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1 Quality of Life and adolescents' communication with their significant others
2 (mother, father and best friend) in adolescents: The mediating effect of
3 attachment to pets.

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1 Quality of Life and adolescents' communication with their significant others
2 (mother, father and best friend): The mediating effect of attachment to pets.

3 Abstract

4 The relationship between adolescents' communication with their significant
5 others (mother, father and best friend) and quality of life (KIDSCREEN) was
6 investigated in 2262 Scottish adolescent pet owners. The variable attachment
7 to pets was also tested and assessed as a mediator of this relationship.

8 A positive relationship between adolescents' communication with their
9 significant other (mother, father and best friend) and quality of life decreased
10 when controlling for attachment to dogs. In cat owners, a positive relationship
11 between communication with a best friend and quality of life decreased when
12 controlling for attachment to cats. In cat and dog owners, attachment to these
13 pets predicted higher levels of quality of life. Higher attachment to dogs and
14 cats was explained by good communication with parents and best friends.
15 Mediation effects of attachment to dogs and cats might be explained in terms
16 of the caring activities associated with these types of pets.

17

18 Keywords: Attachment to pets, Quality of Life, communication, parents, best
19 friend, adolescence.

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22

1 **Introduction**

2 More than 50% of the households in Western countries keep pets, mainly
3 dogs and cats (Barker, Rogers, Turner, Karpf, & Suthers-McCabe 2003;
4 Downes, Canty & More 2009; Marsa-Sambola et al., 2015; Murray, Browne,
5 Roberts, Whitmarsh, & Gruffydd-Jones 2010; Westgarth et al., 2013). There
6 is a growing research interest in the impact of human animal interactions
7 (HAI) on human health in people with a higher risk of social isolation such as
8 older people (Krause-Parello, 2008; Parslow, Jorm, Christensen, Rodgers
9 & Jacomb, 2005), people with HIV (Kruger, Stern, Anstead & Finley, 2014;
10 Siegel, Angulo, Detels, Welsch & Mullen, 1999) or people with mental or
11 physical problems (Crawford, Worsham & Swinehart, 2006; Kwong &
12 Bartholomew, 2011). However, little is known about the influence pets have
13 on the general population, particularly in adolescents (Esposito, McCune,
14 Griffin & Maholmes, 2011). Several studies have suggested attachment to
15 pets may act as a mediating variable on the influence pets have on human
16 health (Crawford et al., 2006; McNicholas et al., 2005; Parslow et al., 2005;
17 Staats, Miller, Carnot, Rada, & Turnes, 1996). Conversely, only one study has
18 properly tested this hypothesis through a mediation analysis (Krause-Parello,
19 2008). In Krause-Parello's study (2008) it was found attachment to pets
20 mediated the relationship between loneliness and general health in older
21 women living in the community (Krause-Parello, 2008). This study in line with
22 Lazarus and Folkman stress theory (1984) considered attachment to pets as
23 a coping mechanism of social and emotional support. It was suggested
24 through this coping mechanism older women could attain from pets the
25 affection and social support they were lacking from their social relationships

1 with a significant other. Krause-Parello's (2008) study considered loneliness
2 as an independent variable (IV) and a general measure of health as a
3 dependent variable (DV) within the mediation analysis. According to previous
4 research, there is wide scientific evidence that supports how a lack of healthy
5 and close relationships with other human beings may act as a risk factor of
6 illness and a worst quality of life (Sanderson, 2014). Thus, Lazarus and
7 Folkman's stress theory (1984) seems to be a logical theoretical framework
8 when understanding the impact pets may have on human health in people
9 with a higher risk of social isolation. However, to our knowledge, no previous
10 studies have used this theoretical framework to understand the influence pets
11 may have on adolescents' daily lives. In line with Headey & Grabka (2007)
12 when understanding the benefits pets may have in human health, diverse
13 benefits may exist between different types of pet owners (older people, shy
14 people, sedentary people or young people who grow up with pets). This study
15 aims to examine the potential role of pets (dogs and cats) in the association
16 between adolescents' communication with their significant others and quality
17 of life

18 *Human-animal interaction: Health benefits in adolescents?*

19 Most studies of pet-keeping among children and adolescents have focused on
20 socio-demographic aspects of pet ownership (Westgarth et al., 2013), children
21 with autism (Grandgeorge et al., 2012) or animal-assisted therapy with
22 adolescents in psychiatric facilities (Banman, 1994). These studies do not
23 necessarily consider the influence of attachment to pets, particularly during a
24 period of development when social relationships with parents and friends
25 have a particularly important influence on quality of life (Park, 2004, Shaffer &

1 Kipp, 2014). Headey and Grabka (2007) suggest there may be benefits to
2 young people of growing up with pets, in terms of opportunities to develop
3 caring behaviours and compassion, as well as the general health benefit of
4 the development of a stronger immune system. However, HAI research often
5 fails to analyze the influence of psychosocial factors on health benefits
6 (Downes et al., 2009; Müllersdorf, Granström, Sahlqvist & Tillgren, 2010;
7 Murray et al., 2010). Westgarth et al., (2013) argue that there is a need to
8 better understand which psychosocial and demographic factors are
9 associated with ownership of, and attachment to, different types of pets.

10

11 *Attachment to pets*

12 Human-pet bonds potentially have an important role in child and adolescent
13 development and health (Covert, Whiren, Keith, & Nelson, 1985; Headey &
14 Grabka, 2007; Marsa-Sambola et al., 2015). A pet can be accepting, openly
15 affectionate, consistent, loyal and honest, characteristics that can fulfil a
16 person's basic need to feel a sense of self-worth and loved (Carr et al., in
17 press; Kwong & Bartholomew, 2011; Zilcha-Mano, Mikulincer, & Shaver,
18 2011a; Zilcha-Mano, Mikulincer, & Shaver, 2011b). Crawford et al., (2006)
19 used the concept of emotional attachment to assess human-pet bonds,
20 including characteristics of Bowlby's (1969) original infant attachment theory.
21 Studies of human-pet attachment and interpersonal closeness (e.g., Carr et
22 al., in press; Crawford et al., 2006; Friedmann, Son, & Tsai, 2000; Payne,
23 Bennett, & McGreevy, 2015) suggest that there are positive effects of
24 attachment to pets for human health. However, because different assessment
25 tools are used, various outcomes ensue and there is no overall agreement on

1 health impact. Some questionnaires use items mainly focused on emotional
2 relationships between the owner and the pet in order to be psychologically
3 meaningful whereas others focus generally on caring, sharing and feeding
4 activities (Anderson, 2006).

5 Furthermore, most research has focused on assessing the physical health
6 benefits of pet ownership, mainly among dog owners (Gadomski, Scribani,
7 Krupa, Jenkins, 2016; Ogechi et al., 2016). There remains a need to use
8 measures of health that combine physical, social and psychological wellbeing
9 such as quality of life (McNicholas et al., 2005). Despite these limitations in
10 evidence, the possibility that attachment to pets is an emotional relationship
11 with consequences for adolescent health and their social interactions has yet
12 to be examined.

13 *Communication with parents and best friends and quality of life*

14 The relationships adolescents have with their parents and best friends are
15 important in the transition from adolescence to adulthood (Hartup & Stevens,
16 1997; Sillars, Koerner & Fitzpatrick, 2005). Poor quality communication
17 between adolescents and their parents, and family conflicts are associated
18 with low self-esteem and poorer psychological well-being among adolescents
19 (Sweeting & West, 1995; Xiao, Li, Stanton, 2011). Moreover, adolescents
20 who have a good relationship with their parents have been found to
21 experience higher levels of wellbeing and fewer emotional problems
22 (Garnefski & Diekstra, 1997), fewer psychological complaints (Moreno et al.,
23 2009) and higher perceived life satisfaction (Levin & Currie, 2010) than those
24 who reported a bad relationship with their parents.

1 A good relationship with peers, specifically with a best friend, has been found
2 to positively influence a range of developmental outcomes, such as levels of
3 physical activity (Duncan, Duncan, & Strycker, 2005), mental health and
4 quality of life (Shaffer & Kipp, 2013). Positive peer relationships are also a
5 source of social and emotional support (Hartup & Stevens, 1997; Shaffer &
6 Kipp, 2014; Widman, Choukas-Bradley, & Helms, 2014). However, there are
7 also studies that show negative influences of peer relationships on health-
8 related habits such as smoking (Holliday, Rothwell, & Moore, 2010) or risky
9 sexual behaviours (Potard, Courtois, Rusch, 2008)

10

11 *The present study*

12 The influence of attachment to pets on adolescents' communication with their
13 significant others (mother, father and best friend) and quality of life is the
14 focus of this study. Pet owners often feel highly connected to their animal
15 companions in a similar manner to members of the family (Albert & Bulcroft,
16 1988). For example, it has been reported that pet owners talk to their pets in a
17 comparable way with how parents talk to their children (Mitchell, 2001). This is
18 reinforced by Kurdek (2008), who reported that undergraduate students
19 assessed their levels of attachment to their dogs as very similar to their
20 attachment to family members. Investigating the implications of pet-ownership
21 and attachment to pets for important human relationships may provide
22 insights into how pets affect adolescents' health. This study examines two key
23 relationships. First, it examines the influence that adolescents' communication
24 with their significant others (mother, father and best friend) has on attachment
25 to pets (cats and dogs). According to Walsh (2009), pets can be a key

1 element in bringing together family members and reducing conflicts between
2 them. Sharing pet care activities between family members has been shown to
3 improve interaction and communication (Melson & Fine, 2006; Sussman,
4 1985). In line with Headey & Grabka (2007), we might expect adolescents
5 who have good communication with their parents and best friends to show
6 stronger levels of attachment to their pets. However, as mentioned earlier
7 strong attachment to pets may be a consequence of lack of social support
8 from their social environment (Krause-Parello, 2008; McNicholas et al., 2005).
9 Secondly the study examines the influence of attachment to pets on the
10 association between adolescents' communication with their significant others
11 (mother, father and best friend) and quality of life. Although it is known that
12 better communication with parents and peers is related to higher levels of
13 quality of life (Schaffer & Kipp, 2013), the potential influence of attachment to
14 pets on this association has not yet been assessed. Previous studies have
15 reported that pets may act as homeostatic regulators in social environments
16 (Allen & Blascovich, 1996) maintaining social systems as stable and constant
17 despite changes such family conflicts that would otherwise alter the
18 equilibrium in social systems. This study sought to provide answers to the
19 following questions

- 20 1. What is the relationship between adolescents' communication with their
21 significant others (mother, father and best friend) and quality of life in
22 adolescents?
- 23 2. What is the relationship between attachment to pets and quality of life in
24 adolescents?

1 3. What is the relationship between adolescents' communication with their
2 significant others (mother, father, best friend) and attachment to pets in
3 adolescents?

4 4. Does attachment to pets mediate the effect of adolescents'
5 communication with their significant others (mother, father and best friend) on
6 quality of life among adolescents? (See Figure 1)

7 **Methods**

8 *Participants*

9 The sample consisted of 2262 participants from the Scottish HBSC survey
10 who reported they had a pet and considered it to be their own (boys = 1041;
11 46, girls = 1221; 54). All the participants came from three age groups sampled
12 through cluster sampling of school classes across Scotland (11 years =
13 33.1%; 13 years = 33%; 15 years = 33.1%). The mean age for boys was
14 13.02 years old (SD = 1.50), and 13.50 years (SD = 1.60) for girls.

15 *Instruments*

16 *The Health Behaviour in School-aged Children: WHO Collaborative Cross-*
17 *National Study (HBSC)* (Currie et al., 2011a) is an internationally standardized
18 self-report questionnaire, which evaluates issues related to health in children
19 and adolescents. From the 2010 Scottish HBSC survey the following items
20 were chosen: "How easy is it for you to talk to your *mother/father/ best friend*
21 about things that really bother you?" (1 = Very easy, 2 = Easy, 3 = Difficult, 4
22 = Very difficult, 5 = Don't have or don't see the person"). Answers from
23 participants who marked "Don't have or don't see the person" were not

1 included in the analyses. For the mediation analyses, Gaito's (1980)
2 suggestion that likert scales be treated as an ordinal scales was followed.
3 Gaito (1980) suggests that the distance between answers to likert-type items
4 (1=Very Easy, 2= Easy, 3=Difficult, 4=Very Difficult, 5=Don't have) is not likely
5 to be the same (i.e., the distance between 1 and 2, 2 and 3 or 4 and 5 may be
6 different). Following Gaito's (1980) suggestions and taking a conservative
7 approach with these variables, communication with parents (mother and
8 father) and best friend were analyzed as categorical variables. These
9 variables were dichotomised as 1(Good communication) = "Very easy" and
10 "Easy" vs. 0 (Poor communication) = "Difficult" and "Very Difficult". We were
11 interested in assessing how response patterns (good communication/bad
12 communication with father/mother/best friend) influenced quality of life and
13 attachment to pets.

14 The Kidscreen 10 index (Ravens-Sieberer et al., 2010) consists of the
15 following 10-items (that assess children's and adolescents' subjective health
16 and well-being: 1) Have you felt fit and well? 2) Have you felt full of energy? 3)
17 Have you felt sad? 4) Have you felt lonely? 5) Have you had enough time for
18 yourself? 6) Have you been able to do the things that you want to do in your
19 free time? 7) Have your parent(s) treated you fairly? 8) Have you had fun with
20 your friends? 9) Have you got on well at school? 10) Have you been able to
21 pay attention? It is a self-reported measure applicable for both healthy and
22 chronically ill children and adolescents aged from 8 to 18 years. Each item is
23 answered on a 5-point response scale (1=Not at all, 2=Slightly, 3=Moderately,
24 4=Very, 5=Extremely). Kidscreen provides a global one-dimensional score. A
25 low score indicates poor quality of life, and a high score is indicative of better

1 quality of life. This is one of the most comprehensive tests for assessing
2 Quality of Life in children and young people with high levels of validity and
3 reliability (Erhart et al., 2009, The Kidscreen Group, 2004).

4 The Short Attachment to Pets Scale (Marsa-Sambola et al., 2015; Muldoon &
5 Williams, 2010) consists of the following 9 items, focusing on aspects of
6 attachment to pets that are salient to children and adolescents, as well as
7 their general perceptions of animals/ pets: 1) I don't really like animals, 2) I
8 spend time every day playing with my pet, 3) I have sometimes talked to my
9 pet and understood what it was trying to tell me, 4) I love pets, 5) I talk to my
10 pet quite a lot, 6) My pet makes me feel happy, 7) I consider my pet to be a
11 friend, 8) My pet knows when I'm upset and tries to comfort me, and 9) There
12 are times I'd be lonely without my pet. Participants were asked to answer on
13 a 5 point Likert scale (1=*Strongly agree*, 2=*Agree*, 3=*Not sure*, 4=*Disagree*,
14 5=*Strongly disagree*). SAPS provides a global one-dimensional score. A low
15 score indicates weak attachment to pets and a high score is indicative of
16 stronger attachment. The test is a reliable and valid self-report tool for
17 assessing general aspects of attachment to pets within surveys for children
18 and young people (Marsa- Sambola et al., 2015).

19 *Procedure*

20 The data are from national surveys conducted in 2009/2010 in Scotland as
21 part of the HBSC study. The HBSC survey is piloted in member countries
22 (currently 43 in Europe and North America) every four years (Currie et al.,
23 2012). The methods employed in gathering this data are described in detail
24 elsewhere (Currie et al., 2011b). Parents had to give their consent for their

1 children to be part of the survey. The Ethics Committee of the Moray House
2 School of Education, University of Edinburgh, approved the protocol. Data
3 collection was anonymous and the demographic information collected did not
4 permit identification of the individual student. The HBSC study uses an
5 anonymous self-administered questionnaire, which was developed according
6 to international standards and distributed in schools (Roberts et al., 2009).

7 *Statistical analysis*

8 Descriptive data (Means and SD), Cronbach's α , Pearson correlation
9 coefficients (KIDSCREEN and SAPS) and point-biserial correlations
10 (Communication with mother, father and best friend) were performed using
11 the Statistical Package for the Social Sciences (SPSS), Version 21 for
12 Windows (SPSS, Inc., 2010). The mediation analyses were performed
13 through PROCESS, a freely-available statistical tool for SPSS and SAS to
14 perform mediation, moderation, or conditional process analysis. In our
15 analysis, adjusting for age and gender, we considered communication with
16 mother/father/best friend as an independent variable, quality of life
17 (KIDSCREEN) as a dependent variable, and attachment to pets (SAPS) as a
18 mediator. Demographic variables such as gender and age are certainly
19 associated with general health and quality of life, and research that does not
20 adjust for these variables may lead to confusing outcomes (Michel, Bisegger,
21 Fuhr, & Abel, 2009).

22 According to Baron and Kenny (1986), mediation exists when (a) the
23 independent variable (communication with mother/father/best friend) is
24 significantly correlated with the dependent variable (Quality of Life); (b) the

1 independent variable (communication with mother/father/best friend) is
2 significantly related to the mediator (attachment to pets); c) the mediator
3 (attachment to pets) is significantly related to the dependent variable (Quality
4 of Life) while controlling for the independent variable (communication with
5 mother/father/best friend); and (d) the relationship of the independent variable
6 (communication with mother/father/best friend) with the dependent variable
7 (Quality of Life) decreases significantly when controlled for the mediator
8 (attachment to pets).

9 **Results**

10 *Correlational analysis*

11 Quality of life (KIDSCREEN) showed positive, significant relationships with
12 attachment to pets (SAPS) and good communication with father, mother and
13 best friend. Table 1 indicates which variables in the analyses are significantly
14 associated with each other and justifies the use of attachment to pets as a
15 mediator between communication with mother/father/best friend and quality of
16 life. It also justifies the use of gender and age as control variables in further
17 analyses.

18 [Insert table 1 here]

19 *Mediational analyses*

20 *Adolescents with their own pet dog*

21 The 3 following mediation analyses are depicted in Figure 2: 1) IV:
22 Communication with mother, M: Attachment to dogs, DV: Quality of Life; 2) IV:

1 Communication with father, M: Attachment to dogs, DV: Quality of Life; 3) IV:
2 Communication with best friend, M: Attachment to dogs, DV: Quality of Life).

3 These analyses permitted the assessment as to whether good
4 communication with mother (IV), father (IV) and best friend (IV) predicts
5 quality of life (DV), and if this relationship is weaker in the presence of
6 attachment to dogs as a mediator variable. The outcome showed that in the
7 first group of models good communication with mother (M1: $\beta=0.57$, $t=11.33$,
8 $p<0.001$), father (M2: $\beta=0.55$, $t=9.09$, $p<0.001$), and best friend (M3: $\beta=0.42$,
9 $t=8.16$, $p<0.001$) predicts higher levels of quality of life. In the second group of
10 models, when attachment to dogs (the mediator) was added into the
11 analyses, in these models β values were reduced somewhat but were still
12 significant for good communication with mother (M4: $\beta=0.55$, $t=11.03$,
13 $p<0.001$), father (M5: $\beta=0.53$, $t=8.75$, $p<0.001$), and best friend (M6: $\beta=0.39$,
14 $t=11.0318$, $p<0.001$).

15 Therefore, in these second group of models, attachment to dogs also
16 predicted higher levels of quality of life (M4: $\beta=0.02$, $t=3.29$, $p=0.0010$; M5:
17 $\beta=0.02$, $t=3.38$, $p=0.007$; and M6: $\beta=0.02$, $t=2.93$, $p=0.0034$). Attachment to
18 dogs was found to improve the prediction of higher levels of quality of life over
19 and above the other independent variables: communication with mother
20 ($\Delta^2=0.02$, $F(4, 1502)=81.74$, $p<0.001$) communication with father ($\Delta^2=0.02$,
21 $F(3, 1480)=82.27$, $p<0.001$) and communication with best friend ($\Delta^2=0.02$,
22 $F(4, 1458)=64.22$, $p<0.001$). In the third group of models, when attachment to
23 dogs was considered as the outcome variable, good communication with
24 mother (M7: $\beta=0.76$, $t=3.96$, $p<0.001$), father (M8: $\beta=0.87$, $t=3.78$, $p<0.001$),

1 and best friend (M9: $\beta=1.32$, $t=6.90$, $p<0.001$) predicted higher levels of
2 attachment to dogs.

3 A Sobel test was performed in each mediation analysis to test the mediating
4 criteria and evaluate whether the mediating influence of attachment to dogs
5 between adolescents' communication with their significant others (mother,
6 father, best friends) and quality of life was statistically significant. The
7 outcomes showed that the mediation effect of attachment to dogs was
8 statistically significant in the 3 mediation analyses: 1) IV: Communication with
9 mother, M: Attachment to dogs, DV: Quality of Life ($z=2.48$, $p=0.012$); 2) IV:
10 Communication with father, M: Attachment to dogs, DV: Quality of Life
11 ($z=2.47$, $p=0.013$) and; 3) IV: Communication with best friend, M: Attachment
12 to dogs, DV: Quality of Life ($z=2.67$, $p=0.007$). Accordingly, this indicates that
13 attachment to dogs partially mediates the effects of communication with
14 mother, father and best friend on quality of life in adolescents who reported
15 owning a dog that they consider their own. See Figure 2 for further details.

16 [Insert Figure 2 here]

17 *Adolescents with their own pet cat*

18 The 3 following mediation analyses are depicted in Figure 3: 1) IV:
19 Communication with mother, M: Attachment to cats, DV: Quality of Life; 2) IV:
20 Communication with father, M: Attachment to cats, DV: Quality of Life; 3) IV:
21 Communication with best friend, M: Attachment to cats, DV: Quality of Life).
22 These analyses permitted the assessment as to whether good communication
23 with mother (IV), father (IV) and best friend (IV) predicts quality of life (DV)
24 and if this relationship is weaker in the presence of attachment to cats as a

1 mediator. In the first group of models, outcomes showed that good
2 communication with mother (M1: $\beta=0.58$, $t=8.82$, $p<0.001$), father (M2:
3 $\beta=0.50$, $t=6.06$, $p<0.001$), and best friend (M3: $\beta=0.42$, $t=5.10$, $p<0.001$)
4 predicts higher levels of quality of life. In the second group of models, when
5 attachment to cats (the mediator) was added in to the analyses, β values
6 were reduced somewhat, but were still significant for good communication
7 with mother (M4: $\beta=0.56$, $t=8.58$, $p<0.001$), father (M5: $\beta=0.48$, $t=5.88$,
8 $p<0.001$), and best friend (M6: $\beta=0.39$, $t=5.67$, $p<0.001$). In the second group
9 of models, attachment to cats also predicted higher levels of quality of life
10 (M4: $\beta=0.03$, $t=3.11$, $p=0.0019$; M5: $\beta=0.02$, $t=3.43$, $p=0.006$; and M6: $\beta=0.02$,
11 $t=5.67$, $p<0.001$). Attachment to cats slightly improved the prediction of higher
12 levels of quality of life over and above the following independent variables:
13 communication with mother ($\Delta^2=0.02$, $F(4, 794)=48.60$, $p<0.001$)
14 communication with father ($\Delta^2=0.02$, $F(4, 777)=37.27$, $p<0.001$) and
15 communication with best friend ($\Delta^2=0.03$, $F(4, 770)=36.16$, $p<0.001$).

16 Furthermore, in the third group of models, when attachment to cats was
17 considered as the outcome variable, good communication with best friend
18 (M9: $\beta=1.33$, $t=5.10$, $p<0.001$) predicted higher levels of attachment to cats.

19 A Sobel test was performed in each mediation analysis to test the mediating
20 criteria and evaluate whether the influence of attachment to cats between
21 adolescents' communication with their significant others (mother, father and
22 best friend) and quality of life was statistically significant. The outcomes
23 showed that the mediation effect of attachment to pets was statistically
24 significant in the following mediation analysis: IV= Communication with best
25 friend, M= Attachment to dogs, DV= Quality of Life ($z=2.45$, $p=0.014$). The

1 Sobel test was not statistically significant in the following mediation analyses:
2 IV= Communication with mother, M= Attachment to dogs, DV= Quality of Life
3 ($z=1.78$, $p=0.07$); 2) IV= Communication with father, M= Attachment to dogs,
4 DV= Quality of Life ($z=1.47$, $p=0.140$). Accordingly, attachment to cats
5 partially mediates the effects of communication with best friend on quality of
6 life but does not mediate the effects of communication with parents (mother
7 and father) and quality of life.

8 [Insert Figure 3 here]

9 **Discussion**

10 This study evaluated several mediational models in which attachment to pets
11 (dogs and cats) served as a mediator in the relations between adolescents'
12 communication with their significant others (mother, father and best friend)
13 and quality of life in 11 to 15-year-old adolescents.

14 *Communication with parents/ best friend (IV) and Quality of Life (DV)*

15 Good communication with adolescents' significant others (mother, father and
16 best friend) predicted higher quality of life among adolescents with pet dogs
17 and cats. During adolescence parents remain a key source of social support
18 and emotional attachment and are influential in socio-emotional development
19 across the life-span (Kullik & Petermann, 2013; Schaffer & Kidd, 2014).
20 Several studies have reported that good communication with parents (Crosby,
21 2002; Sillars, Koerner & Fitzpatrick, 2005) and friends (Hartup, 1983;
22 Newcomb & Bagwell, 1995) have a positive impact on physical and mental
23 health in adolescents.

24

25 *Attachment to pets (dogs and cats) as a mediator*

1 Attachment to pets (dogs and cats) was found in our study to serve as a
2 psychological mechanism to improve adolescents' quality of life. This
3 statement was supported through our mediation analyses. Attachment to pets
4 (dogs) mediated the effect of adolescents' communication with their significant
5 others (mother, father and best friend) on quality of life among adolescent dog
6 owners. In cat owners, the mediation effect only appeared between
7 communication with best friend and quality of life. The mediating effects of
8 attachment to dogs and cats were found to be quite similar, both in terms of
9 the degree of predictability (β values range from 0.30 to 0.61) and the effect
10 itself (Δ^2 =from 0.02 to 0.03). However, differences between the mediational
11 role of attachment to dogs and cats could be explained by the different
12 behavioural profiles of dogs and cats in their interactions with human beings.
13 Dogs are more likely than cats to adapt their behaviours and emotions to
14 emotional human signals (social referencing) (Paynet, Bennet & McGreevy,
15 2015). In line with this it has been suggested that dogs are also more likely
16 than cats to see human beings as peers who frequently offer significant
17 information about the environments (Serpell, 1996; Potter & Mills, 2015). In
18 line with Payne et al., (2015), further HAI research should also consider the
19 influence pets' emotional (fear, happiness) and behavioural (stranger/owner
20 directed aggression, dog/cat directed aggression, trainability, attention
21 seeking, and energy) responses to humans and the impact of these on
22 human-animal interaction.

23 These outcomes agree with Krause-Parello's (2008) study which found that
24 attachment to pets mediated the relationship between loneliness and general
25 health in older females living in the community. In line with Lazarus &

1 Folkman's stress theory (1984), Krause-Parello's (2008) study helped to
2 demonstrate that attachment to pets might function as a coping mechanism
3 (social/emotional support) in the relationship between stress (loneliness) and
4 adaptation (health). Further applications of Lazarus & Folkman's stress theory
5 (1984) in the general population have also demonstrated problem-focused
6 coping mechanisms (logical analysis, seeking guidance, problems solving or
7 social/emotional support) are related to better health outcomes in the general
8 population (Sanderson, 2014). In our representative sample of Scottish
9 adolescents, attachment to pets (dogs and cats) mediated the relationship
10 between adolescents' communication with their significant others (mother,
11 father and best friend) and quality of life (Models 4-6). This finding suggests
12 pets may also be helpful not only in people with a higher risk of social isolation
13 but also in typical adolescent development.

14

15 *Control variables (gender and age): Communication with parents/ best friend*
16 *(IV) and Quality of Life (DV)*

17 Younger age and male gender predicted better levels of quality of life in
18 adolescents who reported owning dogs and cats, even when attachment to
19 these pets was considered as the mediator variable. Previous research has
20 highlighted early adolescence (11-13 years old) and female gender was
21 associated with lower quality of life for a variety of reasons relating to
22 adolescent development including puberty and social development (Hampel,
23 2007; Patton & Vinner, 2007; Plancherel & Bolognini, 1995). Young female
24 adolescents are more likely than young adolescent males to experience rapid
25 physiological changes like the menarche and imbalance of hormonal status

1 (Patton & Viner, 2007), more stressful events (Nolen-Hoeksema, Girgus &
2 Seligman, 1991), and as a consequence, poorer psychological well-being
3 (Gadin & Hammastrom, 2005; Kuehner, 2003; Steinberg & Morris, 2001).

4

5 *Attachment to pets (IV) and quality of life (DV)*

6 While controlling for communication with parents and best friend (Models 4-6),
7 attachment to dogs and cats predicted higher levels of quality of life. In line
8 with Julius, Beetz, Turner, Uvnäs-Moberg, & Kotrschal, (2013) these findings
9 suggest that adolescent dog and cat owners with high levels of attachment to
10 their pets may engage in positive human-animal interactions that support
11 quality of life. Several studies have suggested that taking care of a pet helps
12 owners learn how to be more responsible (Siegel, 1990), increases
13 opportunities to interact with other human beings (Julius et al. 2013;
14 McNicholas et al., 2005; Robin & Bensele, 1985), and provides benefits from
15 sharing secrets and mood states with a non-judgmental "loyal friend" (Zilcha-
16 Mano et al., 2011a). Cat and dog owners may differ in personality variables,
17 which might also relate to their ability to form and maintain social bonds with
18 their pets and other human beings. Studies have found adult dog owners tend
19 to show lower levels of neuroticism and high levels of agreeableness and
20 extroversion whereas adult cat owners tend to show higher levels of
21 neuroticism and openness and lower levels of extraversion, agreeableness
22 and conscientiousness (Gosling, Sandy & Potter, 2010; Payne et al., 2015;
23 Kis, Turcsán, & Gácsi, 2012). This might explain why attachment to dogs and
24 cats showed differential mediation effects in our study. Further research
25 should replicate our results by testing the influence (mediation or moderation)

1 of human personality variables on owner-pet interactions and the way in
2 which human beings relate to other human beings through their pets
3 Our results are also in line with previous research that shows a 'pet effect' on
4 adult health. For example, dog and cat owners have been found to use health
5 care systems less than people with no pets (Headey, 1999). Other studies
6 using general measures of pet ownership report improved survival rates from
7 myocardial infarction (Friedmann, Katcher, Lynch & Thomas, 1980), a lower
8 risk of heart disease (Anderson, Reid & Jennings 1992) and better
9 psychological health (Straede & Gates,1993) compared with people who have
10 no pets. Among children and adolescents, it has also been found that
11 exposure to pet allergens when young, leads to reduced occurrence of
12 allergic rhinitis and asthma later on (Nafstad, Magnus, Gaarder, & Jaakkola
13 2001; Owby, Johnson & Peterson, 2002). Pet owners have also been found to
14 have lower rates of absenteeism from school (McNicholas et al., 2005).

15

16 *Communication with parents/best friend (IV) and attachment to pets (DV)*

17 It was also found a higher attachment to pets (dogs) was also explained by a
18 good communication with the significant others (mother, father, best friend) in
19 adolescent dog owners (Model 7-9). In cat owners only good communication
20 with best friends predicted higher levels of attachment (Model 9). In
21 adolescent dog owners, due to the demanding levels of care, adolescents and
22 their parents could share care activities such as feeding or walking the dog
23 (Julius et al., 2013). Through these shared activities, parents may verbalize
24 caring skills to their children that may help to improve the attachments
25 adolescents have with their dogs. Aspects such as sensitivity, positive affect,

1 affection, synchrony, mutuality, support and stimulation (De Wolf & Ijzendoon,
2 1997) could be taught through caring, feeding, walking and playing activities
3 with pets.

4 Regarding adolescent dog and cat owners, the relationship between better
5 communication with a best friend and higher levels of attachment to these
6 pets could also be explained by social imitation (Bandura, 1986). Adolescent
7 dog and cat owners could share their own positive caring activities with their
8 best friends, which would help to improve and/or reinforce the levels of
9 attachment adolescents have with their pets. According to Cain (1985) pets
10 may be seen as the “glue” that unifies family members and increases family
11 cohesion. Walsh (2009) also suggests that pets may improve daily family life
12 and promote greater interaction and communication within the family. Similar
13 effects could also happen with adolescents and their friends.

14 *Control variables (gender and age): Communication with parents/ best friend*
15 *(IV) and Attachment to pets (DV)*

16 Lower age together with the female gender predicted stronger levels of pet
17 attachment in adolescents. Previous studies have reported similar results in
18 children (Vidovic , Stetic, & Bratko, 1999) and adults (Holcomb, Williams, &
19 Richards, 1985; Kidd & Kidd 1990). Kellert (1985) suggests that females tend
20 to have stronger humanistic and moralistic attitudes than males. However,
21 Ganster and Voith (1983) and Stevens (1990) found no significant differences
22 between gender and generalised attachment to pets. These contrasting
23 results could be explained by the use of different scales and/or populations
24 assessed (Marsa-Sambola et al., 2015; Stevens, 1990; Westgarth et al.,
25 2013). Regarding age, higher levels of attachment to dogs and cats were

1 associated with the lower age group. This is consistent with previous studies
2 that highlight a decline in adolescent's interest in animals with age (Prokop &
3 Tunnicliffe, 2010; Williams, Muldoon, & Lawrence, 2010). This may be related
4 to a greater interest in socializing with best friends, rather than the family
5 (Vidovic et al., 1999).

6

7 *Limitations*

8 Some limitations of the present study should be considered. First, our study
9 focused on assessing cross-sectional relationships between variables. In
10 order to assess the causal effects of our variables a longitudinal study is
11 required. Second, in our study, we were not able to gather information about
12 attachment to parents and best friends and the influence these variables may
13 have in the relationship between adolescents' communication with their
14 significant others (father, mother and best friend) and attachment to pets.
15 Further studies should replicate our analyses adding reliable and valid
16 measures of attachment to parents and best friends to analyze the influence
17 of internal working models of human attachment on attachment to pets.

18

19 *Implications*

20 These results may support Headey & Gabka's (2007) study which suggests
21 different types of pet owners (older people, shy or lonely people, sedentary
22 people and young people) may benefit in different ways of pets' company.
23 Specifically, they stated benefits to young people who grow up with pets may
24 involve both being socialized to look after others and to have a stronger
25 immune system. From our analyses it can also be stated attachment to pets

1 (dogs and cats) may also improve adolescent's quality of life and
2 communication with their significant others.

3 Social contact has long been viewed as important in staving off social
4 isolation and feelings of loneliness, as well as facilitating access to social
5 support. As McNicholas & Collis (2000) argue, pets appear to act as "social
6 catalysts", inducing social contact between people. Caring and playing with
7 dogs and cats may facilitate communication with others through shared
8 emotional bonds with the pet, and also ensures that basic pet care such as
9 feeding, walking and grooming have been carried out. Although it has been
10 stated this is more likely to happen with people with a higher risk of social
11 isolation (Allen, Kellegrew & Jaffre, 2000; Banks & Banks, 2002; Cherniack &
12 Cherniack, 2014; Grandgeorge et al., 2012; Hutton, 2015; Krause-Parello,
13 2008; Lane, McNicholas & Collis, 1998; Siegel, 1990; Siegel et al., 1999;
14 Zimolag & Krupa, 2009), the evidence from this study suggests it may also
15 happen in typical adolescent development. In line with Siegel (1990), we
16 argue that the main health benefits in human-animal interactions ensue when
17 the person plays a significant role in caring for the pet and is highly attached
18 to them. We have demonstrated that attachment to pets affects physical,
19 psychological and social components of wellbeing, as captured by
20 KIDSCREEN showing the breadth of the pet effect on adolescent wellbeing
21 (McNicholas et al., 2005).

22 *Conclusion*

23 Higher levels of attachment to dogs and cats in adolescents may improve
24 their quality of life and enhance communication with parents and best friends.

1 These phenomena can be explained by the caring activities related to dog
2 and cat ownership.

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