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**(REVISED manuscript for the SI: Feline behavior and cognition)**

**Title:**

**A review of over three decades of research on cat-human and human-cat interactions and relationships**

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### **Abstract and Highlights**

A review of the research literature over the last three decades on cat-human and human-cat interactions and relationships is presented. The main topics covered are:

- Socialization and sensitive phase
- Other factors affecting the first cat to human relationship
- The ethology of cat-human interactions
- Combining ethological observations with subjective (psychological) assessments of cat personality traits
- Cat and cat-human communication
- Cat personalities and cat-owner personalities
- Breed differences
- Effects of cats on humans
- Problems caused by cats

### **Key words**

Cat-human relationships, ethology, socialization, personality, communication

*The author has no conflicts of interest and has always followed the Swiss government and university guidelines on ethics and ethical treatment of animals and secured the necessary permits.*

## **1. Introduction**

The author has been involved in, conducted or led research on cat behavior and human-cat relationships while at the University of Zurich from 1982 to 2011 and at the private institute the Institute for Applied Ethology and Animal Psychology (I.E.A.P.) near Zurich from 1991 to today. Over those years Turner has advised many students and had fruitful collaborations with a number of research assistants, to whom he is greatly indebted for their fine work. Before that period, most of the domestic cat research was conducted by the late Paul Leyhausen (1956, 1979) who concentrated on the ethology and evolution of predatory behavior patterns with very little interest in the social behavior of this 'solitary species'. It wasn't until 1970 that Michael Fox, and later, Eileen Karsh (1983a,b) began looking at the 'socialization' of kittens. With the late Leyhausen's retirement, the number of domestic cat researchers and research centers working on cats increased to the point that a symposium seemed useful to assess current knowledge and knowledge gaps. This was organized in Zurich (Cats '86) by the present author and the contributions published in the first edition of *The Domestic Cat. The biology of its behaviour* (Turner & Bateson, 1988), which was translated into several languages and has since enjoyed two further editions (2000, 2014). With some notable exceptions, much of what is known today about cat-human and human-cat interactions and relationships has come from the Zurich lab and will be summarized in this review article. Topics to be covered are: The development of the first relationship of a kitten to humans, in other words, socialization and

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the sensitive phase; other factors affecting the cat to human relationship; the ethology of cat-human interactions; combining ethological observations and subjective assessments of cat personality traits; cat and cat-human communication; cat and cat-owner personalities; breed differences; the effects of cats on humans; and problems caused by cats.

## **2. Socialization and sensitive phase**

Fox (1970) was the first researcher to describe the socialization period in cats, “beginning at 17 days of age”, when increased sensory abilities and improved locomotor abilities allow the kitten to interact with the environment and littermates. Later, Karsh (1983a, 1983b, 1984) conducted well-designed handling experiments of lab colony kittens by humans and demonstrated a sensitive phase for socialization between the second and seventh week of age. For a detailed description of these and related experiments see Karsh and Turner (1988). Casey and Bradshaw (2008) later compared the effect of regular “handling” during the socialization period of kittens in three rescue centers (relatively little direct handling, multiple feedings each day and cleaning the cages with mothers and offspring, involving contact with one to four different persons in the cages) and enhanced handling from 2 to 9 weeks of age (increasing holding the kittens from 2 to 5 minutes at 6 weeks of age and increased time playing with them) before homing. One year later, interviews with the owners revealed that those animals with the enhanced handling showed fewer signs of fear of humans. Meier and Turner (1985) were able to demonstrate the existence of socialized and non-socialized adult cats during encounters between cats and an unfamiliar person on neighborhood streets, while Lowe and Bradshaw (2002) experimentally

demonstrated the stability of responses to being handled by an unfamiliar person from weaning (8 weeks) to three years of age.

Concerning the amount of handling, this certainly affects a cat's attachment to humans. Karsh (1983b) conducted an experiment with her lab cats and found that subjects which had been handled for 40 minutes a day stayed significantly longer with the test person in a holding test than cats handled for only 15 minutes a day. They also approached a person faster, but did not stay with the person significantly longer. Nevertheless, home-reared cats adopted from Karsh's colony still surpassed even the long-handled cats on these measures and their adopters reported total interaction times with the adoptees of one to two hours per day. Similar interaction times (on average, 1.5 hours) were reported by cat owners in Zurich (Turner 1985). Most experimental studies have used handling periods of 30-40 minutes but up to 5 hours per day. It seems though that not much changes after more than an hour of handling (McCune et al., 1995).

Regarding the number of handlers a kitten has experienced, the results probably reflect degree of attachment to an individual person as well as original socialization to humans. Looking at Karsh's 8 lab cats handled daily for 40 minutes by one person during most of the sensitive period for socialization, they could be held significantly longer by their familiar person than by another unfamiliar person. However, when the holding scores of these cats were compared with those of their littermates who were handled and tested by four different people, they were similar. These results indicate that cats are capable of developing a personal relationship with their individual

handlers, but also that socialized animals are able to generalize their responses to other people (see Turner, 1995a).

### **3. Other factors affecting the first cat to human relationship**

#### **3.1 A paternal effect**

Feaver et al. (1986) demonstrated that persons familiar with the cats in a research colony, when asked to make independent assessments of the cats' 'friendliness to people', showed high inter-observer correlations of the rank order in which they placed the cats. Independently and later, Turner et al. (1986) asked persons familiar with the cats at the Cambridge University cat colony to rank both the mothers and their 3-4-month old offspring on 'friendliness to people' without knowledge of the ultimate purpose of their ratings. There was no correlation between the friendliness rankings of the mothers and those of their offspring. The authors later compared paternity of those juveniles, sired by two unrelated fathers over a two-month period, which the offspring had never seen. They found that the friendly-ranked young were significantly disproportionately distributed between the two fathers, assuming expected values intrinsic to the data.

Similarly, at the Zurich colony with different cats bred and born there, Turner had four persons familiar with those mothers and their juvenile offspring (between 3 and 8 months old) rank the animals on 'friendliness to people', again without mentioning the ultimate hypotheses being examined. The inter-observer rankings of the 8 mothers, as well as of the 35 juveniles were again significantly correlated. The mothers were divided equally into more friendly and less-friendly animals based on rank sums. Two unrelated fathers had also sired all of the Zurich offspring and had left the colony before the first litter

arrived. **Thirty-two** of the offspring could be assigned to the friendlier or less-friendly class, and again Turner found that the friendly young were significantly disproportionately distributed between the two fathers. Male and female offspring were proportionately distributed among the friendlier and less-friendly classes. However in Zurich a significant mother effect was also found on 'friendliness to people' and the friendliness of their offspring; this, of course could be genetic and/or modificatory (see below), whereas in both colonies, Cambridge and Zurich, the paternal effect had to be genetic (Turner et al., 1986). The authors never proposed "a gene for friendliness" but rather a genetic effect on some behavioral correlate of what one calls friendliness; later, McCune (1995) determined that the paternal effect was indeed an effect on 'boldness' and exploratory behavior, which of course might promote contact with persons in the room or environment.

### 3.2 Presence of the mother nearby

Studies on the effects of early handling on kittens' behaviour and attachment toward humans have mostly ignored the fact that the mother is normally present during early kitten-human contact. Rodel (1986; see also Turner, 2000) examined this effect experimentally in the lab's human-cat encounter room and found that when the kittens' mother was present (but restrained in a cage) along with an unfamiliar test person, the kittens entered the room on their own at an earlier age than those kittens tested without their mothers; however they went directly to their mothers and not the test person.

Nevertheless these same kittens were still the first ones to start exploring the encounter room with the test person. A human-socialized, calm mother may reduce a kitten's anxiety and build up its confidence enabling bolder

exploration of the environment. On the other hand, if she is shy or nervous, she might induce her kittens to be even more fearful when exposed to humans without her. Further but indirectly, if the mother is fearful or non-socialized to humans she might hide her kittens after birth delaying first kitten contact with people until late or even after the sensitive phase for socialization (Turner, 1995b). Of course any effects of the mother on her kitten's behavior could be either genetic or modificatory or both.

### 3.3 **Curiosity**

Curiosity (exploratory behavior) in older kittens might also promote (first) contact with humans and allow establishment of a relationship with a person, once anxiety in a strange situation has been reduced. Podberscek et al. (1991) even found that adult (2-3 years old) male lab cats - presumably socialized toward humans – made more direct contacts with an unfamiliar person than a familiar test person, but that attention-seeking behaviors to both persons declined from day 1 to day 3. Interestingly, many people report that cats at home will first approach a person in a seated group who doesn't appreciate cat contact. The author hypothesizes that these persons as opposed to other group members avoid eye contact with the cat and any gestures inviting approach by the cat and that the cat is simply 'curious' and attempting to assess that person's position.

### 3.4 Feeding

Many people claim that house cats, especially those allowed outdoors, are mostly interested in securing a meal and therefore associate with us. Clearly the usual feeding time is one of the most important times for social contact with all cats. However, Geering (1986) in an outdoor enclosure experiment

involving two male students unfamiliar to the colony's adult cats, whose position in the enclosure, and role as the "feeder" was experimentally varied, was able to show otherwise. The "feeding" person simply held the large food tray until the cats entered the enclosure then placed it mid-way between the two men on the ground. Neither person was allowed to look at, speak with, or otherwise interact with the cats before both, in time, left the enclosure.

Geering found that a preference for the feeder (not the food, which was the same over all trials) as shown by cat-initiated contacts developed within the first half of the phase after feeding but disappeared during the second half and switched to the other person when he was the feeder. Her interpretation: yes, the act of feeding can facilitate establishment of a relationship between a cat and a person, but it takes more (e.g. speaking with the cat, stroking the cat) to maintain that preference and relationship.

### 3.5 The effect of later experiences with humans after initial socialization

Meier and Turner (1985), Podberscek et al. (1991), Lowe and Bradshaw (2002), and McCune et al. (1995) found evidence that early experience with humans during the sensitive phase for socialization had long-lasting effects well into adulthood. McCune et al. proposed the term *social referencing* to refer to the broadening of an animal's experience during the juvenile period, i.e. after initial socialization. Turner (1995a, 1995b) has proposed that negative and positive experiences with humans after the sensitive period work differently depending on whether or not a kitten was truly socialized during the sensitive period: a human-friendly, trusting cat needs only a few positive experiences with an unfamiliar person (e.g., a new owner) to show positive behavior towards that person but significant negative experience to override

the initial (positive) socialization. A shy, less socialized cat requires a great deal of positive experience with a stranger to overcome its deficit of experience during the sensitive phase; however, it reacts negatively (and strongly) to even minor negative encounters. The human-friendly, socialized cat generalizes positive experiences quickly; the un-socialized or incompletely socialized cat does not generalize its later positive experiences, but rather, its negative ones. The former cats are relatively easy to re-home, the latter cats require more patience and understanding on the part of a new owner, but probably make good 'one person' or 'one family' cats in due course. If the latter are rehomed, they start over at square one with the new owners. Many animal shelter directors agree with the author's premises, but this model still needs testing in the field.

Dinis and Martins (2016) compared the reported attachment levels of cat owners to their animals with those of volunteers from a cat rehoming center and found no significant difference; however amongst the cat owners, duration of ownership had a positive effect on the level of attachment, especially after two years of companionship.

#### **4. The ethology of cat-human interactions**

The period following the initial experimental studies on the sensitive phase of kittens for socialization toward persons witnessed a number of ethological (observational) studies on cat-human interactions both in the lab and home setting. Mertens and Turner (1988) published results on first encounters between 19 socialized cats and a convenience sample (volunteer cat friends including children, 6-10 years, and adults, >18 years) of 240 persons unfamiliar with the cats in a room with a carpet, table and chairs at the

university cat colony. The cats knew each other and were familiar with the encounter room. There were 10 males (all neutered) and 9 females (4 spayed) between 15 and 24 months old. During the first five minutes the human subject had to ignore the cat, which entered the room through a cat-door on the side, and read or look at a magazine. During the following five minutes the person could do as s/he pleased. This allowed recording cat behavior in two different situations. In a second run of only five minutes the person could do as s/he pleased from the start and human behavior toward the cat was recorded. Interactions were observed and recorded through a one-way glass window from outside of the room. The results of these experiments in the lab setting have been substantiated by ethological observations in the home setting and can be summarized as follows: The spontaneous behavior of the cat, e.g. approaches to the person during the first five minutes, was independent of the cats' sex (but again all males were neutered, as in most households), and independent of the person's age or gender. Only the individuality (individual differences) of the cats affected their spontaneous behavior. When data from the second five minutes were compared, the cats *reacted* to differences in the behavior of men and women and between children (especially boys) and adults, which were also found in the second run. Changes in the cats' behavior between the "reading" and following phase included: decreased vocalizations and increased play behavior; decreased approaching and increased withdrawal; and increased head rubbing. Most of these results have been confirmed in studies, e.g. Mertens (1991), of human-cat interactions in the home setting. Men tend to interact from a seated position, while women and girls (no age difference)

more often move down to the level of the cat on the floor. Children, especially the boys, tend to approach the cat directly and quickly as a first social behavior, which is not always appreciated by the cat. Women speak more frequently with the cat and the cats vocalize more frequently with them as well.

Podberscek et al. (1991) observed interactions between lab cats and familiar and unfamiliar persons as mentioned above and found a significant decline in attention behaviors (e.g., rubs against the person, claws the person, stands and watches, stretches head out to person) from the first to second and third day toward both the unfamiliar and familiar person.

Turner's (1991) team visited 158 cat-owning households housing 344 cats in Switzerland (urban, suburban and villages), which had volunteered for participation. Using a catalog of 33 well-defined behavioral elements, which could be exhibited by the person, the cat or both, they recorded all interactions observed between the cat or cats there and the adult woman of the household on three consecutive days (an average 16 hours per household of which a cat was present on average 10.8 hours). The behavioral elements were recorded on an electronic keyboard chronologically with automatic time measurement. Three elements were particularly of interest: Either the woman or the cat could show an "intent" to interact by approaching the partner or vocalizing with/towards the partner. If either the partner reacted to that or if the initiator continued the approach to within one meter of the partner, then "start interaction" was recorded. "End interaction" was typed whenever one of the two moved more than one meter away or withdrew from the scene entirely without being followed by the partner. From these data it was possible to

assess 1) the initiator of an interaction; 2) the partner's willingness to comply with the assumed interactional wishes of its counterpart; 3) the content of the interactions; and 4) the duration of individual interactions and total interaction time in each relationship sampled. Over 6000 social interactions were registered for the final analyses and of course human demographics (single woman, woman with partner but no children, mothers with children at home and partner) and cat housing conditions (indoor cats vs. cats allowed outdoors, domestic mixtures vs. pedigree cats, single cats vs. cats in multiple cat households) were noted and analyzed by the appropriate tests.

Statistically significant results will be summarized here but occasionally also a statistical tendency will be noted as such. For more detail see Turner (1991).

Concerning initiation of interactions and what Turner called "willingness to comply with the partner's assumed wishes to interact": 1) When successful initiations made by the persons and those made by the cats were analyzed separately, the more successful the person was in initiating interactions with the cat, the shorter, the total interaction time with the pet. 2) The higher the proportion of all successful intents to interact that were due to the cat, the more time spent interacting. 3) Willingness to comply with the partner's assumed wishes to interact was significantly, positively correlated between the cat and the human over all pairs examined.

But various parameters were found to influence this "willingness to comply with the partner's interactional wishes" at least for the human partner: Single women had a tendency to be less willing to comply with their cat's wishes to interact than women with a partner (but not mothers). The women in general were less willing to comply with their indoor cats' wishes than those of cats

with outdoor access. No differences were found between the owners of housecats (domestic mixtures) and pedigree cats on willingness to comply with interactional wishes. But the women were more willing to comply with the wishes of cats kept singly than those of cats in multiple cat households. As far as the cats' "willingness to comply with the human partners' interactional wishes" is concerned, none of the above parameters had even the slightest effect, meaning that the cats were equally willing to comply with the women's interactional wishes independent of her civil status, or the cat's genetic heritage and housing conditions.

Looking at the proportion of successful intents to interact that were *due to the cat*, Turner (1991) found that it was significantly lower for single women than for mothers or, as a tendency, women living with just a partner. (More of the intents were due to the women, when they lived alone.) It was significantly higher for indoor cats than for those with outdoor access (meaning the indoor cats are responsible for more interaction time with their owners, perhaps helping to compensate for lower levels of environmental stimuli indoors than outdoors). Further, the proportion of successful intents to interact due to the cat was significantly lower for single cats than for cats living in multiple cat households.

Finally looking at a *total interaction time per cat* and per minute of joint human-cat presence) between the cats and women in these households, Turner (1991) found significant differences between women without children (more) and mothers (less), between indoor (more) and outdoor (less) cats and between owners with single cats (more) and each cat in multiple cat households (less).

Looking specifically at one type of human-cat interaction, namely stroking the cat, Ellis et al. (2015a) analyzed the influence of body region touched and handler familiarity on the cats' behavioral response to being stroked. Both parameters significantly influenced negative responses by the cats.

### **5. Combining ethological observations with subjective (psychological) assessments of cat personality traits**

Following Serpell's (1983) lead indicating the usefulness of combining observational data with subjective character trait assessment for dogs, the Zurich team attempted this in its cat work. As an integral, but methodologically separate part of the above-mentioned study, Turner and Stambach-Geering (1990) asked the women in those 158 households to assess their cats (one of them in the case of multiple cat households) and relationships to them for 31 traits on a continuous visual analog scale between two extremes for each trait. After completing the form the first time using one symbol to mark the position of their actual (real) cat and relationship between the two extremes, they had to complete the form again, this time using a different symbol for their "ideal cat" or the "ideal relationship". Significant correlations (positive and negative) between 18 of the traits over all women and differences between "actual" and "ideal" values for each trait over all women were calculated and analyzed along with the effect of the parameters mentioned above in the observational study (civil status, house- vs. pedigree cats, housing conditions).

Averaged over all 31 traits, 76% of the women rated their actual cat and relationship at exactly the same place along the continuum that their ideal cat/relationship would be found - ranging from 94% for both cleanliness and

owner affection to the cat to a low of 42% for degree of dietary specialization (fussiness at meal time). 76% indicated a high level of satisfaction with the cats at least in this sample of volunteer owners.

Civil status showed no significant effect on owner-assessment of the cats or relationships; only housing conditions (indoor vs. outdoor and number of cats kept) were found to affect trait rating significantly either for the actual or ideal cat and relationship. Women with outdoor cats said their cats should be (ideally) less friendly to strangers than those with indoor cats. The owners of cats with outdoor access rated their animals as being less curious than the owners of indoor cats and since indoor cats initiated contact with their owners more often than cats allowed outdoors, it is possible that the indoor cats might be more inquisitive and seek environmental stimulation even from their owners. Owners of outdoor cats rated them as being more independent than those with indoor cats and also said their cats should be (ideally) more independent than those with indoor cats. Owners of indoor cats wished (ideally) their cats would more often be close to them than those with outdoor cats and were also more tolerant of their animals' destructive tendencies (e.g., scratching furniture), although no differences in the actual ratings for indoor and outdoor animals on the latter trait were found. Possible reasons for these findings are discussed in Turner and Stambach-Geering (1990). Lastly on dietary specialization, owners of more than one cat wished (ideally) their cats would be less fussy about food than owners of single cats did, it probably being easier to cope with the preferences of one cat than several, all being fed at the same time.

The woman-cat pairs were divided into two groups, one where both partners showed above average 'willingness to comply with the other's interactional wishes' (observational data) and the other where both partners showed low willingness to comply. The women in the two groups rated their cats and relationships differently, but only on three of the traits (one trait, actual values; two traits, the difference between actual and ideal values). On actual values for the trait 'dietary specialization', owner-cat pairs showing low willingness to comply with the partner's interactional wishes rated their cats as being less fussy about what they eat. Also when comparing the amount of difference between actual and ideal values on this trait, the owners who were less willing to comply showed a smaller difference statistically whereas owners more willing to comply with their cats' interactional wishes, wished their cats would be less fussy than they were. Further on the trait "independence", women from pairs less willing to comply showed significantly smaller differences between actual and ideal values, while women more willing to comply with the cats' wishes to interact viewed the ideal cat as being even more independent. The more recent work of the team surrounding Kotrschal et al. (2014) also combines ethological observations with psychological (temperament) assessments of cats with the personality traits of their owners and these will be summarized further below with other references on cat-owner personalities.

Potter and Mills (2015) modified the Ainsworth Strange Situation Test to examine the bond between cats and their owners and found that the animals did not show signs of secure attachment to them. The results were consistent

with the view that adult cats are typically autonomous and not necessarily dependent on others to provide as sense of security and safety.

## **6. Cat and cat-human communication**

Excellent summaries of cat-cat communication over olfactory, auditory, visual and tactile channels are already available in Bradshaw (1992), Bradshaw and Cameron-Beaumont (2000) and Bradshaw et al. (2012). Brown and Bradshaw (2014) also added aspects of interspecific (cat-human) communication in a more recent review, which will be mentioned here. Most involve signals used in cat-cat encounters that are applied by the cats in cat-human interactions, some with slight modifications. Early on Mertens and Turner (1988) found that head-rubbing on an unfamiliar human partner increased significantly once the stranger's attention was secured by flank-rubbing. Cats living in the same colony often rub their heads (foreheads, cheeks) on each other upon greeting, which presumably exchanges individual odors of the participants. Whether or not they are mixing a "group odor" has been hypothesized, but not yet examined (Brown and Bradshaw, 2014). Cats employ vocalizations much more frequently when humans are present than when together with conspecifics, probably reflecting a learning process. Generally, meows are typical attention-seeking vocalizations in interspecific settings and higher pitched (more pleasant) than the equivalent vocalization in feral cats and the wild ancestor of the domestic cat (see e.g., Yeon et al., 2011). Meows and purring can be varied by the cat in different situations and be interpreted differently by human listeners (McComb et al., 2009, cited in Brown and Bradshaw, 2014). In food-soliciting situations elements of meow-like vocalizations are found within the purr and humans can detect the difference.

Brown and Bradshaw suggest that this purring may function as a 'manipulative' contact- and care-soliciting signal possibly encouraged by the positive response of the owner. Ellis et al. (2015b) found that 40% of the participants in their study identified the correct contexts of recorded meow vocalizations of their own cats at a level greater than that predicted by chance. However, no participants performed above chance when the vocalizations were from an unfamiliar cat.

One visual signal of the domestic cat must be mentioned: the verticle "tail up". This has long been associated with affiliative behaviour between cats (see Bradshaw and Cameron-Beaumont, 2000; Cafazzo and Natoli, 2009) to signal intention to interact amicably. The same signal is used when cats (re-) establish contact with their owners. Serpell (2014) states that it is likely that a sacred cattery or breeding colony of cats adjoined the Temple of Bastet in Bubastis, ancient Egypt, ca. 450 BCE, and Bateson and Turner (2014) postulate that the "tail-up" signal, which is not present in the domestic cat's ancestor, was favored to indicate friendly intentions to other cats kept in dense breeding colonies at that time.

Concerning cat-human communication, Bahlig-Pieren and Turner (1999) found a clear difference in the ability to interpret facial expressions from still photos and video sequences of behavior of cats and dogs between experienced owners and inexperienced persons, even though the inexperienced persons still interpreted these better than one might expect. Miklosi et al. (2005) compared the ability of dogs and cats to use human pointing gestures in an object-choice task and concluded that both species were equally able to find the hidden food. However, when the hidden food

was made inaccessible so that the animals needed to indicate to their naïve owners its location, the cats lacked some of components of attention-getting behavior that the dogs showed. This was perhaps related to the longer period since domestication and of co-habitation with humans of the canids.

### **7. Cat personalities and cat-owner personalities**

One of the most persistent findings about domestic cat personalities is their 'individuality', which has either had to be statistically blocked out as "noise" in order to investigate how other parameters affect cat behavior (Turner, 1995a), or indeed examined to determine its origin, development and stability (Mendl and Harcourt, 2000; Lowe and Bradshaw 2001). In spite of the cat's individuality, several personality types or behavioral styles have consistently emerged in most studies: Karsh's team (Karsh and Turner, 1988) identified socialized individuals, which were more 'timid'. Feaver et al. (1986) identified active/aggressive cats, timid/nervous animals, and confident/easy-going animals. Meier and Turner (1985), Turner (1988) and Mertens and Turner (1991) identified two basic cat types: trusting (initiative friendly) and shy/fearful (reserved friendly) when encountering strangers, which remind us of personality dimensions found in other animal species as well as human children (see Mendl and Harcourt, 2000). At least some traits (e.g. boldness) formed during the socialization period appear to remain stable into adulthood in cats (Lowe and Bradshaw, 2001, 2002).

Stammbach and Turner (1999) analyzed how social support from other humans, emotional support from the cat, and owner attachment to the cat are interrelated. Overall the results indicated that for some of the 330 volunteer participants filling out all five standardized questionnaires (all confirmed for

reliability and validity), cats can substitute for, or replace persons in the social network. But in most cases, cats appear to be an additional source of emotional support, especially for those persons who are strongly attached to their animals. Therefore, both social support and attachment are at work in these relationships, the relative importance of each depending upon the individual person.

Kotrschal et al. (2014) have provided the most recent review about cat personalities and how human personalities interact with those of the cat. In particular, the results of the study by Wedl et al. (2011), again combining ethological observations of interactions in the home setting with psychological personality assessments (five cat personality axes identified by PCA on the behavioral data; owner personality assessment by NEO-FFI), take investigation of these questions to a higher level than in the past. The PCA identified four cat personality axes very similar to those determined by Feaver et al. (1986) and others. On the human side, owners scoring higher in Openness had cats that were less anxious and tense and these cats more often ignored the object in a novel object test. Owners high on Neuroticism turned to their cats mainly as emotional social supporters and hence, thereby, may offer a less secure base for the cat than the owners high in Openness. The latter consider their cats companions for play rather than social supporters.

Gosling et al. (2010) also found significant differences between the personalities of self-identified “dog people” and “cat people” using an Internet survey (over 4'500 participants who completed the NEO-FFI, Big Five Inventory). Self-proclaimed dog people were higher on Extraversion,

Agreeableness and Conscientiousness, but lower on Neuroticism and Openness than were the cat people.

### **8. Breed differences**

There have been very few observational studies comparing the behavior of different breeds of cats with each other or with non-pedigree cats (domestic short- or longhaired cats) or their interactions with humans. Turner (1995b, 2000a, 2000b) compared observed behavior and ratings of behavioral traits by owners of the two oldest breeds, Siamese and Persian cats, and domestic mixtures (taking into account housing differences). The popular descriptions of the character of these two breeds are the most divergent of all pedigree cats and the rationale for their selection was to “ensure” finding differences between cat breeds in behavior and trait ratings. A few differences were indeed found (Siamese being very vocal and active, Persians quiet and lethargic, domestic mixtures very independent) coinciding with the popular breed descriptions, but not as many as one might expect, indicating convergent artificial selection in the pedigree cats, mostly favoring human-cat interactions and relationships. Nevertheless, the domestic housecats were much more highly rated than either of the pedigree cats on the trait ‘independence’, a cat trait highly appreciated by most cat owners.

Hart and Hart (2013) interviewed some 80 veterinarians in feline practices randomly chosen across the US and considered to be unbiased authorities on breed differences in cats. These vets first compared neutered males and spayed females independently of cat breed, then ranked a random selection of seven (five breeds plus domestic short- and longhaired cats) out of the 15 cat breeds under consideration along 12 behavioral traits. There were three

traits with high predictive value to distinguish the breeds, seven traits with moderate, and two traits with low predictive value. It remains to be seen if comparative behavioral observations coincide with the subjective rankings made by the veterinarians.

### **9. Effects of cats on humans**

There have been numerous studies reporting the effect of dogs and cats on cardiovascular health risk factors and especially survival rates after a heart attack (Friedmann et al., 1980; Friedmann and Thomas, 1995). Interestingly, although the effect of stroking dogs and cats is different on systolic and diastolic blood pressure (which has not yet been explained), the aforementioned authors as well as Qureshi et al. (2009) have found that for cats considered separately, and for both current and past cat owners the risk rates for cardiovascular disease are significantly lower than for non-cat owners.

In an early study, Zasloff and Kidd (1994) found that adult women living entirely alone were significantly more lonely than those living with pets only, with both other people and pets, and with other people but without pets. Since cats can apparently be a source of emotional support to their owners (Stammach and Turner, 1999), especially those with strong attachment to their animals, it seemed reasonable to hypothesize that cats might affect human moods and that human mood might affect behavior towards the cat. Rieger and Turner (1999), Turner and Rieger (2001) and Turner et al. (2003) tested these hypotheses with behavior observations of human-cat interactions and psychological (mood) testing before and after those interactions in private households. The results can be summarized as follows: A depressive mood in

the owner significantly affected intentions to interact, the starting of interactions, willingness to comply and interact, head- and flank-rubbing, and vocalizations by the cat. Interacting with one's own cat can reduce (improve) negative moods (fear, anxiety, depressiveness, introversion), but an affect (increase or change) on positive moods was not found. More mood subscales were affected by the cat (presence and/or interactions) in women than in men, and they were more strongly affected in women than in men. Given these effects on human moods, it should not surprise the reader to note that cats are often present in or around psychiatric clinics and in psychotherapeutic practices (Turner, 2007). Nevertheless, dogs are much more frequently involved in animal-assisted interventions than cats, probably because they are more easily understood (after tens of thousands of years of co-habitation with people), more easily controlled (trained) and more willing to interact with clients than the felines are due to their basic social nature.

Lastly, pets can be considered as social capital of a society. Pet owners have been found to be significantly more likely to get to know people in their neighborhood than non-pet owners, whereas dog owners were significantly more likely than owners of other types of pets to regard people whom they met through their pet as a friend. Pet owners also reported receiving one or more types of social support via people they met through their pet and scored higher on civic engagement scales (Wood et al., 2005; Wood et al. 2015).

#### **10. Problems caused by cats**

No review of human-cat interactions and relationships would be complete without at least mentioning the problems that can be caused by domestic

cats, namely: allergies, bites and scratches on owners and non-owners, zoonotic diseases, and predation.

Based on a large scale stratified random sample of over 8,300 Swiss adults, Wuethrich et al. (1995) determined a prevalence of allergic reactions via skin prick tests to grass (12.7%), followed by house dust mite (8.9%), silver birch pollen (7.9%), cat (3.8%) and dog (2.8%) allergens. Especially the cat allergen prevalence seems to be much lower than that reported orally (e.g., by parents in school classes) without medical testing. Nevertheless, Wuethrich (*pers. comm.*) cautions about encouraging contact with pets when a child is predestined to develop full-blown asthma from a less serious allergic reaction. On the other hand, there are numerous studies, e.g. Roduit et al. (2010), indicating an advantage of mothers having pre-natal contact with cats and farm animals on their toddler's atopic dermatitis during their first few years.

Very few countries require mandatory reporting of cat bites, let alone medical treatment of cat scratches. Both are to be taken seriously given the pathogens found in the mouths and on the claws of this carnivorous species. Bites and zoonotic disease transmission by pets were the topics of a recent three-year study financed by the European Commission Framework Program called CALLISTO and the results are summarized on the website <http://www.callistoproject.eu/joomla/index.php/about-callisto> and in Sterneberg-van der Maaten et al. (2015).

Another problem is purportedly caused by cats, namely the endangerment of wildlife (birds, mammals, reptiles and amphibians) by owned cats allowed outdoors and feral (free-living) cats. No doubt, such cats kill and consume millions of prey each year (see e.g., Churcher and Lawton, 1987; Loss et al.,

2013), but unless such extrapolations take many factors known to influence predation by cats into account - including prey species density and annual prey production rates, they lack credibility. The results of over 60 field studies about cat predation on the continents and on oceanic island were analyzed by ecologist Fitzgerald (1988), who came to the conclusion that on the mainland, such cats were not the main cause for the disappearance of endemic wildlife species, as opposed to the situation on small oceanic islands. Further studies and factors were added in Fitzgerald and Turner (2000a) and Turner (2014) all arriving at the same conclusion.

More recently it would appear that extreme conservationists consider the outdoor cat to be an enemy “imported” by man, overpopulating the mainland because of human activities (Swiss Animal Protection, Wildlife Office, 2016, pers. comm.). The facts that cats more or less domesticated themselves albeit with some support from early human agrarian settlements (Leyhausen, 1988; Bradshaw, 1992; Serpell, 2014), are socially and environmentally flexible (Bradshaw, 2015) and capable of surviving on their own, and dispersed from the fertile crescent northwards and eastwards in spite of attempts to prevent that dispersal, speak against this categorization. Cats have *themselves* successfully expanded their geographic range and increased in population size, using their superior hunting abilities when outside and signals that solicit human support when inside. Random samples of adult persons in all countries that have been surveyed (n = 12) consider cats to be ideal pet animals and do not agree that stray cats are causing problems in their countries (Turner, 2010; Fehlbaum et al. 2010). Intervening to reduce that population is an unwarranted and unjustified intervention in a naturally

evolving predator-prey system.

Despite the problems potentially caused by domestic cats, one should never forget the health benefits that cat ownership and social support from companion cats bring to millions of cat people throughout the world. As always, one has to balance the costs against the benefits and the present author is convinced that this will favor having cats as companions.

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