CHAPTER

9

Kitten Development

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OUTLINE

The development of a kitten from a dependent neonate with a limited ability to perceive and respond to stimuli to an independent creature with a fully developed physiology that is able to care for itself, hunt, and interact with other cats is a rapid yet complex process that is affected by many factors. These include the genetics of the sire and dam, the environment of the uterus, and the kitten's environment after birth. There is a complex ballet of neurologic, physiologic, musculoskeletal, and psychologic development that must occur in the correct sequence if the kitten is to develop normally. One of the most important stages in a kitten's development is the socialization period, wherein kittens are most receptive to learning the things and individuals in their environment that they should avoid, ignore, or derive benefit from.

Problems can occur at any stage of development and can have far-reaching effects for the kitten, especially in the role of a companion cat. Cats whose behavior does not meet owner expectations are at risk of being surrendered to a shelter,[36] where they are likely to be euthanized. Understanding normal kitten development allows owners to provide the right environment for healthy kitten development. It is also important that veterinarians understand the behaviors that kittens normally display at various stages of development and educate owners accordingly.

INFLUENCE OF PARENTAL FACTORS ON BEHAVIORAL DEVELOPMENT

Genetics

Cats are unique among domesticated animals because the majority of their breeding is not controlled by humans.[11] Many kittens are the result of opportunistic matings wherein male social skills and female preferences dictate who sires the kittens. The breeding season for the modern domestic cat is based on multiple estrous cycles throughout the year, especially spring through summer, with a second peak in kitten numbers in late autumn. The modern domestic cat is capable of producing two or three litters annually, depending on the length of time that the kittens remain with the queen after weaning. Natural selection pressures are working, as opposed to human preferences for coat and eye color, size, and temperament. Although this works to keep the feline population relatively free of genetic diseases, it can have important effects on the suitability of kittens to be companion animals. Development of behavior is the result of the complex interrelationship between inherited factors (i.e., genetics) and noninherited environmental influences.[6]

FIGURE 9-1 Newborn kittens are totally dependent on the queen.

In Utero Effects

The environment in the uterus during pregnancy can have far-reaching effects on the behavior and development of the individual kitten. Poor quality of nutrition for the queen during pregnancy has been shown to produce a wide variety of behavioral and physical abnormalities in kittens. Kittens from queens fed a low-protein diet during late gestation and through lactation have been found to be more emotional and move and vocalize more frequently than kittens from queens fed an adequately formulated diet.[20] These kittens also lost their balance more often and had poor social attachment and fewer social interactions with the queen. It is not clear if the restricted protein leads to the emotionality or if changes in the queen's behavior caused by the protein deficiency lead to the change in the kittens' behavior. In another study, when queens were restricted to half of their nutritional requirements, the kittens demonstrated growth deficits in some brain regions (e.g., cerebrum, cerebellum, and brain stem).[38] Delays were apparent in many areas of development, including suckling, eye opening, crawling, posture, walking, running, playing, and climbing.

Tactile sensitivity is present in the embryo by day 24 of prenatal life, and the vestibular righting reflex develops by approximately day 54 of gestation.[6] Kittens are generally born after a 63-day gestation.

Maternal Factors

Good maternal behavior is essential for healthy kitten development. In fact, because kittens are born blind, with limited ability to move and regulate body temperature, they are totally dependent on their mothers (Figure 9-1). Kittens may be communally reared by other female cats, especially in environments where food is abundant.[18] Kittens that were separated from their mother and hand raised from 2 weeks of age were more fearful and aggressive toward people and other cats, were more sensitive to novel stimuli, learned poorly, and developed poor social and parenting skills.[34,37] These effects may be attenuated, at least in part, if kittens are hand reared in a home with other cats.[15,34] When queens are fed a rationed diet, their kittens were more active, engaged in more object-directed play, and were more likely to hunt.[1,7] Stressors on the queen before and after the birth of her kittens can affect the behavior of her kittens. Kittens from queens fed a restricted-protein diet were found to vocalize more than kittens from queens fed a balanced diet.[7]

Paternal Factors

Though the tom is not involved in raising the kittens, he appears to have a strong effect on the kitten's social development. Studies of cat personality have identified three personality types: sociable, confident, and easy-going; timid and nervous; and active and aggressive.[29,32] Although maternal genetics and the influence of the mother and offspring on early development are important, paternal genetic factors appear to have the strongest influence on the development of personality. Kittens sired by toms considered to be "bold" have been found to be significantly friendlier to familiar people, less stressed by the approach of unfamiliar people, and more likely to spend time near a novel object.[32]

Of course, the socialization of kittens is a complex process that involves the interplay of genetics, environment, and learning. However, it is likely that some feral cats are genetically shy, which hinders their ability to live close to humans. Their kittens will be similarly affected, making their socialization to humans and their suitability as pets less certain.

BEHAVIORAL DEVELOPMENT

Development after Birth

Similar to the patterns identified in dogs during puppy development, kittens have several sensitive periods of intense development from birth to 6 months of age. They tend to have shorter sensitive periods than do puppies, and the 8-week-old kitten is quite different from the 8-week-old puppy with regard to its physical, mental, and social development. The earlier stages of development, the neonatal and transition period, tend to occur very quickly. Important milestones occur in each of the sensitive periods that correspond to the physical development of the kittens. For example, the myelination of nerves must occur before the kitten can show the fine motor control to send social signals by using changes in

body posture or to practice hunting behaviors such as pouncing.

Sensitive Periods

Neonatal (0 to 7 Days)

The neonatal period is a time primarily of nursing and sleeping in which the kitten is fully dependent on its mother. During the first 2 weeks, nursing and eliminative behaviors are initiated by the queen, who provides food and warmth, cleans the kittens, and stimulates defecation and urination by licking the anogenital area of the kittens. The kitten is guided by tactile, thermal, and olfactory stimuli to find the queen and littermates. Kittens are unable to hear at birth, but hearing is present by the fifth day. Kittens maintain their body temperature by huddling together and with the queen. The actions of newborn kittens are initially very clumsy, but as the nervous system and muscles mature and behaviors are repeated, their actions become smoother and more efficient. For example, by 4 days after birth, most kittens are proficient at locating and attaching to their preferred teat.[9] Olfaction is present and highly developed at birth, insofar as kittens use their sense of smell to locate the queen's teats and find their preferred teats. This is important when kittens have upper respiratory tract infections because they will not actively suckle and may need artificial feeding. Even 2-day-old kittens will show pronounced avoidance of offensive odors.[8,27]

The neonatal kitten has a limited range of behaviors. It can orientate its body toward touch and warmth, move by squirming along with swimming movements of the forelimbs, suckle, and vocalize. Kittens begin vocalizing soon after birth. These sounds attract the queen and increase the likelihood that she will allow nursing. She will also locate a lost kitten by its vocalizations and carry it back to the nest.[9]

Kittens have several reflexes present at birth. If touched on the face, a kitten will turn toward the side that was touched (auriculonasocephalic reflex). A kitten will also turn to the side being touched when it is touched on the flank. The rooting reflex, wherein the kitten burrows into its mother, littermates, or any warm material, may be present for up to 16 days. This behavior is used to locate teats. Newborn kittens have a strong suckling reflex, which is initially stimulated by objects in the mouth or being touched on the face. The suckle reflex is strongest on waking. Kittens rapidly develop teat preferences and will preferentially feed from one or two teats.[24] The suckling reflex can be stimulated initially by touching a large area of the kitten's face or putting small objects in the mouth. However, as the kitten gains experience, the area that will produce this response is reduced to the lip area. At the same time, foreign bodies placed in the mouth will be rejected.[28] The suckling reflex usually disappears after approximately 20 days.[28]

Transitional (7 to 14 Days)

During the transitional period the kitten changes from expressing limited neonate behaviors to beginning to show adult behaviors in eating, elimination, locomotion, and social interactions. From about 2 weeks of age, kittens begin to raise their bodies off the ground and move with a slow, paddling gait. Between weeks 2 and 3, the eyes and ears open, allowing the kitten to process more information about the environment. The eyes open at around 7 to 10 days. Although hearing is present by the fifth day of age, the kitten does not begin to orient to sounds until approximately 2 weeks of age. Olfaction is fully mature by 3 weeks. Dental development commences between 2 and 3 weeks of age.

Communal nesting results in kittens leaving the nest earlier: 20 days compared with 30 days for kittens raised in single-litter nests.[19]

Socialization (14 Days to 7 Weeks)

During the socialization period, kittens begin to explore their environment and learn its hazards and pleasures. Visual orienting and following develop in the third week, but obstacle avoidance is not developed until 4 to 5 weeks of age. Full visual acuity may not be achieved until 3 to 4 months of age. Rudimentary walking begins at approximately 3 weeks and develops into brief episodes of running by 5 weeks; kittens use all gait patterns of adult locomotion by 6 to 7 weeks of age.[6] Between the third and sixth weeks, kittens develop air righting, which is the ability to land on their feet.[23]

By 4 weeks the kitten begins to move away from the nest and develops social relationships with people and other animals in its environment. Social play with siblings and the mother begins at approximately 4 weeks and includes wrestling, rolling, and biting. When there are no other kittens or cats present, these behaviors may be directed toward human hands and other moving body parts. Social play peaks at 7 to 9 weeks and continues at a relatively high level to approximately 16 weeks of age.

At 4 weeks weaning begins, and kittens begin to eat solid foods. By 7 to 8 weeks weaning is largely completed, although suckling may continue intermittently for several more weeks.[6,30] From about 4 weeks of age, the mother may begin to bring dead prey; over the next several weeks, the mother may bring home weakened and then live prey, which she releases at the nest, providing the kittens with an opportunity to hunt and kill.[13] Kittens generally share their mother's food choices and choice of prey.[13] Kittens that are weaned early (4 weeks) are more likely to be mouse killers, whereas late weaning (9 weeks) is associated with a delayed development of predation and reduced propensity to kill mice.[39] Time of weaning is associated with a change from social play to object play.[3] In fact, kittens weaned early showed higher

rates of play.[7,31] Locomotor play also begins at around this age.

By 5 to 6 weeks of age, the kitten has full voluntary control of elimination, and digging and covering feces and urine on loose soil may begin.

Fearful reactions to threatening stimuli may begin to be displayed by 6 weeks of age.[27] Individual differences in behavior begin to be displayed during the second month of life, owing to both genetic influences and contrasting early environments.[2]

Juvenile (7 Weeks to Sexual Maturity at 6 to 12 Months)

The juvenile period is associated with kittens becoming ready to disperse from their queen's home range and become fully independent for their food needs. Play and exploration of inanimate objects and locomotory play begins to escalate at approximately 7 to 8 weeks of age and peaks at approximately 18 weeks of age. Social play, on the other hand, is most prevalent from about 4 weeks to 16 weeks of age. Social play begins to take on aspects of predation in the third month. Object play may be social or solitary and may consist of pawing, stalking, leaping, and biting of objects and securing them with the paws. This type of play simulates a variety of aspects of the predatory sequence.

Adult (Sexual and Social Maturity)

The adult period begins and the juvenile period ends with the development of sexual maturity. Female kittens may show their first signs of estrus between 3.5 and 12 months of age, although first estrus typically occurs at 5 to 9 months.[9] Earlier signs of estrus can be influenced by environmental factors such as being born in the early spring, exposure to mature tomcats, presence of other female cats in estrus, or periods of increasing light.[9,23] Although cats are able to reproduce at sexual maturity, sexual maturity is not equivalent to social maturity. *Social maturity* refers to the development of adult social behavior and interactions with other cats and is believed to occur between 36 and 48 months of age. Social maturity includes defense of territory. Male domestic kittens reach sexual maturity between 9 and 12 months of age. Wild or feral male cats may not reach sexual maturity until 18 months of age.

SPECIFIC BEHAVIOR PATTERNS

Play

Of all the behaviors in which kittens engage, play behaviors are probably the most fascinating to watch. Play is normal and possibly essential to the normal development of kittens. Play helps kittens develop physical fitness and practice behavior patterns essential for their survival as adults. Hunting, for example, is a complex behavior that has to be practiced to bring all the elements together successfully. Hunting inanimate objects such as leaves helps the kitten coordinate muscles and practice timing different elements of the hunting sequence. Play allows kittens to explore their environment and also make social contacts.[9]

Because the expression of play behaviors depends on the physical development of the kitten, play changes over time. Play can be divided into social play, which involves two or more cats, and individual or object-directed play, which appears to be independently organized and separately controlled.[3] A kitten's first play attempts are generally seen at approximately 2 weeks of age, when the kitten will attempt to bat at objects it finds.[9] At 3 weeks of age, social play takes the form of orientated pawing and occasional biting.[9] Development of leaping occurs from 2.5 weeks to 6 weeks. Between 5 and 6 weeks, stalking, chasing, and wrestling begin. Climbing and balancing on ledges begins at approximately 7 weeks (Figure 9-2).[9] Play behavior patterns contain elements of other behavior patterns, such as hunting, killing, and social behavior patterns.

Social play is seen most commonly between the ages of 4 and 16 weeks of age.[9,41] Eight different play behaviors, all occurring at different ages, have been identified (Table 9-1): belly up and stand up (3 weeks), side step and pounce (4.5 weeks), rearing (5 weeks), chase (5.5 weeks), horizontal leap (6 weeks), and face off (7 weeks). The general decline in social play between 12 and 16 weeks of age may coincide with the decrease in social interest before dispersal.[9] Sexual behaviors may be seen during play, beginning between 3 and 4 months of age, with some male kittens showing mounting, neck biting, and pelvic thrusting.[9]

Individual or object-directed play is also seen in kittens starting at 2 weeks of age and begins to increase with weaning, at approximately 7 weeks of age.[7,9,31] It

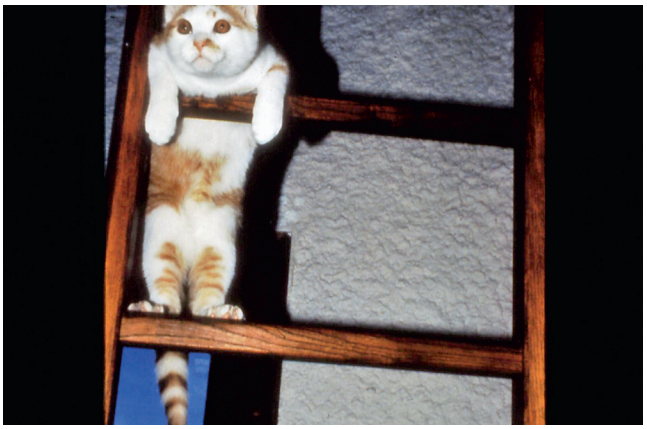

FIGURE 9-2 The ability to climb and balance on objects begins at approximately 7 weeks of age.

TABLE 9-1 Play Behavior of Kittens

	Age at Which Play Behavior Is First Seen and Percentage of Time Spent in Play							
Play behavior*	**2 Weeks**	**3 Weeks**	**4 Weeks**	**5 Weeks**	**6 Weeks**	**7-9 Weeks**	**12 Weeks**	**16 Weeks**
Belly up		21-23 days			13%		16%	
Stand up		23 days						
Side step			32 days		20%			
Pounce			33-35 days		42%		37%	
Rearing				35 days			25%	
Chase				38-41 days				
Horizontal leap					43 days			
Face off					48 days			
Object-directed play	14 days					Peaks at 50 days		

***Belly up:** Kitten is in dorsal recumbency with its forelimbs pawing and hind limbs treading. Its mouth may be open, with teeth exposed. **Stand up:** Kitten sits up on its hind limbs with forepaws pawing. **Side step:** Kitten stands by the side of its play partner with its back slightly arched and an upward curve in its tail. **Pounce:** This is similar to the ambush rush of the hunting sequence. The kitten crouches with its hind limbs under it and tail straight out. It shifts its weight between the hind limbs before rushing at the play partner. **Vertical stance/rearing:** This is similar to stand up, except the kitten pushes itself up so that it is standing on its hind limbs. **Chase:** This involves pursuit and flight between kittens. Sometimes one will run, but the play partner will not chase. **Horizontal leap:** From the side step posture, the kitten leaps off the ground. **Face off:** The kitten faces the play partner and directs pawing movements at the partner's face. The partner may also reciprocate the behavior. **Object-directed play:** This play is directed toward inanimate objects such as toys or leaves.
Adapted from Caro TM: The effects of experience on the predatory patterns of cats, *Behav Neural Biol* 29:1, 1980.

may be important for the development of hunting skills. Kittens are interested in moving objects and will leap, strike, and grab at small, erratically moving objects (Figure 9-3). At other times, kittens appear to play with imaginary objects and will leap at and bat at what seems to be an imaginary object. Another version of this exuberant play occurs when kittens dash wildly around the house, often in the evening, for no reason apparent to humans.

Single kittens play more with objects and with their mothers compared with kittens in litters.[35] Kittens need opportunities for social play, object play, and exploration that are acceptable to both the cat and the pet owner. Toys encourage normal development and prevent kittens from directing normal play behavior toward humans. The most attractive toys for cats and kittens have been shown to be small (mouse size) and appealing in texture and movement; play is increased by hunger.[21,22]

FIGURE 9-3 Laser toys simulate moving objects, and kittens will leap and grab in response to the erratic movement.

Social Behavior

Kittens begin to develop social responses when their eyes have opened and their muscles are sufficiently coordinated to send signals. This is first seen at the transitional period, at about 3 weeks of age. The most receptive time for socializing kittens to humans and other species is between 2 and 7 weeks of age, and the more handling by people, the less likely that fear of humans will develop.[6,25,26]

Adult-like responses to urine from strange cats begin to be seen at approximately 8 weeks of age in kittens, whereas fear responses to a black silhouette of a threatening cat are seen from 6 weeks of age.[27] Social behaviors associated with positive interactions between cats, such as mutual rubbing, have been recorded between 4-month-old kittens that are littermates.[29]

Feeding

Although the urge to suckle is an innate, natural behavior, newborn kittens are initially very clumsy when attempting to nurse; however, within 4 days they generally are proficient at locating the teat and attaching to

FIGURE 9-4 Newborn kittens cannot voluntarily eliminate urine and feces; the queen licks the anogenital area to stimulate elimination and ingests the waste products to keep the nest clean. *(Photo courtesy Susan Little.)*

suckle. The young kitten spends about 25% of its time nursing. By 5 weeks of age, this has decreased to 20% of the kitten's time.

Weaning usually begins at approximately 4 weeks of age and tends to be initiated by the queen. As the kittens become skilled and bold in initiating nursing bouts at approximately 4 weeks, the queen becomes increasingly evasive.[9] The kittens begin to show an interest in solid food—either prey items or food supplied for the queen by humans—and nonfood items such as dirt and kitty litter between 28 and 50 days.

The queen shows a distinct series of behaviors when she begins to introduce her kittens to prey, and encouragement by the mother could play a large part in the development of predation in cats.[13] Experience with specific types of prey as a young kitten affects the adult cat's preferences for prey species.[12] The queen's preferences for prey species also affect her kittens' preferences. The kittens start to follow the queen on hunts at 15 to 18 weeks of age and watch her locate, stalk, ambush, and kill prey. It is not clear if the queen's modeling acts to excite predatory responses already in the repertoire of the young animals[1] or if the kittens learn by direct observation of the queen's behavior. Feral kittens are generally hunting independently by 6 months of age.[13]

Toileting

Initially, the queen stimulates the kitten to void bowels and bladder by licking the anogenital area (Figure 9-4). She ingests the waste materials. The anogenital reflex disappears between 23 and 39 days. Voluntary control of the bowels and bladder begins to develop at 3 weeks. The queen may still clean up after the kittens until they are 6 weeks old because they remain close to the nest.[9] The nest must be clean and relatively free of odors to keep the kittens safe from predators.

At approximately 30 days the kittens start exploring loose, light toilet materials. They appear to be attracted to the queen's toileting area or litter tray by olfactory cues and will get into the tray or area and begin to dig around. Ingestion of the litter as a form of exploration is not uncommon at this age. Soon after this they begin to show adult elimination behaviors, such as using areas with loose, light material and covering feces and urine.

Many kittens are adopted into their new homes with the expectation that they are fully house trained. However, their litter box habits should not be considered reliable before 6 months of age because they are still forming location and substrate preferences for toileting.[9] Some kittens need to be shown the owner's preferred kitten toileting area and material. This is easily done by taking the kitten to the litter box or toilet area after eating, drinking, sleeping, and playing. Giving the kitten plenty of opportunities to use the litter box, keeping it clean and in a location that appeals to the kitten, and preventing accidents by watching the kitten or confining it with a litter box will generally result in a house-trained cat.

Grooming

During the first few weeks of life, feline newborns depend on the queen to meet their grooming needs. She conditions their coats, stimulates urination and defecation, and provides tactile stimulation. Self-grooming begins at approximately 2 weeks of age, but the kitten's efforts are clumsy and incomplete. The kitten's first efforts usually involve licking a front paw; within a few days the kitten is licking the rest of its body. Scratching with a hind limb occurs by 18 days of age. At approximately 4 weeks a kitten will begin to use its forepaws as a tool for grooming the head and neck after eating. By maturity a cat will devote 30% to 50% of its waking time budget to grooming.[9] The primary purpose of grooming is body hygiene, which includes removing loose hair and dander and minimizing external parasites. Most grooming is performed with the tongue (licking) or teeth and usually takes place after rest, sleep, or eating. In hot weather evaporative cooling is achieved by licking the skin and hair.

Grooming is also an affiliative behavior among cats. In addition to queen–kitten grooming, some female cats will groom both females and males in their social group; males generally groom only females.[4] Cats are likely to have closer proximity and are more likely to groom familiar cats (i.e., those within their social group). However, the most frequent allogrooming and closest proximity are likely to occur among related cats.[16] Mutual grooming may also be demonstrated by cats toward humans by licking and by humans toward cats by

petting. However, it is not unusual for humans to extend petting sessions beyond what is acceptable to the cat or to pet areas of the body other than the head or neck, which sometimes results in aggression.

Cats may engage in increased grooming after a stressful event and may display displacement grooming in situations of conflict. Although grooming that leads to excessive hair loss may be associated with stress and compulsive disorders, most cases are likely to have a medical cause including external parasites such as fleas. On the other hand, grooming practices may decrease in situations of chronic or recurrent stress. This may be accompanied by concurrent signs, including alterations in appetite, a decreased interest in social interactions, and avoidance or hiding. Of course, because decreased grooming may be due to medical problems, including systemic illness such as gastrointestinal and dental disease, metabolic disorders, pain, and aging, these must be ruled out first.

LEARNING

Although operant learning principles apply to training cats, as they do in other domestic species, it can be particularly challenging to find an appropriate incentive or motivator for cats. In addition, species-typical behaviors influence what behaviors are more likely to be learned. Therefore it is important that cats, as both a predator and a prey species, be in an environment that is conducive to learning new tasks.

Kittens can learn immediately after birth on the basis of sensory development. They learn to locate the preferred teat by 10 days through trial and error and olfactory cues.[9] Conditioned responses to sounds are seen by 10 days. Active avoidance also begins at this age. Passive avoidance, in which the kitten learns to associate cues with noxious stimuli, develops between 25 and 50 days.[17]

Kittens are not capable of learning to respond to purely visual cues until at least 1 month of age. By 6 to 8 weeks, kittens begin to show adult-like responses to both visual and olfactory social threats.[6]

Cats learn well by observation of other cats; kittens learn best by observing their own mother, but they can also learn by observing siblings and other feline members of the colony.[14] Ideally, kittens learn instinctive imitations that are required for self-preservation, such as hunting behavior, from the queen. Adult cats also display social learning by observing other cats and perhaps even humans. It is more significant for cats to watch another cat acquire a skill than to watch a skill that has been previously learned.[6]

At 8 weeks kittens can begin to solve problems, but their attention span is not yet stable.[9] Experiences such as human interactions and exposure to new environments when the kitten is between 5 and 6.5 weeks can result in latent learning; later in life they are less fearful when exposed to new people and novel stimuli.[9] Another important process of learning is habituation, in which kittens learn about threats and things of no consequence to them. This is not the same as socialization.

SOCIALIZATION AND THE KITTEN

The process by which näive kittens learn to accept the close proximity of members of their own species and members of other species is termed *socialization.* The most receptive time for socializing kittens to humans and other species is between 2 and 7 weeks of age.[25,26] Fear of people may be decreased by nonthreatening, gentle handling and exposure to humans during this period, which may persist into adulthood.[5,10] Conversely, lack of human exposure during this time increases the chance that the cat will interact poorly with humans, although genetic variables also play an important role.

Socialization is repeated in each generation of kittens and is not the same as domestication. It is strongly tied to the neurologic and physical development of the kitten. However, the socialization process is not just confined to kittenhood but continues throughout the life of the cat. A cat's socialization as a kitten can play a role in how they socialize to new individuals as adults. Problems can arise in the behavior of the adult cat if their socialization was inadequate, but poor socialization as a kitten is not insurmountable. Attachments can be formed at other times outside the sensitive period, although the process is much slower and involves extensive exposure.

Hand-raised kittens may still develop social attachments to other kittens, but this occurs much more slowly (Figure 9-5). However, a recent study found that kittens reared by hand were no more likely to display human and conspecific-directed aggression and fear, provided that there was a second cat in the home and wand-type toys were used to stimulate play and chase.[15]

Early handling of kittens by humans not only is beneficial for improving social relationships between kittens and humans but also leads to accelerated physical and central nervous system development and a general reduction of fearfulness. Kittens that were held and lightly stroked daily for the first few weeks of life opened their eyes earlier and began to explore earlier.[33] Kittens handled daily from birth to 45 days approached strange toys and people more frequently and were slower to learn avoidance.[42]

Social contact with the mother is also important for normal social development of kittens. Insufficient maternal care can result in cats that are fearful of humans and other cats. However, with sufficient human handling and care, the presence of another cat during the kitten's social development, and the use of wand-type play toys, problems may be minimized or prevented.[15]

FIGURE 9-5 Hand-raised kittens may suffer from poor socialization, which can be overcome by sufficient handling and care, the presence of another cat during social development, and the use of wand-type play toys.

Cats, like other social species, are born with the capacity for species-specific social skills but need experience with their own species during the sensitive period of development to refine their social and communication skills with other cats. A kitten separated from its mother and littermates and kept as a sole cat in a household may be unable to form functional social attachments with other cats later in life, having missed opportunities for future socialization during this early developmental period.

What is not known in detail is how much handling is required to socialize a kitten to humans and human environments or what kinds of experiences are necessary for kittens to develop normally. For example, should all experiences be positive, or does the kitten need to have some moderately unpleasant experiences to develop fully? Research is hinting at the answers to some of these questions, but detailed investigation is necessary to determine the best socialization process for domestic kittens. In fact, studies in which kittens were handled from 1 minute to 5 hours daily suggest that in general, the more handling, the friendlier the kitten, although there may be an upper limit of approximately 1 hour above which no further benefit is seen.[40]

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