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Feeding Cats for Optimal Mental and Behavioral Well-Being

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Introduction

Cats that are confined indoors are dependent on their owners to determine when, what and how they eat, which impacts a cat's welfare on multiple levels. Obesity and behavior problems are common in pet cats[1–3], and these conditions, although multifactorial, may be related to the ways that cats are fed[1,4,5]. The feeding of cats should follow these key principles:

- how cats are fed should reflect the way that cats naturally eat
- feeding should promote the physical and mental/behavioral health of the cat
- cats should be given choices to assess their preferences whenever possible.

How cats eat

Feral cats are generalist predators[6], likely able to survive in many environments because of their ability to adapt to variable prey. The natural feeding behavior of feral cats is highly dependent on available resources. Unowned island cats who were not additionally provisioned by humans primarily hunted and ate small rodents[6] and birds[7], although fish, invertebrates, and reptiles/amphibians were also consumed[8].

Human provision does not eliminate predatory behavior. One study in a national park found that the native rodent and bird populations were significantly lower in areas where cats colonies were fed compared to areas where cats were not observed[9]. Another study found

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that feral cats hunted and consumed approximately four times the amount of prey as housecats. The percent of feeding from prey for housecats varied from 15–90% of their daily intake[10]. The feline diet changes with season and prey availability[11], and some cats specialize on a particular type of prey while others are generalists[12]. It is unknown whether a cat's preference for varied prey predicts their preference for a varied diet, in terms of meat source, textures or tastes.

Previous studies have found that more than 40% of cat owners report feeding their cats dry food exclusively, with around 30% feeding a diet of at least half canned food[13]. Many cats (40–60%) are free fed or fed twice daily[13,14], with free-feeding more common for obese cats[14,15].

The caloric intake of the average neutered adult cat varies widely but has been estimated at approximately 55 kcal/kg per day[16]. Because the most common natural prey of both domestic cats and their closest ancestors is mice (30 kcal/mouse), it is likely that this lineage of cats evolved eating several small meals per day. When allowed to choose their own feeding patterns, cats tend to eat between roughly 8 and 16 meals a day[16,17]. It is unknown how feeding relatively infrequent meals impacts the health or behavior of cats, although one study of twenty laboratory-housed male cats found increased aggression, and less consumption of food and water when meal-fed compared to when fed ad libitum (unrestricted access to food – time and quantity)[5]

Foraging and contrafreeloading

Because all animals must forage for food, whether by hunting, scavenging, or searching, enrichment that encourages foraging behavior can provide an outlet for natural behaviors. Many captive animals appear to prefer working for food over receiving freely available food, a phenomenon known as contrafreeloading[18,19].

Because one study found that cats preferred to eat freely available food before lever pressing (working) to receive food[20], they have been described as "the only species so far tested that showed no contrafreeloading[18]." Due to some methodological issues (small sample size, food restriction, the task required by cats to acquire food) the results of this study should be interpreted with caution, and more studies are clearly needed. Cats naturally work for food, and only around a third of cats' hunting attempts lead to a kill[21]. Cats will continue to kill prey (i.e., contrafreeload) before consuming previously killed prey[21,22]. Although hunger is not necessary for cats to hunt or play, hunger increases hunting and play[23,24], and would for example, likely increase a cat's desire to use a foraging toy (food puzzle).

Food puzzles

Food puzzles have been recommended for cats and dogs as a mode of environmental enrichment[25–27], as well as one tool in the treatment of pet obesity[28,29]. In theory, food puzzles should increase activity and encourage problem solving[30]. Previous studies of confined companion animals have demonstrated positive effects of foraging toys on behavior, including calmer behavior in shelter dogs[31] and reduced feather-picking in parrots[32].

Case studies suggest positive effects of food puzzles on the behavior, and well-being of cats[25], although a recent study found that their use may not increase overall activity[33]. Using a randomized crossover design, nineteen housecats were fed from either a bowl, or a set of food puzzles while wearing an accelerometer. No differences were found in daily or weekly activity levels between the two feeding conditions.

Food puzzles are not commonly used by cat owners. One survey found that less than five percent of owners provided food puzzles or hid food around the home to stimulate their cat's foraging behavior[3]. A more recent survey found that 30% of participants used food puzzles, but only occasionally, and another 18% had previously tried, but no longer used food puzzles[34]. It is challenging to quantify how much enrichment owners provide for their cats, and there are few empirically-based guidelines for what types and how much enrichment improves the welfare of cats. However, food puzzles should not harm pet cats and may offer benefits for their welfare; current feline care guidelines encourage their routine use[35].

Using food puzzles

- Food puzzles can be used with wet or dry food.
- Mobile puzzles are objects with holes that can be filled with dry food and rolled around to release food.
- Stationary puzzles have a base and wells or cups from which food may be fished out.
- Puzzles can be purchased or homemade.
- The difficulty of the food puzzle should match the abilities of the cat, and at first, the food puzzle should require little effort on the cat's part to release food.
- Food puzzles can be filled with treats at first or introduced to the cat before meals to increase motivation.
- A recent publication offered detailed information on how to introduce food puzzles to cats, suggestions for troubleshooting, and a handout for veterinary clients[25], and more information is available at: http://foodpuzzlesforcats.com (Figures 1–3).

Other options to encourage foraging activity

- Divide a cat's food into small, naturally-sized portions to place in different locations in the home to stimulate search behavior.
- Toss pieces of dry food across the floor for a cat to chase and retrieve.
- Place food on elevated surfaces, such as cat furniture or tables. The physical condition of a cat (age, joint mobility) should be considered.

Feeding practices

Offering small, frequent meals would be most similar to cats' observed preferences[17,36,37]. Owners can allow cats to graze or offer multiple feeding choices (food puzzles, as well as meals). In either case, owners should track the overall daily intake of their cat by weighing food with a scale[38] and following recommendations from their veterinarian. Reassessing the cat's weight, body and muscle condition will determine how the program is working for the individual (See: Assessing nutritional requirements and current intake by Witzel-Rollins and Murphy).

Owners may need education about proper cleanliness of feeding areas, which may impact cat feeding behavior. Many cat owners do not completely or routinely empty and wash bowls, and instead "top off" dry cat food. Saliva and crumbs can quickly accumulate, and a dirty bowl increases bacteria and may be unpleasant to cats; pet food bowls have been ranked among the most bacteria-laded kitchen surfaces[39,40]. Food and water dishes should be washed daily[41], and food replaced as needed. When wet food is left out for long periods of time, it can become dry, which may reduce its appeal for cats.

There has been recent attention to a potential issue for cats, labelled "whisker stress[42]", the assumed discomfort experienced when a cat's whiskers touch the side of a narrow bowl while eating. To date there is no empirical evidence on whether whisker stress occurs[43]; however, owners may choose to offer food in a few different styles of dishes to see if their cat shows a preference.

Another open question is whether cats prefer water separated from their food, a frequent recommendation[44,45], based on the assumption that dead prey would contaminate a water source. As with "whisker stress," there is no empirical evidence demonstrating a preference for separate food and water areas. Many cats are fed dry food, and dry food increases water consumption[16,46], so cats may prefer a water source close to their food. Studies are needed, but owners can provide their cats with choices of water and food locations to determine individual preferences.

Problems related to feeding

Obesity

Although free feeding is associated with obesity, opportunities to graze may also allow cats to eat in a manner closest to what is natural to them. The relationship between free-feeding and weight gain may be due to the continual availability of calorically-dense food, but there are other related factors, such as neuter status, which may reduce a cat's maintenance energy requirements and ability to regulate intake[47,48]. Living in a multi-pet household is associated with a higher body condition score[4,49,50], which could be due to stress, increased competition for food, or to a larger amount of food being available.

Not all free-fed cats become overweight, thus freely available food is not the only cause of obesity. There has been little exploration of the effects of negative emotions on the feeding behavior of companion animals, although stressors and changes in routine have been

associated with anorexia in cats[51,52]. Emotional overeating has been well-established in humans and laboratory animals, and may be caused by frustration, stress, boredom or other factors besides hunger[53]. Recent research suggests a relationship between impulse control and overeating in cats[54], similar to findings in humans[55]. Unfortunately, obesity and overweight may further reduce an animal's quality of life by restricting their activity and through related physical conditions, such as diabetes mellitus or joint disease.

Obesity may be prevented with an appropriately enriched environment that provides exercise, mental stimulation, and a sense of control and safety. Cats who are at a healthy weight may be able to free feed without excessive weight gain, particularly if owners monitor food intake and their cat's weight. However, cats switched from meal feeding to ad libitum feeding may initially increase their food intake, which can lead to at least short-term weight gain[56,57] (Figure 4).

Pickiness

Cats are known to be particular about flavor profiles, textures, shapes, and temperature of food[58,59]. A reduced appetite can be caused by a diversity of pathological or disease processes and should not be considered "normal behavior" associated with food preferences until health issues have been addressed or ruled out. Cats can be neophobic toward new foods, particularly when they do not find the food palatable[37], and may instead develop a fixation on one type of food[59]. These cats may sniff at the new food before tasting it or refuse to try it altogether[37].

One study found behavioral differences between cats eating a preferred versus a less palatable food[60]. When eating less desirable food, cats were more likely to flick their tail, groom their body, flick their ears backwards, and lick their nose without tasting the food. Cats eating a preferred food were more likely to lip-lick[60].

Owners can prevent pickiness by offering new foods as choices, alongside previously accepted foods[61]. Cats appear to appreciate some variety in foods offered, and may initially show a preference for a novel food, but the effect is usually transient[62]. Accepted foods should be regularly rotated into a feeding regimen to maintain consumption, otherwise, neophobia may be observed during future presentations[63]. Cat owners should also keep in mind that some cats prefer their food at room temperature or warmer[59].

Begging/Meowing for food

Cats increase activity and exhibit anticipatory behaviors as feeding time approaches[64,65]. As these behaviors (e.g., pacing, meowing, purring) become associated with the delivery of food, they may be reinforced. Some cats may exhibit demanding behavior (e.g., meowing, knocking things off shelves) at other times to get food or attention. Cats on restricted intake show more "affectionate" behaviors (such as sitting in a lap) in addition to attention-seeking behaviors (such as begging, following owners, and meowing)[66], likely in an attempt to solicit food from the owner. Some cats may even become aggressive when waiting for food or try to steal human food from counters and tables[67]. Owners are sensitive to the intensity of cats' solicitation behaviors[68] and may misinterpret these social interactions as hunger, and give the cat more food, which can lead to weight problems[62] (Figure 5).

Providing cats with food on a routine or schedule rather than feeding cats exclusively when they “ask” will reduce begging behavior, although owners will likely observe increased anticipatory behaviors close to scheduled feeding times[64,65]. Cats who have been reinforced for meowing at other times may experience an extinction burst (increased behavior in response to removal of reinforcement) when owners stop feeding the cat on demand[69]. An extinction burst may be avoided by including differential reinforcement of alternative behaviors[69]. One cat with aggressive behaviors around food was successfully treated with a combination of routine, enrichment, training for quiet and calm behaviors, and ignore demanding behavior that previously led to being fed[67].

Automated feeders

If a cat is overly dependent or demanding on their human for food, a timed automated feeder can be implemented. This reduces the connection between the human and the arrival of food and also allows an owner to program multiple feedings per day, at a schedule that works better for their cat (e.g., great frequency of small meals) and for them (e.g., being able to feed the cat in the middle of the night without the owner having to wake up) (Figure 6).

Cats are solitary hunters; they hunt small prey[70] that they do not share, aside from mothers with kittens[36]. The ability of natural occurring groups of cats to exist at high density is directly related to the availability and dispersal of resources, including prey. Cats fed inside homes should also be treated as solitary feeders, and resources should be ample and spaced out sufficiently to prevent competition or stress when eating. Aggression between cats can be influenced by conflict over availability of resources, including food[71,72] (See also Heath: Environment and Feline Health: At Home and in the Clinic in Part I).

In one survey, approximately half (56.4%) of multi-cat households provided multiple food bowls[73] although it was not noted whether feeding areas were in proximity to one another, rather in separate locations. In the same study, almost half of multi-cat households only provided one food dish for multiple cats. When cats are required to share a feeding bowl or station, a cat may be forced to eat while feeling stress or anxiety, rather than forgo a meal. In some cases, cats may fight at a shared food station both before and during feeding due to crowding[74], whereas other cats may choose to avoid conflict by waiting to eat until another cat is finished (Figure 7).

Another study found a relationship between aggressive encounters away from the food bowl, feeding order, and agonistic behavior around a feeding station in an owned cat colony[75]. This and a study of an outdoor colony of feral cats in Italy suggested that social interactions around the food bowl are complex[71,76]. Some cats appeared to tolerate eating close to specific individuals, and other cats chose to leave the feeding area and return after other cats had already fed and vacated. In both studies, food was only available from a single, central location.

Although some cats may not mind sharing a food dish, the best way to accommodate multiple cats is to give each cat the choice to eat alone. Some cats will carry food away from the food dish to eat it; this is a normal feline behavior, and cats who hunt often carry their prey away from the kill[36]. Carrying food away from the source can also indicate that the cat

has a preferred feeding area. Owners should position bowls to allow cats a vantage point while eating, so they can observe if humans or animals approach while they eat.

Managing dietary issues in multi-pet households

- Multi-pet households may have animals with different diets or eating preferences, or adversarial relationships.
- Many therapeutic diets provide complete nutrition, so if all cats find it palatable, they can often be transitioned to the same diet.
- The SureFeed® is a motorized bowl that can only be accessed by the cat(s) with the correct microchip(s). A microchip-activated flap installed in a door or wall can also limit access to specific cats.
- Other devices are being added to the market (PortionPro Rx™, CatsPad©, etc.) that allow owners to manage feeding while avoiding confining cats, limiting access to food, or punishment/correction.
- These tools can allow cats to eat according to their personal preferences (grazing versus eating larger meals) (Figure 8).

Meal feeding can be part of a cat's daily routine. Knowing when to expect food and having a routine are known to reduce sickness behaviors in cats[51]. Meal feeding may increase the cat-owner bond and allows the owner to use food as reinforcement for behaviors, such as asking a cat to sit quietly in a desired location (e.g., a mat). Feeding a large meal before bedtime and after an exercise session can reduce nighttime activity, a common complaint of cat owners[36]. A complementary recommendation to prevent or modify night activity is for the cat owner to introduce food puzzles and leave them available overnight so the cat can self-feed, while using other feeding methods during the day.

Using food in behavior therapy interventions: Applications in clinical behavioral medicine and feline mental health care

As previously explained in this chapter, diet and food intake have a role not only in general health but also in mental and emotional well-being. Specific nutrients cause changes in brain structure, chemistry, and physiology, leading to behavioral changes[77]. Besides the usefulness of food as a tool in veterinary behavior therapy, this understanding allowed for the production of prescription diets that are part of mental health treatments for animals, including cats[78]. Besides providing precursors to important mood-regulating neurotransmitters (such as tryptophan for serotonin synthesis), food ingestion regulates receptors and causes release of neurotransmitters associated with pleasure and calmness.

Overall, food is a fundamental aid in three main types of interventions commonly used in veterinary psychiatry and psychological care: the application of environmental enrichment and meeting basic behavioral needs, counterconditioning therapy, operant conditioning, and differential reinforcement of alternative behaviors. These interventions are of benefit not only to owned cats but also to cats living in shelters and laboratories[79,80]. The efficacy of

these tools is generally related to food value[81], with more palatable reinforcers leading to increased response[82].

The literature citing benefits of environmental enrichment for brain health is extensive and beyond the scope of this chapter. Benefits can be externally measured and are part of assessment, treatment evaluation, and prognosis of feline patients (such as increases in behavioral diversity, presentation of normal species-specific behaviors, utilization and exploration of the environment, ability to cope with stressors, reductions in the frequency and intensity of abnormal and pathological behaviors, and decreased clinical signs of anxiety)[27,52]. However, benefits at the neuroanatomical and neurochemical levels are also well-known (from changes in cortical thickness, size of synaptic contacts, number of dendritic spines and dendritic branching, to increased brain weight)[83].

In 2013, the American Association of Feline Practitioners and the ISFM published their Feline Environmental Needs Guidelines that recommended, among other techniques, the use of food puzzles for feline well-being[84]. This recommendation has been supported by several other publications and studies. Consequently, in behavioral medicine and veterinary psychiatry, environmental enrichment in the form of food toys, puzzles and games are an important aid for all feline patients regardless of their diagnoses. However, it can be particularly helpful for specific conditions such as separation anxiety disorder (e.g., by giving the cat options of rewarding and stimulating activities not related to interacting with and the presence of the owner), generalized anxiety disorder (e.g., by decreasing clinical signs of hypervigilance and arousal) and for cases of inter-cat conflict (e.g., by taking the cats' focus away from each other and towards a rewarding and relaxing activity, which might also promote counterconditioning between cats)[25,85].

Counterconditioning therapy is commonly used as part of the treatment and management of fear, phobias and other anxiety disorders. It is based on classical conditioning (i.e., learning through association) which is involved in the development of fear responses[86]. Classical counterconditioning does not require a specific response from the animal, but instead depends on changing an animal's emotional or motivational state in the presence of a conditioned stimuli. Because food affects neurophysiology and neuroendocrinology and therefore the cat's emotional state, the association of high value food and/or food toys and puzzle with specific situations and conditioned stimuli (e.g., another animal, sounds) can decrease stress, fear and anxiety (Figure 9).

Counterconditioning is ideally paired with systematic desensitization (i.e., progressive exposure) and it is tailored for every individual cat with gradual steps based on the cat's body language, facial expression and emotional responses. A few examples of this type of therapy are to decrease fear of veterinary visits, the carrier and car rides, people, appliances and other animals[87]. Counterconditioning is key when integrating or re-integrating cats in a multi-cat household[25,88].

Differential reinforcement of alternative behaviors (DRA) is based on both classical conditioning and operant conditioning. This type of therapy replaces dysfunctional behaviors with actions that are more appropriate for a situation. The general guidelines

involve removing the reinforcers for unwanted behaviors when possible/applicable, teaching acceptable alternative behaviors in the same context, and using positive reinforcement to maintain desired behaviors long term. Again, food (especially when high value) is a powerful reward for most cats, as the changes achieved are not only external (behavioral) but also happen at a neurochemical level. When applied properly and consistently, these interventions can lead to long lasting behavioral and emotional change. This form of therapy is fundamental for the treatment and management of cats whose stress response escalates into aggression. For example, DRA is used to teach avoidance to replace or substitute threatening signals and aggression between cats[88]. Differential reinforcement is also effective for the treatment of obsessive-compulsive disorders, by modifying stereotypical behaviors while reinforcing other, functional responses[85]. Details on the use of food rewards, food puzzles and toys for veterinary mental health and behavioral care is covered extensively in the most current literature.

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Synopsis

In this chapter, we review cats' feeding behaviors, and discuss ways of feeding cats that promote physical and mental/behavioral health, while providing cats with choices that allow expression of preferences. We address the management of several feeding issues that cat owners may face, such as obesity, pickiness, begging for food, and feeding in multi-cat households. Food puzzles are one way to provide environmental enrichment for cats, and food can be used in multiple ways for behavior modification in the clinical setting, including counterconditioning and differential reinforcement of alternative behaviors.

Key Points

- Cats naturally eat several small meals per day, but cats in homes are typically either free-fed or fed twice daily.
- Foraging enrichment can encourage natural feeding behaviors, and food puzzles are advised as a form of mental stimulation and behavior modification.
- Free-feeding is likely necessary, but other factors also play a role in the development of obesity.
- Several recommendations for managing feeding issues in cats are offered.
- Diet and food intake have an important role not only in general health but also in mental and behavioral well-being.

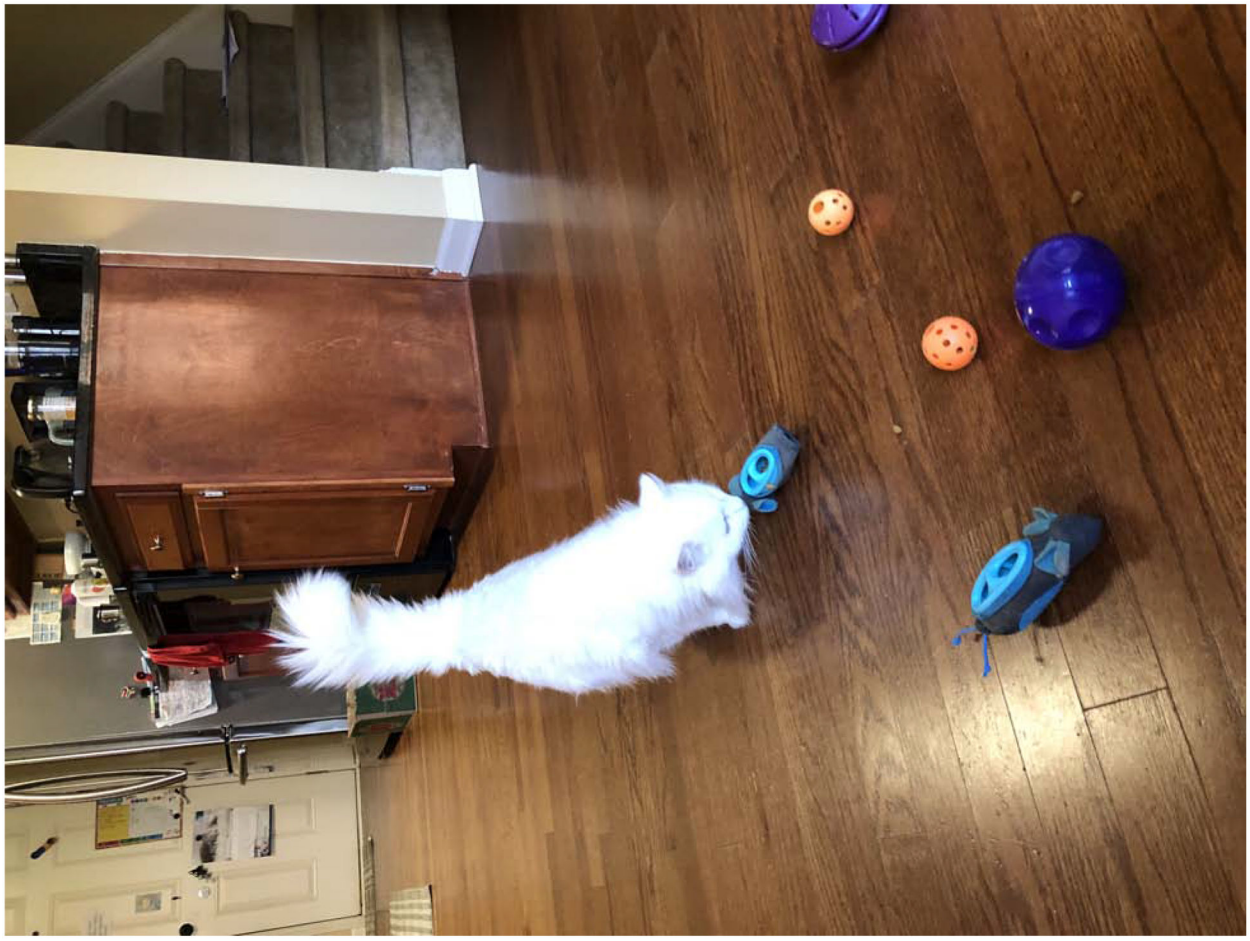

Figure 1.
Mobile food puzzles can be manipulated to release food.

Figure 2.
Example of a stationary food puzzle.

Figure 3.
Gege, 13 year-old male neutered DSH cat, using a home-made food toy.

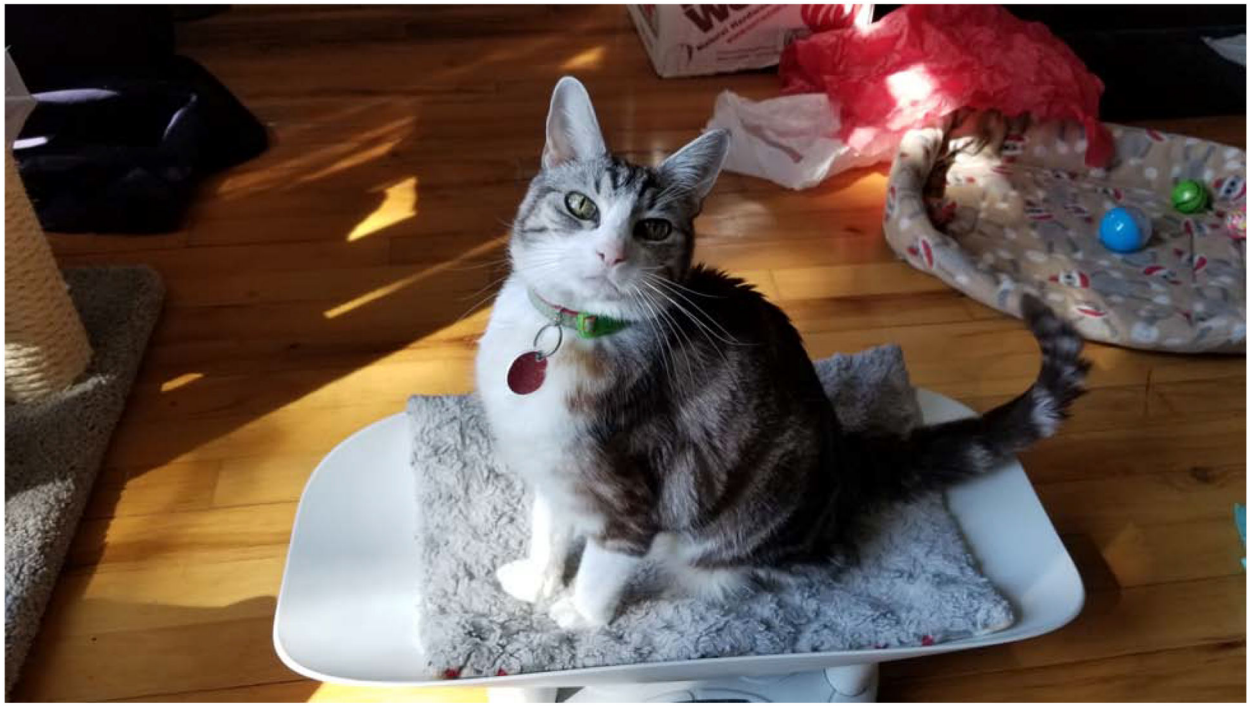

Figure 4.
Cats can be trained to sit on a scale for routine weight monitoring.

Figure 5.
Cats may engage in attention-seeking behaviors to solicit food from owners.

Figure 6.
Nina, 1 year-old female spayed DSH cat, using an automatic feeder.

Figure 7.
Cats should be fed at least a few feed apart from one another. Courtesy of S. Globerman, DVM, Marietta, GA.

Figure 8.
Senior cat using a microchip activated feeder. Courtesy of I. Johnson, CCBC, Marietta, GA.

Figure 9.
Food puzzles are instrumental in behavior therapy, promoting counter conditioning between cats, encouraging positive social behavior and decreasing conflict.