; Herzing 2000; Douglas-Hamilton *et al* 2006), and that dogs (*Canis* spp) and cats (*Felis catus*) also experience a sustained grief response (Schwartz 2003).

There is ample literature providing evidence that cows (*Bos* spp), pigs (*Sus scrofa domesticus*), sheep (*Ovis aries*), goats (*Capra hircus*), horses (*Equus caballus*) and chickens (*Gallus domesticus*) experience separation distress as a result of maternal separation and temporary or chronic isolation (eg Weary *et al* 1999; Watts *et al* 2001; Siebert *et al* 2011; Ungerfeld *et al* 2011). Separation distress, in these cases, typically includes distress vocalisations, increased activity or locomotion, escape attempts, and increased heart-rate, or increased hypothalamic-pituitary activity indicating stress. However, none of these accounts detail the bi-phasic protest-despair reaction typical of grief. This does not mean that these animals are incapable of grieving, and some other reactions, such as chronic stereotypies in horses, may be indicative of a prolonged reaction to separation (Waran 2001). Neuroscientific studies also suggest that mammals have the brain mechanisms that mediate grief reactions (Panksepp & Watt 2011), and animals are often used in scientific models of anxiety and depression (D'Aquila *et al* 1994; Cryan *et al* 2005; David *et al* 2009).

Farm animal production systems often result in permanent separation of farm animals: for example, maternal separation during weaning, separation from peers during herd changes, or as a result of death or sale. Temporary separations may involve social isolation during routine procedures or when an animal is sick. Weaning is a natural process which involves a reduction in maternal care and provision of milk initiated by the mother (Jensen 2001; Jasper *et al* 2008). However, this process can be stressful for young animals, and typically there are behavioural responses, such as increased locomotion and vocalisation which indicate distress, and function to solicit attention from the caregiver (Weary *et al* 2008). In addition, early weaning can initially reduce growth rates (Jasper *et al* 2008).

Although scientific studies provide evidence that animals suffer under modern husbandry practices, such as during artificial weaning (Weary *et al* 2008), or social isolation, they are unlikely to bring about improvements in welfare unless the public has the appropriate knowledge about current practices and scientific findings (Serpell 2004). Public opinion has been the driving force behind significant legislation changes (Lawrence 2008). However, to date, no study has examined public belief about whether animals can experience grief. Therefore, our aim was to explore public beliefs about grief in animals and specifically to reveal what types of animals people believe can grieve, and compare this with scientific findings. Establishing the gap between these two knowledge bases would then provide the basis for further education of the public.

Studies which examine public opinion on the types of emotions animals may feel have been conducted, but these have been limited to dogs and other pets (Rasmussen 1995; Morris *et al* 2008). This questionnaire analysed the demographic effects on responses in order to most effectively target future education of the public regarding scientific evidence for grief in animals and the management practices that may produce such an emotional challenge.

Materials and methods

Participants and procedure

A face-to-face survey was conducted with 1,000 participants during April and May 2011 in four city-centre locations in Brisbane, Queensland, Australia. Three researchers collected survey answers. A script was carefully written for the survey and all collectors used this to ensure accurate standardised delivery of the questionnaire to all participants. Simple random sampling (De Vaus 2002) was used to select participants. All aspects of this research were approved by The University of Queensland Behavioural & Social Sciences Ethical Review Committee (reference number 2011000356).

Questionnaire design

A pilot study was conducted using 25 randomly chosen participants in Brisbane city centre in April. Changes were made to the structure of some of the questions afterwards, as well as the order in which questions were asked, in order to reduce bias from questions about pet ownership that may have influenced answers to subsequent questions about animals in general. The new order was then tested on five students at the University of Queensland to determine if it reduced the potential bias. The resulting format was kept due to a consistently less-biased response from these test subjects.

The questionnaire was divided into three sections and comprised a combination of: i) questions to determine people's beliefs as to whether animals could experience emotions, with a specific focus on grief; ii) questions about pet ownership; and iii) demographic questions. The effects of pet ownership will be addressed in a separate paper.

The questionnaire gave a definition of grief which was derived from the literature on human grief (Archer 1999; Granek 2010):

> An emotional reaction to loss, including sorrow, distress, sadness, anxiety and depression, which causes behavioural, emotional, mental, physical and social symptoms.

Subjects were asked to consider this definition when answering further questions. Participants were asked whether they believed any animal species could grieve. Respondents who answered 'some' or 'none' were then asked to state the reasons they thought some or all animal species might not grieve. Participants who agreed that some or all animal species could grieve were asked to specify which, from a pre-defined list of species.

Statistical analysis

All questionnaire data were entered into Microsoft Excel (Microsoft 2007) and then exported to Minitab Version 15 for statistical analysis.

The marital status category was collapsed and re-coded post-survey completion to reflect the Australian Census 2006 categories of 'Never married', 'Married', 'Separated and Divorced', 'Widowed' (ABS 2006a) and to reduce statistical error from the small numbers of participants in some categories.

Multivariate analysis was used to examine associations between demographics and beliefs about grief in animals. Logistic regression models have an advantage over cross-tabulation analysis as they control for other variables within the model. This ensures that significant differences are not 'masked' and any significance found is a true reflection of how that factor is affecting response when all other variables are controlled for:

$$Z = b_0 + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5 + b_6X_6 + b_7X_7$$

Where Z is the log odds of the dependent variable, b_0 is a constant, b_1 = logistic regression coefficient for age (X_1), b_2 = logistic regression coefficient for gender (X_2), b_3 = logistic regression coefficient for nationality (X_3), b_4 = logistic regression coefficient for marital status (X_4), b_5 = logistic regression coefficient for education level (X_5), b_6 = logistic regression coefficient for income (X_6) and b_7 = logistic regression coefficient for where people lived (X_7). The results are presented as odds ratios (OR) and *P*-values.

Comment on the methodology

Random sampling was used when conducting this face-to-face survey. We approached members of the public at random, and those approached did not know the nature of the survey before we began, hence a biased response was minimised. Face-to-face surveys have a much higher response rate (in this survey a 70% response rate was achieved) than postal or web surveys which typically have response rates of 45 or 34%, respectively (Shih & Fan 2008).

Results

A total of 1,000 completed responses were collected. One response was discarded from the data after it was collated due to inconsistency of responses.

Out of the total 999 people surveyed, 901 (90%) respondents believed animals could grieve according to our definition, with 229 (23%) saying all animals could grieve and 672 (67%) saying some animals could grieve (Table 1). Very high numbers of these respondents believed dogs (n = 883; 98%), chimpanzees (*Pan troglodytes*) (n = 872; 97%), dolphins (n = 850; 94%) and elephants (n = 848; 94%) could grieve (Figure 1). The majority of respondents believed that cats (n = 797; 88%), pigs (n = 662; 73%), cows (n = 637; 71%) and magpies (*Pica* spp) (n = 530; 59%) could experience grief. Less than half the respondents believed that turtles (Testudines) (n = 443; 49%), bats (Chiroptera) (n = 359; 40%), chickens (n = 358; 40%), and crocodiles (Crocodylidae) (n = 353; 39%) could grieve. At the lower end of the scale, only 10% (n = 91) of respondents believed that prawns (Dendrobrachiata) could grieve, and low numbers of respondents believed that stick insects (*Carausius morosus*) (n = 107; 12%), ants (Formicidae) (n = 160; 18%) and fish (Pisces) (n = 168; 19%) could grieve.

Demographic effects

When asked whether all, some or no animals could grieve, females were more likely than males to respond that all animals could grieve (OR = 1.49, $P = 0.007$; Table 2). They were also more likely than males to say that cats (OR = 2.99, $P < 0.001$), dogs (OR = 3.82, $P = 0.04$), pigs (OR = 1.47, $P = 0.02$), chickens (OR = 1.69, $P < 0.001$), crocodiles (OR = 1.48, $P = 0.004$), bats (OR = 1.31, $P = 0.049$), stick insects (OR = 1.61, $P = 0.001$), magpies (OR = 1.50, $P = 0.006$), turtles (OR = 1.50, $P = 0.004$), ants (OR = 1.60, $P = 0.001$) and fish (OR = 1.58, $P = 0.002$) could grieve. However, there was no statistically significant difference between males and females in response to whether dolphins, elephants, cows or prawns could grieve ($P > 0.05$).

As age increased, respondents were more likely to be uncertain as to whether elephants could grieve (OR = 0.74, $P = 0.02$) and less likely to believe that cats (OR = 0.78, $P = 0.01$), cows (OR = 0.87, $P = 0.03$), pigs (OR = 0.85, $P = 0.02$), chickens (OR = 0.85, $P = 0.004$), crocodiles (OR = 0.85, $P = 0.005$), bats (OR = 0.86, $P = 0.007$) or turtles (OR = 0.82, $P = 0.001$) could grieve (Table 3).

Discussion

Our survey showed there was a strong public belief that animals can experience grief. Other studies have found that people believed animals could experience guilt, shame (Rasmussen 1995), and jealousy (Morris *et al* 2008). Emotions are therefore not seen as an exclusively human domain.

Table 1 Participant Demographics (n = 999) showing a comparison of survey sample sizes with Brisbane and National Statistics.

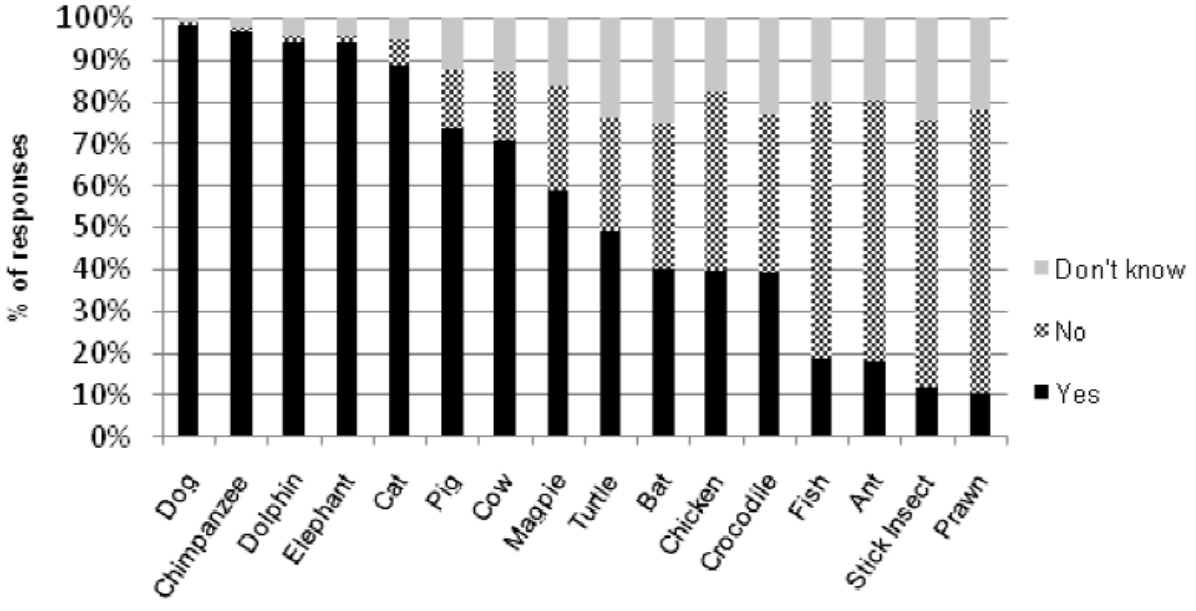
Statistics		n	Survey sample	Brisbane Statistical Division at June 2010	Census 2006 Brisbane	Census 2006 Australia
Age	18–25	271	27.1%	15.3%*		
	26–35	215	21.5%	15.2%		
	36–45	165	16.5%	14.7%		
	46–55	144	14.4%	13.2%		
	56–65	126	12.6%	10.6%		
	66+	78	7.8%	11.1%		
Gender	Male	521	52.2%		49.1%	49.4%
	Female	478	47.8%		50.9%	50.6%
Nationality	Australian	679	68.0%		72.0%	70.9%
	New Zealand	50	5.0%		4.1%	2.0%
	British	73	7.3%		5.2%	4.3%**
	Other	197	19.7%		18.7*	22.8%
Marital status	Never married	523	52.5%		48.1%	49.6%
(Two missing values)	Married	372	37.3%		35.0%	33.2%
	Separated or divorced	72	7.2%		11.8%	11.3%
	Widowed	30	3.0%		5.1%	5.9%
Education level	Primary	6	0.6%			
	Secondary	372	37.2%		48.4%	
	Certificate	89	8.9%		9.9%	
	Diploma	106	10.6%		7.6%	
	Undergraduate	236	23.6%		30.9%	
	Postgraduate	190	19.0%			
Income level	Less than $10k	177	17.7%			
(90 missing values)	$10,000–$30,000	195	19.5%			
	$30,001–$50,000	151	15.1%			
	$50,001–$70,000	142	14.2%			
	$70,001–$90,000	96	9.6%			
	$90,001–$120,000	86	8.6%			
	$120,001–$150,000	27	2.7%			
	> $150,001	35	3.5%			

* ABS source includes persons aged 15–24.
** ABS source refers to England rather than Great Britain as country of birth.
Source: (ABS 2006a,b, 2011).

Which animals can grieve?

Our aim was to establish which specific types of animals people believed could grieve. Dogs were the most frequently cited animal, which may reflect the high incidence of pet-ownership amongst our respondents. Only 5% of respondents had never owned a pet. Dogs form attachments to their owners which have been suggested to be analogous to those of human infants to their mothers (Topal *et al* 2005). Selection traits for breeding have tended towards neoteny (McGreevy & Nicholas 1999), increasing the likelihood that dogs are more reliant on us, and develop strong attachment bonds. Strong responses to separation have been documented in scientific studies with dogs (Lund & Jorgensen 1999; Mendl *et al* 2010; Soares *et al* 2010), in addition to prolonged greeting behaviour after temporary separation (Flannigan & Dodman 2001; Konok *et al* 2011). Schwartz (2003) also suggested dogs exhibit signs of depression and social withdrawal which may be indicative of grief.

Figure 1



Percentage of 'Yes', 'No' and 'Don't know' responses to 'Can these animals grieve?'

Humans are prone to anthropomorphise about dogs (Serpell 2003) which is a reflection of the close relationship that we have developed with this domesticated animal. However, pet-owners have been demonstrated to provide meaningful and consistent reports about the behaviour of their animals, and the implication is that they can interpret these behavioural cues to infer what their animals may feel, using their expert knowledge of individual animals (Morris *et al* 2008). Current public knowledge about whether dogs can experience grief is consistent with the previously described scientific evidence.

The majority of the public believed that chimpanzees could grieve. There is an enormous amount of literature supporting the occurrence of grief in primates, as defined by a bi-phasic protest-despair behavioural reaction (Seay *et al* 1962; Mineka & Suomi 1978; Suomi 1983). Primates form highly complex social groups, including strong mother-infant bonds, and also attachment between peers. Examples of behaviour symptomatic of grief have been recorded in many primates. Some studies have revealed examples of withdrawal and self-directed behaviour in gorilla (*Gorilla gorilla* spp), orangutan (*Pongo* spp) and chimpanzee infants separated from their mother (Codner & Nadler 1984). Other experiments have provided evidence for a two-stage protest-despair reaction to maternal separation in rhesus macaques (*Macaca mulatta*) (Seay *et al* 1962), pig-tailed macaques (*Macaca nemestrina*) (Laudenslager *et al* 1990) and bonnet macaques (*Macaca radiate*) (Reite *et al* 1989), and increased vocalisations and stress hormones in squirrel monkeys (*Saimiri sciureus*) (Wiener *et al* 1990) as well as distress vocalisations in marmosets (Callitrichidae) (Norcross & Newman 1999). Maternally deprived rhesus macaques have also been used as a non-human primate model for depression (Paul *et al* 2000).

Maternal separation has been shown to evoke strong behavioural reactions in chimpanzees (Cronin *et al* 2011). Cronin *et al* documented activity demonstrating the existence of a sustained mother-infant bond even after the death of the infant. In this account, a mother chimpanzee was observed carrying its dead infant's body around and then exhibiting various behaviours, such as approaching the body, touching the face of the dead infant, and maintaining visual contact. In addition, members of the peer group also attended to the dead infant, approaching and touching the body (Cronin *et al* 2011). Another study by Bard and Nadler (1983) demonstrated a bi-phasic separation distress reaction to peer social separation in chimpanzees. Mineka and Suomi (1978) have commented that the separation response depends on many variables, such as behaviour prior to separation and the nature of the separation and reunion environment. Individual differences are also important factors in determining the level of attachment and therefore the strength of separation response (Hennessy 1997).

That the public believe that chimpanzees can grieve is most likely a reflection of their knowledge of scientific findings which are widely disseminated in the media, including evidence of chimpanzees' advanced cognitive abilities (Call & Tomasello 2008). The implications of these findings may affect the protection chimpanzees are afforded in the wild, and also improve welfare where chimpanzees are held captive under human management. Primates, such as macaques and marmosets, are still used in pre-clinical pharmaceutical toxicology trials (Smith *et al* 2001). Laboratory housing and testing practices may involve isolation from conspecifics, either permanently or temporarily. Therefore, there is the potential that some laboratory primates may suffer from grief.

Table 2 Gender effects.

		All animals		Some animals		No animals		Odds ratio	*P*-value
		n	%	n	%	n	%	(OR)	
Can any animal grieve?	M	99	19%	362	69%	60	12%		
	F	130	27%	310	65%	38	8%	1.49	0.007
		Yes		No		Don't know		Odds ratio	*P*-value
		n	%	n	%	n	%	(OR)	
Can cats grieve?	M	389	84%	44	10%	28	6%		
	F	408	93%	14	3%	18	4%	2.99	0.000
Can dogs grieve?	M	449	97%	5	1%	7	2%		
	F	434	99%	4	1%	2	0%	3.82	0.040
Can crocodiles grieve?	M	155	34%	202	44%	104	22%		
	F	198	45%	139	32%	103	23%	1.48	0.004
Can bats grieve?	M	169	37%	177	38%	115	25%		
	F	190	43%	134	31%	116	26%	1.31	0.049
Can ants grieve?	M	67	15%	318	69%	76	16%		
	F	93	21%	246	56%	101	23%	1.60	0.001
Can fish grieve?	M	63	14%	310	67%	88	19%		
	F	105	24%	242	55%	93	21%	1.58	0.002
Can turtles grieve?	M	204	44%	148	32%	109	24%		
	F	239	54%	96	22%	105	24%	1.50	0.004
Can stick insects grieve?	M	41	9%	319	69%	101	22%		
	F	66	15%	253	57%	121	28%	1.61	0.001
Can magpies grieve?	M	248	54%	129	28%	84	18%		
	F	282	64%	95	22%	63	14%	1.50	0.006
Can chickens grieve?	M	152	33%	223	48%	86	19%		
	F	206	47%	162	37%	72	16%	1.69	0.000
Can pigs grieve?	M	328	71%	73	16%	60	13%		
	F	334	76%	55	13%	51	11%	1.47	0.020

Responses to questions showing significant ($P < 0.05$) gender effects on the proportion of 'Yes', 'No' and 'Don't know' responses. F: female; M: male.

Elephants and dolphins were widely believed to be capable of grief. Elephants mainly live in family units, which are held together by a matriarch which is responsible for the transmission of information, such as location of food, to other members of the social group (Douglas-Hamilton *et al* 2006). Field studies have documented strong reactions of other family members to the death of a matriarch (Douglas-Hamilton *et al* 2006) and the death of a calf (Payne 2003). Elephants have strong mother-calf relationships and weaning occurs naturally when the calf is four-years old. In addition, there are strong co-operative relationships between females in the group, which includes allomothering (Bates *et al* 2008). Bates *et al* (2008) report that elephants give excited greetings on reunion with other group members, and that the attention elephants give to bones and carcases is consistent with them comprehending and responding to death of a conspecific. Distress vocalisations from calves which elicit responses from mothers and other members of the family group (allomothers and siblings) have been documented (Lee 1987). In addition, studies have shown that elephants have advanced cognitive abilities (Byrne *et al* 2009).

Dolphins and whales (Cetacea) also form complex social groups which are often co-operative, especially during predation (Mann & Smuts 1999; Simmonds 2006). Strong associations develop between mothers and infants, female kin (Wells *et al* 1987) and other adult females (Smolker *et al* 1992), and research has shown that some dolphins give allomaternal care (Mann & Smuts 1998). Separation between mother and infant dolphins is common when the young forage (Mann & Smuts 1998, 1999). Some anecdotal accounts reveal behaviour which may indicate that these animals experience grief as a result of social loss (Fertl & Schiro 1994; Herzing 2000; Rose 2000).

Table 3 Age effects.

	Age	All animals		Some animals		No animals		Odds ratio	*P*-value
		n	%	n	%	n	%	(OR)	
Can any animal grieve?	18–25	78	29%	173	64%	20	7%	0.91	0.12
	26–35	48	22%	152	71%	15	7%		
	36–45	31	19%	112	68%	22	13%		
	46–55	29	20%	103	72%	12	8%		
	56–65	27	21%	82	65%	17	13%		
	66+	16	21%	50	64%	12	15%		
	Age	**Yes**		**No**		**Don't know**		**Odds ratio**	***P*-value**
		n	%	n	%	n	%	(OR)	
Can elephants grieve?	18–25	243	97%	5	2%	3	1%	0.74	0.018
	26–35	185	92%	5	3%	10	5%		
	36–45	136	95%	0	0%	7	5%		
	46–55	124	94%	2	2%	6	4%		
	56–65	101	93%	0	0%	8	7%		
	66+	59	89%	1	2%	6	9%		
Can cats grieve?	18–25	237	95%	13	5%	1	0%	0.78	0.011
	26–35	181	90%	9	5%	10	5%		
	36–45	127	89%	11	8%	5	3%		
	46–55	110	83%	13	10%	9	7%		
	56–65	91	83%	6	6%	12	11%		
	66+	51	77%	6	9%	9	14%		
Can cows grieve?	18–25	188	75%	48	19%	15	6%	0.87	0.027
	26–35	151	75%	29	15%	20	10%		
	36–45	102	72%	19	13%	22	15%		
	46–55	79	60%	26	20%	27	20%		
	56–65	79	72%	17	16%	13	12%		
	66+	38	58%	10	15%	18	27%		
Can pigs grieve?	18–25	198	79%	42	17%	11	4%	0.85	0.017
	26–35	147	74%	27	13%	26	13%		
	36–45	118	83%	13	9%	12	8%		
	46–55	88	67%	17	13%	27	20%		
	56–65	78	71%	16	15%	15	14%		
	66+	33	50%	13	20%	20	30%		
Can chickens grieve?	18–25	136	54%	99	40%	16	6%	0.85	0.004
	26–35	76	38%	85	43%	39	19%		
	36–45	60	42%	57	40%	26	18%		
	46–55	41	31%	62	47%	29	22%		
	56–65	33	30%	51	47%	25	23%		
	66+	12	18%	31	47%	23	35%		

Responses to questions showing significant ($P < 0.05$) age effects on the proportion of 'Yes', 'No and 'Don't know' responses.

Table 3 (cont)

	Age	Yes		No		Don't know		Odds ratio	*P*-value
		n	%	n	%	n	%	(OR)	
Can turtles grieve?	18–25	162	65%	64	25%	25	10%	0.82	0.001
	26–35	110	55%	52	26%	38	19%		
	36–45	63	44%	36	25%	44	31%		
	46–55	44	33%	49	37%	39	30%		
	56–65	47	43%	24	22%	38	35%		
	66+	17	26%	19	29%	30	45%		
Can crocodiles grieve?	18–25	146	58%	77	31%	28	11%	0.85	0.005
	26–35	73	37%	81	40%	46	23%		
	36–45	49	34%	55	39%	39	27%		
	46–55	41	31%	60	45%	31	24%		
	56–65	31	28%	38	35%	40	37%		
	66+	13	20%	30	45%	23	35%		
Can bats grieve?	18–25	135	54%	92	36%	24	10%	0.86	0.007
	26–35	75	38%	76	38%	49	24%		
	36–45	60	42%	38	27%	45	31%		
	46–55	39	30%	48	36%	45	34%		
	56–65	36	33%	34	31%	39	36%		
	66+	14	21%	23	35%	29	44%		

Dolphins are also thought to be highly intelligent (Kuczaj *et al* 2009), and are reported to be capable of expressing empathy towards humans (Mercado III & De Long 2010). As much scientific evidence about elephant and dolphin intelligence is made available to the public via the media, people may make associations between this perceived intelligence/empathy, and the ability to grieve.

Cats are not typically portrayed as social animals. However, they do form affiliations and even strong relationships with individuals which form part of a complex social group (Crowell-Davis *et al* 2004). Kittens will emit distress vocalisations when the mother leaves the nest as newborns (Schwartz 2003). Schwartz (2003) also suggests that symptoms of grief, such as persistent depression or anxiety, are apparent in cats. That the public believed strongly that cats could grieve could again be a reflection of the high incidence of pet-ownership in our studies. There was a gender effect in our results, which is supported by the literature. Specific studies about the relationship between women and cats show that females are more likely to see cats as sentient (Phillips *et al* 2010), and to grieve more when their cats die (Wrobel & Dye 2003).

Over 70% of participants believed that pigs and cows could experience grief. Cows are highly social animals (Rushen *et al* 1999). The natural weaning age of cattle is 7–14 months (Reinhardt & Reinhardt 1981), but dairy calves are weaned early, often within 24 h after birth (Marchant-Forde *et al* 2002). This is for a variety of reasons, including reducing the welfare complications associated with weaning after a strong bond has formed (Weary & Chua 2000), to enable the mother to return to oestrus quickly, and to increase milk production (Flower & Weary 2003). Studies have shown that dairy cows and calves have an increased separation response as they get older (Weary & Chua 2000), which includes locomotion and vocalisation, and increased cortisol in calves (Loberg *et al* 2008) indicating stress. However, work done by Hopster *et al* (1995) did not detect a cortisol response in mothers when separated from their calves, although the authors caution that observation time and sample size were both restricted.

Cows also form attachments to their peers (Flower & Weary 2003). Social isolation of dairy cows for brief periods has also been shown to produce symptoms indicative of stress, inducing increased heart rate, hypothalamic-pituitary axis activity and vocalisation (Rushen *et al* 1999). High frequency call rates increase with the amount of social contact prior to separation (Boissy & Le Neindre 1997).

Beef calves are not often raised in isolation. However, artificial weaning is usually abrupt and necessitated by the need to encourage the cow to return to reproductive cyclicity

(Enriquez *et al* 2011), even though the age they are weaned approaches those of natural conditions (Weary *et al* 2008). As a result of the longer period of suckling, the mother-young bond is stronger than in dairy cows (Enriquez *et al* 2011). Beef cattle and calves have been shown to increase activity and vocalise in response to weaning (Ungerfeld *et al* 2011) and isolation (Watts *et al* 2001) and to have increased heart rate and vocalisations when separated from peers (Boissy & Le Neindre 1997). Social isolation also occurs when veal calves are isolated in crates (Bouissou *et al* 2001) and during routine procedures.

Pigs are a very gregarious species, which live naturally in social groupings of two to four sows and their litters (Gonyou 2001). The natural weaning age for piglets is around 4–5 months. Under commercial conditions, however, pigs are weaned abruptly at around 3–4 weeks of age to facilitate higher production, despite potential costs to welfare (Weary & Chua 2000). Piglets are known to stop eating for 1–3 days after weaning (Metz & Gonyou 1990) and studies have shown high rates of vocalisation, with younger piglets having a stronger reaction (Weary & Fraser 1997; Weary *et al* 1999). Pigs are also isolated socially in common practice (Gonyou 2001), and research indicates that vocalisations by isolated piglets are a good predictor of their level of need (Weary *et al* 1997).

Other farm animals also react to maternal separation and isolation. Sheep and goats are social animals, living in social groupings (Lyons *et al* 1993) and developing strong mother-offspring bonds (Fisher & Matthews 2001) and attachments to peers (Lyons *et al* 1993). Adult sheep maintain close relationships with the rest of the herd. They are also weaned earlier than they would be under natural conditions, which causes stress (Fisher & Matthews 2001). Both sheep and goats produce vocalisations and increased activity during social isolation (Carbonaro *et al* 1992; Lyons *et al* 1993; Orgeur *et al* 1999; Rault *et al* 2011; Siebert *et al* 2011), and sheep also experience increases in plasma cortisol during isolation, indicating stress (Cockram *et al* 1994; Guesdon *et al* 2012)

However, there have been no scientific studies on any of the farm animals discussed above (cows, pigs, sheep or goats) which have resulted in evidence for a two-stage protest-despair response characteristic of grief. This may be due to the fact that these are prey animals and therefore a period of withdrawal or inactivity could compromise their survival. In addition, there has been no systematic investigation into the long-term reactions to extensive separation periods. Despite this, there is ample evidence that these animals do experience distress, and the results of our survey suggest that the public are aware of this. However, Hills' (1993) study on Australian attitudes towards farm animals revealed ambivalent dispositions in many types of respondents. She found that the urban public did not assign more value to farm animals than would be expected from a utilitarian viewpoint. Their unwillingness to reconcile the values that they assign to animals with the desire to eat them may stem from widespread cultural acceptance of livestock farming in Australia, and also from the fact that they do not see animal issues as being very important in their lives (Hills 1993). This observation is supported by social research, in which respondents rated animal welfare lowest out of a list of ten major issues they felt the government should address (Mazur 2006). Serpell (2004) points out that referring to farm animals as 'food' or 'production' animals reduces them to instrumental objects.

The one remaining farm animal species from our survey is the chicken, which is also a social species, and chicks will emit distress calls when separated from their mothers (Kent 1987) or from conspecifics (Panksepp *et al* 1978; Marx *et al* 2001). In commercial systems, the young are rarely kept with the mother after birth (Mench & Keeling 2001). Only 40% of the public attributed grief to chickens. Conversely, nearly 60% believed Australian magpies (*Gymnorhina tibicen*) could grieve. Magpies are iconic Australian birds which live in co-operative groups of between 2–20 birds (Brown & Farabaugh 1997) and which share territory with humans (Kaplan 2004). Humans, therefore, often have the opportunity to observe their behaviour. Anecdotally, during our survey, people attributed intelligent behaviour to magpies, however there is no scientific evidence that they suffer from grief. The difference in attitudes to these two bird species supports the previous contention that people assign values to farm animals according to a utilitarian viewpoint (Hills 1993).

Bats are highly social animals which live in colonies and some are known to be nursed by their mothers for a month after birth (Matsumura 1981). In addition, it has been noted that vampire bats (Desmodontinae) perform reciprocal altruism, regurgitating meals for individuals which have been unsuccessful in finding food, and also practice mutual self-grooming (Denault & McFarlane 1995). Research has found evidence of vocalisations emitted in mother-infant situations. The researchers have suggested that these are isolation calls, given by the infant when the mother is flying in and out of the nursery colony, possibly as cues for location, facilitating recognition by the mother (Barclay *et al* 1979; Wilkinson 2003). However, only 40% of respondents attributed grief to bats, which is lower than any of our other mammals, and which placed them on a similar level to crocodiles. Crocodiles, however, are known to exhibit parental care (Burghardt 1977) and also to emit distress calls (Vergne *et al* 2009). The mother-infant bond is strong in some crocodiles, with the infants staying with the mother after hatching. Research has suggested that specific calls attract the mother's protection and facilitate group cohesion (Vergne *et al* 2011).

Crocodiles and bats are sometimes seen as animals to be feared and our results may reflect this belief. Previous research shows differences in attitudes associated with the phylogenetic relatedness of animals to humans (Eddy *et al* 1993; Harrison 2010; Phillips *et al* 2010), and the appearance of animals (Serpell 2003; Schlegel & Rupf 2010). Kellert (1985) found that people appeared to have more negative attitudes towards predators which could be related

to fear. Davey *et al* (1998) also suggest that phylogenetically based predispositions predict fear attitudes. Kellert (1985) found that older people had more negative attitudes towards predators, and our results support this.

Of the other animals presented in our survey, only ants are a social species. Ants form colonies of related individuals that participate in co-operative behaviour (Bos *et al* 2012). However, no studies have investigated separation distress in ants. Ants also voluntarily separate from the group if they are sick and die in isolation (Bos *et al* 2012), rather than soliciting care from nest-mates. Public knowledge about ants therefore seems to be consistent with the lack of scientific evidence for grief or distress in this species.

Demographic effects

Our results imply some gender differences in empathy for animals. Women were more likely than men to say that all animals could grieve, and although evidence from pet-ownership shows that men and women like companion animals equally (Herzog 2007), other studies suggest women have greater empathy for animals (Hills 1993; Taylor & Signal 2005; Signal & Taylor 2006). This includes greater concern for animal use (Pifer *et al* 1994; Knight *et al* 2004), farm animal welfare (Hills 1993), and animal rights (Kruse 1999; Phillips *et al* 2010). It would therefore be logical to target women's support for animal welfare and protection issues. However, it is worth noting that the gender effects were not large across all the species.

Animal welfare implications

That the overwhelming majority of the respondents in this survey believe that some animals can experience grief is significant for the welfare of many animals. This belief may result in increased demand for better welfare standards and could produce benefits in terms of animal welfare improvement. However, in the long term, the most benefits for animals would be seen where scientific evidence demonstrates what the animals need, and public demand for improved welfare standards is in line with this scientific evidence. Thus, further education of the public on modern husbandry practices may be needed in order to advance the welfare of these animals, in combination with consumer preferences for practices that avoid complex and negative emotions such as grief. In addition, more advanced scientific techniques to elucidate the emotional state of animals are required, without resorting to highly invasive physiological studies.

Conclusion

There is a growing body of evidence which suggests that some animals have the requisite neural mechanisms that mediate reward processing in humans and animals (Berridge & Kringelbach 2008; Haber & Knutson 2010) and emotions in humans (Panksepp 1998, 2011; Damasio *et al* 2000; Burgdorf & Panksepp 2006). In addition, electrical brain stimulation (ESB) studies have managed to evoke behaviour suggestive of specific emotional states in some animals, by stimulating the brain networks associated with emotions, which are homologous in humans and other mammals. These stimulations appear to be either rewarding or punishing to the animal, and Panksepp (2011) has suggested that this is evidence that the behaviour is linked to an affective experience. The position that some animals may have a conscious experience of emotions has many proponents (Cabanac 1999; Bekoff 2007; Burghardt 2007). However, in giving animals the benefit of the doubt as to whether they have emotions, we are making an assumption that they may be experiencing something similar to our own experience. This projection of our own experience is also necessary with other humans, as we cannot always be confident that what another human is experiencing, or even reporting, is the same as our experiences in similar situations.

It is clear from our study that public beliefs about grief in some animals extend beyond current scientific findings. Although a grief response, defined by a bi-phasic protest-despair reaction, has not been reported in farm animals, such as cows and pigs, over 70% of respondents believed these animals could grieve in ways described for humans. These results have implications for the welfare of animals. For example, the public may desire welfare standards that acknowledge emotions for which there is currently little evidence.

People evidently believe that animals experience psychological grief to the loss of a conspecific, and this belief may stem from empathy, which is an ability to relate behaviour to feelings and to share the perceived emotional experience of an animal. However, it may also be due to people anthropomorphising, which involves projecting human-like experiences and behaviours on to animals (Wynne 2007). Both these possibilities have implications for the welfare of animals under our care. The existence of empathy may mean people increasingly give the benefit of the doubt to animals, and make or would like to make adjustments to management practices to ensure no animal suffers unnecessarily. However, in contrast to this, anthropomorphism may lead to the inappropriate treatment of animals which may, in turn, compromise their welfare. For example, owners' overprotective behaviour towards their companion animals may result in the animals developing neuroses, such as separation anxiety.

Our study suggests that there is scope for educating the public on specific human management practices connected with separation distress in order to improve welfare for animals under our care. Although potentially not as strong an emotional reaction as grief, separation distress impacts severely on the behaviour and physiology of animals, such that their welfare can be compromised. Public knowledge about these practices and the effects they have on some animals, such as farm animals, or laboratory animals, could help drive improvements in animal welfare, supported by the relevant scientific evidence.

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