

SENSORY,  
EMOTIONAL &  
SOCIAL  
DEVELOPMENT OF  
THE YOUNG

DOG-Dr. Joel Dehasse

© Dr. Joël Dehasse

3 avenue du Cosmonaute, B-1150

Brussels

[www.joeldehasse.com](http://www.joeldehasse.com)

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This article has been published extensively, with images and charts, in The Bulletin for veterinary Clinical Ethology, vol.2, n°1-2, pp 6-29, 1994 (Brussels).

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## Introduction

In our Western culture, the relation between humans and dogs is played out in a historical and socio-economic context that fosters the emergence of behavioral dysfunctions in animals (the discrepancy between the imagined dog and reality). *Many behavioral problems in dogs arise from a failure to recognize social and environmental constraints during their growth.* In this article we shall briefly trace these phases of a dog's social and behavioral ontogeny and epigenesis. We shall also point out the *risk factors* that can undermine the harmonious interaction between humans and their dogs.

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## The main phases in neurological development

Like humans, dogs belong to a species that matures slowly after birth: the new-born is not completely developed and is incapable of surviving on its own. This implies a structured and caring parental environment (caring for the young), reflexes that orient the young puppy to its parents, and the existence of optimal, even crucial, periods in the development of the animal's nervous system.

1-The **growth** of the nervous system underlies behavioral epigenesis. The immaturity of the nervous system at birth is obvious: Cragg (1975) calculated that in cats the number of synapses per cortical neuron grows from a few hundred to nearly 12,000 in the 10th to 35th day after birth (in Changeux, 1983). Various measurements (volume, weight, percentage of dry matter, oxygen consumption) of the brain show that growth is rapid until the 6-7th week when development suddenly slackens considerably. The number of brain cells and their

myelination reaches full adult maturity at 4 weeks. It is worth mentioning that the brain is totally unmyelinated at birth, except for the trigeminal nerve and the non-acoustic part of the auditory nerve which correspond to the new-born's orientation reflexes (Herman 1958, in Scott & Fuller 1965). The motor cortex is the more developed at birth. The occipital cortex, however, then grows more rapidly than the motor and frontal lobes; it also contains several immature neuroblasts that reach full development only around 3 weeks of age (Fox, 1965).

2-Behavioural epigenesis (ethogenesis) is linked to the way neuronal connections are *organised* (theory of **selective stabilization**). The development of the neuronal networks is a characteristic process: "the phase of synaptic redundancy followed by a phase of regression in the axonal and dendritic branches is a critical period of development... The redundancy is temporary. Active nerve endings are eliminated all the while the nervous system itself is expanding... **This neuronal hecatomb is part of the normal development.** ... The hypothesis that spontaneous, and later evoked, nervous activity contributes to the development of neural networks and synapses appears to be plausible" (Changeux, 1983).

3-Behavioural epigenesis is influenced by *environmental factors, by the surroundings*.

**Activity regulates neuronal development.** In a now classic experiment (by Weisel and Hubel from 1963, in Changeux 1983) with monkeys, noticeable visual defects were caused when one eye was sewn shut during the first six weeks of life; the problems were reversible if the eye was re-opened after three weeks' time. The same experiment on adult monkeys showed no effect on vision. Similar experiments on cats show there is a sensitive period for visual development between 3 and 7 weeks of age, and incapacity to recover vision after three months (Weisel and Hubel, in Vastrade, 1987). "There is a critical period during which the abnormal functioning of a system causes irreversible lesions." (Changeux, 1983). According to Klossovskii (1963), puppies and kittens that undergo periods of forced rotation for several days have vestibular neurons that are larger than those of animals that have not received this stimulus (in Fox: 1965).

\*In rodents, postnatal temporary occlusion of the ears leads to subsequent difficulties to locate sounds in space and to reduction of discrimination of auditive patterns (Caston: 1993). In rodents always, precocious exposition to other species odors eases future interspecific socialization (decrease in aggressions, lowering of corticosteroids hormones) (Caston: 1993).

\* This reflects Cyrulnik's (1991) remarks that **the brain becomes atrophied when [an animal] is raised in sensorial isolation**, and it **develops more than average in an environment of hyperstimulation** in noise, affectivity, odors, tastes, sight, etc....

4-Neurobiological studies have showed that *prolonged precocious isolation was responsible for long-lasting structural or functional cerebral modifications*. Isolation leads to a diminution of the dendritic network in the monkey frontal cortex; it also induces a reversible diminution of the activity of the mesocorticofrontal dopaminergic pathways (with hyperreactivity to stress), associated with a slight increase of the activity of the mesolimbic and nigrostriatal dopaminergic pathways (Verdoux and Bourgeois: 1991).

5-Development thus seems to come about in **stages**; although these stages are possibly nothing more than a "simplified classification system where the classifier traces a straight line through a continuum" (Bateson, 1981). Pampiglione (1963) observed marked changes in EEG

patterns at 7-8 days, 5-6 weeks (reaching adult levels), and 4-5 months (Fox, 1965). According to Charles and Fuller (1956) (in Scott and Fuller: 1965) the alpha rhythm that appears at 21 days signals an activation of the sense of sight. Scott (1958, 1962) (in Scott and Fuller: 1965, and Fox: 1965) speaks of several stages of neurological, reflexive and behavioral development that are particularly *didactic*: neonatal (0-14 days), transitional (14-21 days, starting when the eyes open and ending when the animal starts on hearing a noise), socialization (21-70 days) and juvenile (70 days and older). These periods overlap considerably. Since these stages are still used in the literature, they are worth mentioning. We recommend reading Vastrade (1986), Markwell & Thorne (1987), and Nott (1992) for an overview, or Scott and Fuller (1965) or Fox (1965) for a more in-depth study. In *conclusion*: behavioral patterns develop over successive phases, according to internal and external factors that interact in a complex and continuous manner. As Cyrulnik wrote, "the World of each animal is built around the double constraint of genetics and development".

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## The concept of sensitive periods

Bateson (1981) has described the developing individual as a train with its windows closed - at a certain point (maturing) the windows open and the traveler is encouraged to study the information passing by outside. Depending on the information presented (learning), he/she either continues (motivation) or stops (habituation, impregnation, or self-limitation) looking out the open window. In other cases the windows close when a new point is reached.

This notion of learning in phases has various names: sensitive period, critical moment, optimal period, vulnerable point, crucial stage, susceptible period, and so on.

A *sensitive period* is a point in the maturing process when events are susceptible to leaving long-term effects, or a period when learning is easier and knowledge gained is stored in the long-term memory. *During the sensitive period, a small number of determining experiences have major effects (or damages) on future behavior.* The sensitive period is preceded and followed by periods of lower sensitivity, and the transition is gradual.

The notion of sensitive period is used in the place of critical period because the former extends over a longer period of time. Ducklings become attached to their mother between the 13th and 16th hour of life (Hess 1959, in Cyrulnik 1989), it takes 5 minutes of contact during the first hour after birth for a she-goat to become attached to the odor of her kid (Bateson, 1981), and a ewe needs contact within 4 hours after the birth of her lamb. Without this contact the mother will reject her young in the last two cases (Collias, 1956, in Scott and Fuller, 1965). These very short periods justify the term *critical*. Since puppies do not have such short periods of facilitated learning, we will use the term sensitive period.

I was one of the people who helped spread this concept in French-speaking countries (Dehasse and De Buyser: 1983, 1989, 1991) by emphasizing on several occasions that the sensitive period in the behavioral epigenesis in puppies extended from *3 weeks to 3 months*

of age. The duration of this sensitive period had to be verified by delving into the literature on experiments in this realm and clinical review.

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## The prenatal period

Pregnant rats that have been placed under stress or injected with ACTH or adrenaline give birth to young rats that are emotive and perform less well than a control group. (These young rats are raised by another mother that has not been placed under stress to preclude the possibility of postnatal maternal influence.) (Fox, 1978)

In a similar vein, when a pregnant animal is petted her litter is more docile (Denenberg and Whimbey 1963, in Fox 1978). This effect, called the "gentling", "petting" or "caress" effect, can be prolonged by caresses to the new-born. According to Fox (1975, in Fox 1978) this activates the parasympathetic system, facilitating relaxation, digestion and emotional **attachment**, and thus socialization as well. Experiments by Cyrulnik with cats have shown that attachment depends on the cholinergic system; anti-cholinergics block the attachment process. The object of attachment is a being whose presence soothes and whose absence causes distress, who possess the signs of familiarization; a "reference being" (Eibl-Eibesfeldt 1984). This is probably linked to the social species' innate need for contact.

A dog's tactile capacities develop before birth, and it is possible that it already becomes used to contact in the uterus, when the mother is petted. Puppies manipulated this way show a greater tolerance to touching than dogs born of a mother who was not petted.

In rats, once again, manipulation (contact, exposure to cold, etc.) at a young age or before birth (manipulation of the pregnant mother) gives greater resistance to stress (cold, hunger) and disease (implanted tumors). This phenotypical effect is transmitted non-genetically for several generations (Denenberg and Rosenberg, in Fox 1978).

These experiments enable us to deduce that when a gestating pet is given a friendly and caring human environment (with affectionate physical contact), the domestication and emotional balance of her offspring is facilitated, as compared with an environment where there is no contact and interaction with people.

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## The neonatal period

We will only say a few words about this period, which arbitrarily ranges from birth to the opening of the eyes at approximately 13 days.

Superficial, limited observation of the new-born puppy could lead one to believe it did not even belong to the canine species: awkward, dragging itself around, oriented to contact, the mother's teats and the smell of milk, yapping in distress when isolated, cold, hungry or in pain, and having only a limited capacity to keep itself warm and to learn. The new-born puppy is a

completely dependent being, and apparently hardly influenceable psychologically in classical conditioning tests. As such this phase holds only minor interest in our study.

It is possible, however, that the future holds surprising discoveries about the epigenetic importance of this neonatal period, especially as concerns the "manipulation" effect on neuro-hormonal development.

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## The identification phase

At birth the puppy has not an innate recognition of members of its species; in a way it does not know it is a dog. This must be *learned*!

Through species identification a puppy is able to recognize its parents (**filial imprinting**), and develop preferential intraspecific social relations (**fraternal imprinting**) and the relations (**sexual imprinting**) which mean the survival of the species (filial and sexual imprinting). An animal that is badly imprinted is lost for the species.

Here are a few examples:

Christy, a female puppy, was raised in complete isolation from other dogs by the "colony" of students at the Jackson Laboratory. At 9 weeks she was introduced to other dogs: the adults growled at her but showed no further signs of aggression and the puppies (litter-mates) began to play-fight and she responded. In 4 days time her behavior was indistinguishable from that of the other puppies (Scott and Fuller, 1965).

Note that, unlike goats and sheep, adult dogs show no parental rejection of their young!

A fox terrier puppy (male) raised in complete isolation and introduced to other dogs at 16 weeks displayed inhibited behavior and was attacked by the other puppies that were normally socialized. He was placed with other dogs also raised in isolation; the dogs lived alongside each other, without aggression but also without interaction (Fisher, 1955 in Scott and Fuller, 1965). Dogs raised in isolation and placed in contact with others of their species at 16 weeks are attacked and rejected. When the experimenters mime *play-fights* against these same dogs, they are able to recover a positive dog-dog interaction and complete integration in the same pack within a few days (Fuller, 1961 in Scott and Fuller, 1965).

Male chihuahuas raised by cats until 16 weeks of age demonstrate preference for the presence of cats, and submission - or fear - in the presence of dogs (they also show no reaction to their reflection in a mirror). When they are placed with other dogs at 16 weeks, they recover intraspecies socialization in two weeks; they now prefer dogs to cats and react to images of themselves in a mirror (Fox, 1971, in Pieters 1984).

On the other hand, puppies raised in a family from 4 weeks of age (becoming used to dogs, cats and/or children), without renewed contact with the laboratory dogs, show greater familiarity with people than with dogs. An adult sheltie (who had lived with a cat and two children) showed sexual attraction for the cat and attacked all dogs (male and female alike); a beagle became "attached" to a vacuum cleaner bag; a basenji (who lived with a female dog) became a delinquent stray who attacked other dogs (Scott and Fuller, 1965).

Clinical practice shows that when a puppy is acquired at 6 weeks this is already a handicap in developing its adult social and sexual preferences.

We should also mention that the first signs of humping (pre-imitation of future sexual behavior) appear as early as 3 to 4 weeks (Scott and Fuller, 1965).

This behavior is provoked by pressing on the sternum or the stomach. It is possible that this is a factor in *sexual imprinting*, but it has yet to be proven.

To my knowledge, no statistical studies have been made on dogs raised in isolation, covering a broad range of breeds (for ethical reasons?), which means that crucial experimental data are lacking. Our knowledge is partially extrapolated from ethology studies in birds. Among birds, imprinting lasts throughout parental care and this period is shortened when there is a danger of mixing species. Preference is given to visual and auditory imprinting whose effects last almost a whole lifetime. With mixed imprinting, there is a preference (innate predisposition?) for one's own species over a neighboring species, and for this species over a more distant one (such as humans).

In conclusion, species identification (filial, fraternal and sexual imprinting) is acquired during a sensitive phase of development, and depends on "play-fighting" among puppies (litter-mates). This begins about the third ( $3\pm\frac{1}{2}$ ) week and ends somewhere between 11 and 17 weeks ( $12\pm 5$ ), when the dogs lose their ability to play with unfamiliar dogs and become "serious" in defending their group. In the absence of siblings, a puppy establishes identification through care-giving, care-searching and/or playful interaction with its parents or other dogs. This interaction must last until at least, if not beyond, the 6th week. The presence of other species during this period does not hamper identification with one's own species.

The end of this phase varies depending on factors that are internal (breed, line of descendants, individual) and external (behavior of the mother, other dogs, quality of the surroundings). A stressful environment (feral dog) will close this phase ahead of time (probably around 7 to 9 weeks).

This type of learning presents several *characteristics*:

- it is stable, rigid and persistent (sometimes for life);
- it is easily acquired;
- sexual imprinting occurs on supra-individual and supra-breed characteristics, which permits species generalization;
- filial imprinting (attachment) seems to be more discriminating and is limited to parents;
- fraternal imprinting is the basis of sociability;
- attachment is an interactive process.

#### *Risk factors:*

They are similar to those found among birds.

The *total absence of other dogs* (own species) between 3 and  $12\pm 5$  weeks fosters identification with another species that is closest (in general humans, but occasionally cats, rabbits, etc.) or an appropriate substitute (stuffed animal, vacuum cleaner bag, etc.). This identification is persistent, occasionally for life. In adults this leads to:

Courting behavior and attempts to copulate with the identification species (despite activation by pheromones of one's own species), no behavior of this type or else awkward attempts with a sexual partner of the same species,

Social preference for the identification species,

Rejection (flight or fight) of one's own species (including mirror images).

The *relative absence of other dogs* between 3 and 12±5 weeks leads to relative, total or no handicaps depending on circumstances:

possible recovery of the dog's species identity at 9 weeks when it plays with other puppies, attachment to the identification species and disinterest or aggression towards canines,

despite the (almost) normal capacity to reproduce,

etc.

The imprinting effects of a *mirror* placed in the surroundings of a puppy isolated from other puppies have not been studied (to my knowledge). Since no interaction is possible with a mirror image, this seems to be a poor substitute for suitable "imprinting".

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## The socialization-domestication phase

A puppy is not programmed to interact socially with another species. Twelve thousand years of domestication, however, has shown that this is possible. The dog's particular nature - a puppy has to learn to identify its own species - can serve to foster socialization with other species (called domestication when it involves interaction with humans).

Let's look at a few experimental cases:

Puppies raised in a semi-open environment in (nearly) complete isolation from humans reacted differently towards an active unfamiliar observer depending on their age. Each puppy was taken from the surrounding in which it was raised, placed in contact with humans for one week, and again tested. Fear in the presence of a human that handled him decreased from 3 to 5 weeks, was minimal at 5 weeks, then increased again afterwards. "Recovery"

(improvement or disappearance of fear) after a week of interaction-socialization was more efficient at 3 weeks; it was roughly the same at 5, 7 and 9 weeks (Freedman, King, Elliott, 1961, in Scott and Fuller, 1965).

A puppy - raised in the same type of surroundings - was placed 10 minutes a day with a passive observer, calmly sitting in the room and paying no attention to the dog (Scott and Fuller, 1965):

- at 3 to 5 weeks, the puppy investigated the observer openly;
- at 7 weeks, it took 2 days before it investigated (2 10-minute sessions)
- at 9 weeks, 3 days;
- at 14 weeks it no longer investigated the observer.



At 12 weeks a puppy is easily frightened. Confinement and hand feeding enable it to accept contact with its laboratory handler(s) but not with strangers, and it still prefers the presence of dogs to that of humans (Scott and Fuller, 1965).

This fearful reaction has been found in all breeds tested. When put on the defensive a cocker's bite is "softer" than that of other breeds tested (basenji, terrier, beagle, sheltie). According to Fuller (1961), puppies raised in isolation in a laboratory develop adequate socialization to humans if they receive two 20-minute periods of human contact per week. This short contact, however, is not enough for basenji puppies; this variability is thus truly linked to breed (genetics) (Scott and Fuller, 1965).

**In conclusion, puppies demonstrate an investigation-attraction behavior towards the unfamiliar as soon as they are able to express this attraction (almost adult motor capacity), in other words at 3±½ weeks. This attraction subsides in an almost linear manner after the fifth week until at least 9 weeks. The attraction recedes under the influence of fear of the unknown behavior which grows after 5 weeks; the puppy "recovers" from its initial fearful reaction instantaneously from 3 to 5 weeks (investigation behavior effect), and then it remains wary for longer periods as it grows older. At 12 weeks socialization requires active manipulation (mimicking play-fights), at 14 weeks socialization seems to be impossible.**

In birds fear of the unknown is delayed when they are raised in isolation; this phenomenon thus appears to depend on experience rather than maturing of the nervous system (McFarland, 1981) - one must first be able to refer to something "known" before fearing the unknown.

An arbitrary limit can thus be set for spontaneous socialization to another species, during a *first encounter*, at **12 ± 2 weeks**. *Nothing, however, enables us to affirm or deny that rapid habituation to close stimuli cannot be achieved after 12 weeks.*

Interspecies socialization (attachment) does not have the same *characteristics* as species identification:

It is *easily acquired* but *requires permanent reinforcement* to avoid de-socialization; it is *not generalized* (generalisable) to all individuals of the *species* concerned, but remains relatively limited to the individual's characteristics. It is thus infra-species: it is a "type" socialization (human: man, woman, adolescent, child, baby, black, white, with/without beard, hat, white apron, etc.). The *capacity to generalize* varies from one species to another (dog and wolf, more than coyotes), breed (watchdogs less than other dogs, according to Fox, 1978), the family line and individual (no statistical studies available).

the *threshold of socialization* (number of interactions) is variable and depends on factors that are internal (breed, individual) or external (mother's fearful behavior, quality of the surroundings, etc.).

#### Risk Factors:

Domestication depends on the presence of humans between 3 and 12 ± 2 weeks in the surroundings in which a puppy develops and this socialization must be continued throughout

the animal's life. The lack of human contact between 3 and 12 ± 2 weeks fosters the development of fear/wariness of humans (feral dog).

The relative absence of human contact leads to relative handicaps, such as fear/wariness/phobia towards a type of human (children, men,...).

Advantages:

The interactive presence of different types of humans between 3 and 12 ± 2 weeks facilitates a puppy's generalized socialization to humans.

The interactive presence of other animals leads to *interspecific socialization and attachment, and it counters predatory behavior*.

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Interspecific socialization counters predatory behavior towards the type of attachment individual.

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## The emotional self-regulation (homeostasis) phase

*Homeostasis* is the ability of an organism to maintain an equilibrium in a variable environment. Just as we have thermo-regulation (thermal homeostasis), we can also speak of emotional and relational homeostasis (Vincent, 1986). And we could even stretch the analogy somewhat: the organism has a thermostat for heat regulation, and a 'ponderostat' to maintain an ideal weight (Vincent, 1986). Likewise for emotional and relational homeostasis we could also envisage the existence of a "*sensoriostat*", "*thymostat*" or "*sociostat*" respectively measuring a being's sensorial perception, and emotional and social equilibrium.

Living in a group and adapting to varied environments calls for a certain degree of emotional equilibrium (with minor fluctuations). This adaptation is possible only through habituation (disappearance of reactions) to certain stimuli. That this process is essentially learned, rather than genetically acquired is a sign of the species' ability to conquer - and adapt to - varied and new environments. This ability is an opportunity, but also a cause for risk.

Among animals, *innate fears* do exist, although in dogs they remain to be demonstrated: for example the fear of "beating" or "gunshots" is not innate, despite various writings along these lines. Nonetheless, you can talk about acoustic sensitivity in individuals or breeds. This has been demonstrated in rodents: certain strains of mice (DBJ/2J) have shown an innate hypersensitivity to certain sound frequencies which give them convulsions (Dantzer, 1988).

A large number of fears arise from an individual's development. Is there a sensitive phase during which it would be easier to establish emotional homeostasis, enabling the individual to develop frames of reference (*referential, thymostat*) and long-term habituation? The answer is "yes".

Here are a few examples:

A dog's typical reaction to an unfamiliar situation is fear: starting, fleeing or inhibition. In a semi-open milieu, the dog tends to flee (and is impossible to catch after the age of 4 months) (Scott and Fuller, 1965). When it is raised in isolation in a closed environment (0.2 m<sup>2</sup> cage) the flight reaction does not develop; instead only inhibition or fear-provoked aggression develop (Fisher, 1955; Fuller, Clark, Walker, 1960 in Scott and Fuller, 1965).

If guide dogs for the blind are placed in a foster family at 12 weeks, they generally adapt well, but placement at 14 weeks can prove to hinder performance in later training (Scott and Fuller, 1965).

Fox (1975) experimented with puppies placed in contact with increasingly complex stimuli (*enrichment*) at 5, 8, 12 and 16 weeks: as they grow the puppies tended to seek out complex environments. Puppies raised in surroundings poor in stimuli ("stimulus-poor puppies") and placed for the first time in a highly stimulating environment at 12 or 16 weeks are inhibited (fear) and search less complex environments. *Enriched puppies are systematically dominant in the presence of stimulus-poor dogs.*

Male dogs are raised in normally lightened cages for the 10 first months of their life, but without any contact with the outside world (*restricted sensorial situation*). They are tested at 10 months old. Their activity level is 6 times higher than average dogs raised in normal surroundings (*motor hyperexcitement*). They learn slowly and forget easily (every trial is like a new experience). When they have learned some behavior, they reproduce it even when the rewarding factor has been removed (*lack of the extinction process*). Put in the presence of a bitch in oestrus, they show a state of increased excitement but they direct it towards stereotyped habitual behaviors and not towards the stimuli coming from the bitch. (Caston: 1993). For Caston, sensorial and social deprivation has impeached the maturation of the brain: it can not exert an inhibitory influence on the mesencephalic reticular formation (MRF) anymore; MRF is becoming hyperactive, and produces unfocalised and unadaptive behaviors. This has been verified by EEG recordings (in rabbits). In rhesus monkeys, this *deprivation syndrome* leads to high level of blood cortisol. \*

Stimulus-poor primates show a greater degree of attachment to their mother (pathological hyper-attachment), which led Bobbitt (1968, in Fox 1975) to propose that *detachment from the mother is a continual process linked to a young being's attachment to the environment*. This conclusion can most likely also be applied to dogs.

In clinical practice we have observed dogs acquired at 3 or 4 months that had phobic behavior, whereas their siblings, acquired at 2 months, were emotionally balanced.

I also participated in a study on the effects of a serotonergic psychotropic drug on the behavior of beagles raised in a kennel. The beagles were chosen for their anxious-inhibited (depressive) behavior. In exactly identical conditions, with limited human contact (kennel staff) it was easy to choose 16 dogs of 8 - 13 months in which the following symptomatic behavior towards the presence of humans could be observed:

-*expectancy posture* (Pageat, 1986) (locomotor inhibition, almost crouching, tail between the legs, head extended towards the stimulus presented),

-refusing, or cringing from, hand contact,

-lack of interest or catatonic immobility in the presence of a colored moving object,

-inhibited movements outside the kennel (limited city noise).

In this single-breed kennel (little variation in genotype) in a relatively deprived sensorial environment, there was a high degree of phenotype variation with, nevertheless, a large percentage (more than 50%) of dogs displaying inhibited behavior (more than 75% of the dogs were anxious). An overall inhibition index was established (4 tests each rated from 1 to 6, for a total ranging from 4 to 24 points, with 24 being the value for a normal dog).

-At the start of the experiment, all the dogs tested between 4 to 10 points.

-After 2 months they ranged from 8 to 21.

-As the effects of the psychotropic drug were not significantly demonstrated compared to that of a placebo, the evolution towards 'normal' behavior could be imputed to the effects of the experiment itself, since the dogs were tested every other week (5 minutes maximum per dog) and given medicine twice a day.

In conclusion: "industrial" kennel conditions suffice to cause anxiety and inhibition (undoubtedly favored in this case by the breed and enclosure in a 9m<sup>2</sup> cage). Nevertheless a mere daily contact, and handling every other week were enough to lower the level of inhibition and anxiety in this group of young adult dogs significantly.

Indeed, *the process of organizing stimuli from the outside world*, classifying them as known or unknown, agreeable, disagreeable or indifferent (their "significance", meaning, socialization) is similar to the process of *interspecific socialization*. Eventually, this is merely one element in the acquisition of self-regulation as regards particular stimuli because they are *interactive*.

We thus have a phase of facilitated spontaneous learning that begins with a dog's sensorial opening and investigation of stimuli ( $3 \pm \frac{1}{2}$  weeks) and ends when it develops fear of the unknown ( $12 \pm 2$  weeks).

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The *characteristics* of this learning phase are the same as those of interspecific socialization (facilitated but requiring reinforcement, low level of generalization, etc.).

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The result is *frames of reference* acquired for each isolated or grouped sense (multi-sensorial *referential*, or *tolerance level* (according to Fox, 1975), or even "*thymostat*"), since each referential is probably a "mental object" identified by an activated assembly of neurons, according to Changeux, 1983).

This referential determines the stimulation level at which the individual must begin to adjust by activating the appropriate emotion (fear, wariness, etc.) and adopting the most appropriate adaptive behavior (investigation, avoidance, flight, aggression, inhibition, etc.).

The referentials that come into play are level of noise, visual agitation, intensity of olfactory stimulation, number of vibrations, occupation of three-dimensional space, flexibility or rigidity of movements, etc. Here we can directly see the overall differences between a city and rural environment of development.

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The corollary to the development of a puppy's attachment to its surroundings is its ***detachment*** from its parent(s).

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### Advantages:

A puppy's malleability enables it to rapidly adapt to almost all human environments without undo stress.

### Risk factors:

Differences in the quality and amount of stimuli a puppy receives in its environment of development as compared to its adult surroundings determine the degree of *risk it may not be able to adapt* its sensorial referential (thymostat) and thus achieve emotional homeostasis (this includes development of *phobias* and *anxieties*). Clinical observation has also confirmed that it is easier to transfer from an environment with a high level of stimulation (city) to an environment with a low level (rural) than the contrary. A puppy raised in a deprived environment may be tempted to compensate for this lack of sensorial stimulation by *self-stimulation*: this is how certain stereotyped behavior develops, as well as self-centered behavior (Fox, 1975), such as self-induced dermatoses.

Lastly, stimulus-poor puppies run the risk of developing *hyper-attachments* to their biological or adoptive parents (transposition of hyper-attachment to its new human masters), which is a source of intolerance to isolation, attention-seeking behavior, reutilization of behavior acquired during illnesses, etc.

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## The precocious learning-conditioning phase

This is another variant of the phase sensitive to emotional development that occurs between  $3 \pm \frac{1}{2}$  and  $12 \pm 2$  weeks. Three behavioral situations are of particular interest in precocious learning: *elimination*, *eating*, and *vocalization*.

### Elimination

Elimination is a reflex present at birth (it is provoked when the mother licks the puppy's perineum) and becomes spontaneous around **2-3** weeks. From 3 weeks on, the elimination reflex disappears and the puppy tends to leave its bedding to eliminate. At **8½** weeks it defecates in specific spots, usually at a distance from its eating and sleeping area.

Elimination behavior (1) is preceded by sniffing around, probably in search of typical odors (urine, feces, chlorine, ammonia, etc.) that will spark the elimination reflex, (2) occurs almost every waking hour, (3) is not activated for several hours during sleep.

It is thus the dog breeder who conditions the location and medium favored for elimination. The acquirer (when he receives the 7-9 week old puppy) must then respect these socio-ecological conditions - he must limit the space available when the puppy is not under human control and

provide the adequate elimination medium (why not a large litter box in an apartment?) placed at the right location (at least 2-3 meters from where the puppy eats and sleeps).

#### Risk factors

Clinical observation shows that when some puppies are limited to one spot and medium until the age of 15 weeks (puppies kept in the house and elimination on newspapers, for example) it becomes almost impossible for them to learn to use other media and locations (conditioning) and they retain themselves for hours when walking outside until they can eliminate on their preferred medium and spot.

#### Advantages

This ease of conditioning can be put to an advantage in teaching dogs to eliminate in gutters and other sewer outlets.

## Feeding

Food conditioning studies have been conducted on cats that became vegetarian or imitated their mother who ate bananas. This type of conditioning is also well-known in humans: preferences or aversions for certain odors or tastes are already determined before birth (preference-aversion experiments with a rubber teat dipped in garlic sauce) (Cyrulnik, 1989). We can postulate an *intra-uterine and post-natal food acculturation*. To my knowledge, no experiments have been made to determine the duration of the food imprinting phase. It is possible that this phase is similar to the self-regulation phase, both in its duration and characteristics, since it engenders a food or feeding preference that is persistent but changeable over time.

#### Risk factors:

Feeding a puppy solely on standardized food, invariable in taste and appearance (dry or moist) can lead to long-term preferences and rejection of other types of food (this has been clinically proven in cats). This problem can be avoided by giving the puppy a variety of food.

## Vocalization

Barking from distress when left alone in an unknown place increases from 3 to **6-8** weeks (maximum) then decreases until 12 weeks. The rising curve reflects a *progressive attachment to a familiar place* (attachment location) while the descending curve after 7-8 weeks is a sign of *emotional maturing* (more than habituation) and motivation to explore the unknown.

When a puppy is acquired at 7 weeks and left alone at night it will bark in distress. This barking disappears spontaneously after a few days as it becomes familiar with its new home (with reassuring significance), unless its behavior receives positive reinforcement from its new masters (who come to pet, calm or scold the distressed puppy, or take it into their room, all signs of attention - thus positive reinforcement).

The intensity and frequency of this vocalization normally diminish, to be replaced by intraspecific communication such as postures and rituals. Vocalization is used to ward off strangers ('territorial' defense) from the age of 11-15 weeks (see below). Some breeds have a

greater tendency to bark than others (Hounds, Poodles, Yorkshires, etc.). Barking is easy to condition.

Risk factors:

Interspecific communication with humans, also a vocal and verbal animal, reinforces the vocal element (learning by imitation), which then becomes preponderant, even disruptive.

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## Play-fighting and learning to control biting

Play-fighting, which begins at 3 weeks, can sometimes be painful when a puppy begins cutting teeth, especially when its ears are bitten. A bitten puppy whimpers or squeals. In a one-on-one or one-on-two fight the bitten puppy is able to turn the tide of the 'battle' and bite its adversary(ies). And this is precisely one of the "rules of the game": to change roles, with the biter becoming the bitten and vice versa.

w The puppy learns to make an empathetic link between the opponent's squeal and the pain invoked.

w Reciprocal biting negatively reinforces its intensity.

w *Biting* is thus stopped, *inhibited and controlled*.

These play-fights also lead to a certain hierarchization of relations (less than 25% among litter-mates at 5 weeks of age)

The intensity of the bite is (congenitally) variable depending on the individual, line and breed, and can be modified considerably by training.

From 7 weeks on puppies of a litter occasionally form groups to gang up on a lone puppy. In these cases biting is uncontrolled and the attacked puppy can be wounded (sometimes fatally). This phenomenon is more prominent in certain breeds or lines (Fox terriers, according to Scott and Fuller, 1965; Schnauzers, Huskies, and Malamutes among others, in my experience).

From **11 to 15** weeks play-fighting recedes; it becomes less aggressive and more controlled.

The fights become ritualized, a sign that stable hierarchical relations are being established.

Agonistic co-operation is directed towards outsiders who are investigated and attacked in a manner more "serious" than play-fighting.

Learning to control the intensity of its bite is actually part of a puppy's growing general **control of its movements**, enabling it to adopt postures and facial mimics which become the prevalent form of communication in animals having highly developed brains.

Risk factors:

If the puppy's owners *fail to reproduce play-fighting postures and allow it to bite their hands, arms and legs*, this can lead to:

1- the puppy's hierarchical dominance that can induce relational problems later on (competitive aggressivity, sociopathy).

2- failure to control the intensity of biting and risk of serious (wounding) biting in minor confrontations.

Human skin is more fragile than a dog's. Dogs that are family pets must be given more thorough training in controlling the intensity of their bite.

A dog encouraged to *pull* at objects it holds in its jaws reinforces the biting reaction, which is undesirable in a family pet (although it may be useful for police and guard dogs).

And lastly, failure to develop a dog's general motor control encourages *hyperkinetic* forms of behavior.

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## Weaning-detachment and (food) hierarchization

A mother's care and attachment towards her puppies are strongest during the first 3 weeks of life, and after that progressively recede.

The first phase of weaning begins around  $5 \pm \frac{1}{2}$  weeks; the mother growls and bares her teeth when puppies attempt to nurse (painful when the puppies cut their teeth); the puppy yaps and rolls over on its back and then learns to keep away from its mother's teats (Scott and Fuller, 1965). An aggression-inhibition relationship - a dominant-submissive hierarchization - is then established between the mother and puppy for access to the mother's teats.

This attitude is extended towards other mother-young conflicts and adopted in the presence of other adults, as shown by the following personal observation. In a husky breeding station the presence of the mother beyond the 5th week led to her puppies' spontaneous submission to the adults of the pack. In another station the mother was taken from the breeding kennel when her puppies were 5 weeks old; these puppies were not submissive to adults when they were first placed with the rest of the group at 12 to 16 weeks. They did not use the submissive posture (rolling over); the ritual was not acquired.

*The presence of the mother is thus favorable, even necessary, for the development of appeasement-submission rituals and for the puppy's hierarchization in the adult pack.*

Lactation wanes around 7 to 10 weeks.

From the age of 5 weeks the puppies begin to growl to gain possession of their food. At the mother's arrival the puppies assemble in the attempt to nurse and wait for their mother to regurgitate pre-digested food: they wag their tails, lick and bite at the mother's chops and try to take regurgitated food directly from her mouth.

The mother does not compete with her young (7 weeks of age) and allows them full access to the food (even if it is a bone) (Scott and Fuller, 1965). This free access ends as the puppy becomes autonomous and takes its place in the adult hierarchy (Pageat). At about 16 weeks



the puppies must take their place in line for food, i.e. after the dominant and sub-dominant members, almost last. The puppies share and fight over what is left, and gobble it up rapidly, to the complete indifference of the dominant members who return to other activities. Puppies attempting to snatch food while the dominant members are eating are snapped at, growled at and threatened with being bitten. Some puppies nonetheless manage through appeasement rituals to grab some food and escape with it to a corner. Hierarchization for food privileges thus occurs around 16 weeks.

When a pair of puppies not competing for maternal attention are given a *bone* there is aggressive competition ending with a winner and a loser. The fight is rarely traumatic since adult fighting capacities are as yet undeveloped. *Hierarchization between litter-mates* varies with age and breed (Scott and Fuller, 1965):

- - 25% at 5 weeks,
- - 50% at 11 weeks,
- - 75% at 15 weeks in terriers,
- - 75% at 1 year in basenjis and shelties,
- - 50% maximum in cockers and beagles.

*Food hierarchization* varies by race and age. According to Scott and Fuller (1965), it is predominant in short-haired fox terriers and basenjis (the male dominates the female); and rare in shelties at 11 and even 15 weeks (less than 50% of couples although this figure increases to 75% around 1 year). This breed has been shown to "respect" (accept) the female's priority to food. Food hierarchization is average in cockers and beagles with no predominance of either sex. The sheltie, on the other hand, develops a strong hierarchy in defending the nest (spatial-territorial) and submissive members (females) are pushed inside the nest.

The more "aggressive" the litter (line, breed), the greater the tendency for linear hierarchization.

All puppies that are correctly socialized will "leap" towards humans who enter their area (bed, cage,...). The boldest ones are generally the most dominant; they push back their submissive pack-mates, barring access. Choosing a bold puppy (to avoid adopting a seemingly unsociable one who stays at the back of the cage) may thus mean selecting a dog that will be more aggressive to other dogs.

In conclusion: **this period leads to food hierarchization among litter-mates from 5 to 15 weeks**(occasionally later), **between puppies and adults from 4 ± ½ months, and reutilization of submissive postures** (dorsal-lateral decubitus) **towards adults (from 5 weeks) and appeasement postures** (nibbling the chop and extending the paw) **from 8 weeks.**

*Risk factors:*

There can be several risks involved in acquiring a puppy as a *pet*:

1- The human desire to *give* and receive *attention* is opposed to the normal (agonistic) parental behavior to wean the puppy, detach oneself and encourage autonomy. The result can be attachment, even *hyper-attachment*, later engendering a separation anxiety syndrome.

2- The human tends to fear for the puppy's health and thus pays particular *attention to its appetite*, watching it while it eats, indulging it when it begs, worrying about finicky appetites or loss of appetite, varying food, and hand-feeding, which become invested with the social symbol of dominance.

3- The *anthropomorphic* tendency of a human-dog relationship to develop into that of parent-child, or parent-baby postpones the puppy's training towards adulthood at 5-10 months as well as the order-obedience relationship that is part of hierarchization. This *delay* can foster sociopathy and certainly does not facilitate obedience.

4- Furthermore *the lack of rituals* lead to their *malfunction*, and even changes in their significance: if a dog in a submissive posture is petted (positive reinforcement) it will adopt this posture more often in the search for attention. The master then obeys by petting it. The relationship risks reverting to one with a demanding-dominant dog and a obedient-submissive owner.

5- Dogs have a *cynomorphic* approach to the human-dog relationship, seeing it first as one between puppy-adult dog, then as an interaction between pack-mates (pre-adult-adult). A dog views human behavior through the social lens of its own species and attempts to gain privileges as high as possible on the hierarchical scale.

These risks are avoided when dog owners behave in a way that can be assimilated to the parent-dog relationship. It is clear how the Western world's custom of acquiring pets favors the emergence of hyper-attachment and sociopathies (dog as a toy, an object (a live teddy bear), a substitute for children, a catalyser for social reactions, spoiled dog, etc.).

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## **The cognitive sensitisation-rationalisation phase in pre-puberty**

In clinical practice we have observed cases where phobic behavior (both towards the dog's immediate surroundings and towards humans with which the dog has little contact) and anxiety develop in pre-puberty. This occasionally leads to an anxiety syndrome which I call "anticipated defense behavior" (Dehasse, 1990a). A Bernese sheep-dog (raised in Belgium) developed intermittent anxiety (with pathological anticipations) around the age of 6 months, despite a social and sensorial enrichment between 3 weeks and 4 months. Her sister acquired the same tendency in a completely different environment (Netherlands), as did her brother (in Switzerland). A family of briards (Brie sheep-dogs) displayed the same tendency, despite differences in the surroundings in which they were raised. This enables us to propose

*two hypotheses*: the hypothesis of *inherited temperament* and that of *the phase of pre-puberty sensitization*.

A bibliographic study confirms there is a phylogenetic and/or epigenetic tendency for pre-puberty sensitization. Fox (1978) studied primary and secondary socialization in wild dogs and other canines that were raised in identical environments and had daily contact with the trainer and intermittent contact with unfamiliar humans. The wild canines all remained attached to the trainer, at least until they reached maturity, and then became less tolerant to contact with or proximity to the trainer all the while welcoming him with appeasement postures (whereas in the beginning he was welcomed with active postures: jumping, licking, nudging).

*Wariness of strangers* develops:

w quickly in the solitary species (from 4 months in foxes),

w later in species of average sociability (around 1 year for jackals and coyotes),

w and much later in social species such as wolves (between 6 and 18 months) or dogs (beagle, pointer or Chihuahua - between 1 and 2 years).

There is a correlation in canines between wariness and the arrival of puberty (10 months in the coyote, 2 years in the wolf), except in foxes (wariness largely precedes puberty) and dogs (wariness follows puberty which appears around 6 months). In dogs, precocious neutering can delay or preclude the emergence of wariness towards strangers (Brunner, 1968, in Fox, 1978), which could possibly confirm the tendency's hormonal cause. It is Fox's opinion that domestication led to a dissociation between gonadal maturing (precocity) and maturing of the central nervous system (late).

Figures given for dogs, however, are hardly conclusive. We all know how the age of puberty, temperament, emotivity, sociability etc. can vary among breeds and individuals. It is thus normal to see the appearance of wariness towards strangers (or the unknown) or a loss of certain social experience and sensorial references between 4 months (as in foxes) and 2 years (as in wolves). This can also be compared to the development of so-called *territorial aggressivity*.

Woolpy (1968, in Fox, 1975) accustomed adult wild wolves to contact with humans in 6 months' time; he then isolated them somewhat from humans: in this case they retained their socialization experience. He also accustomed wolf cubs to humans, then isolated them: in this case there was *de-socialization* (instability of precocious socialization). *Young animals need continuous reinforcement*.

The same holds for dogs: when a normally socialized puppy is isolated from humans and placed in a kennel from 3-4 months of age to 6-8 months he becomes fearful in the presence of humans, even the trainer. Woolpy's interpretation (for wolves) is that socialization is limited by fear of the unknown. Although the behavioral signs are precocious, the *subjective element* evolves gradually over a year (at least). Thus before socialization can be acquired, the subjective (cognitive) element of fear must first mature.

In other words, fear of the unknown has both an emotional and behavioral phase (starting around 5 weeks) and a *cognitive phase* (near puberty).

It is my *hypothesis* that an optimal period of attraction-habituation (acquiring sensorial and emotion homeostasic referentials) closes with an emotional and behavioral phase of

aversion-fear of the unknown (5-14 weeks). There follows a *vulnerable period of cognitive sensitization at pre-puberty or puberty* during which minor trauma can occasionally entrench wariness or fear, (ill)adaptations, and cognitive and emotional distortions that are undesirable in a dog living among humans in a city environment.

*Risk factors:*

Sensitization (and the often indissociable generalization) is the process that engenders wariness, fear, phobia and anxiety. The cognitive process it entails leads to a dog's *anticipating* harmful situations that exist only in its mind (in a way, fear of being attacked) and thus behavioral strategies (defense mechanisms: flight, aggression, inhibition).

It is at this sensitive age that dogs often begin group training courses. It is imperative for the training environment to be controlled to ensure the dog does not suffer any psychological trauma. At pre-puberty, however, dogs emit pheromones that activate demonstrations of authority by the group's dominant dogs. It is best to begin group courses around 3 months of age, so that the dogs can become familiar with each other and hierarchies before puberty.

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## Puberty and hierarchization

Dogs are social animals that need company, living in a hierarchical pack (or family-pack). In clinical practice we continually observe cases of conflicts (competitive aggression) at puberty, and later in adulthood. These conflicts revolve around access to the opposite sex (intra- or interspecific), but they can also arise over occupation of certain areas of the group's common space (in the house in cases of conflicts with the dog's owners, and rarely outdoors), in particular feeding and sleeping areas.

Our hypothesis is the following: an optimal period of intraspecific socialization (identification) is followed by several *crucial periods of hierarchization* that occur in successive phases: food, territory, socio-sexual at *puberty* and *maturity*.

Pageat (1984) demonstrated the existence of a triple surge of social aggressivity in dogs (male spaniels):

the first peaks around 4-5 months with the dog returning to normal around 6-6½ months, when it begins obedience lessons (the owners assert their dominance);

the second surge coincides with the production of sexual steroids (±5 months);

the third corresponds to a "second attempt to obtain reproduction rights" and only occurs in dogs who are allowed to live in the house. Pageat explains this as follows: in a dog-pack, adolescent males at puberty are pushed to the fringe of the group (by the alpha male and the other older males). The third aggressivity surge does not appear at this time. This is because in a group, the dominant members react and put the young dog in its place each time it tries to compete aggressively, barring its access (satellisation) to socially invested areas and sexual partners. If the dominant members fail to react, aggressivity is reinforced and the young dog rises in hierarchy.

In Fox's experiment (1975) with various wild and domesticated canines, there was a surge in aggressivity in male jackals and wolves at the onset of puberty which increased until it peaked at 2 years. Aggressivity was directed toward males (canines and humans). Note that canines are perfectly capable of distinguishing the sex of humans, even when they are dressed alike; this is probably through their sense of smell. Fox also pointed out that competitive aggressivity may not appear in wolves (males as well as females) until 4-5 years of age (maturity).

We have seen that hierarchization occurs during a *first "food" phase* between puppies (from 5 weeks and is practically established, depending on the breed, between 3 to 12 months), then between adults and puppies (around  $4 \pm \frac{1}{2}$  months). This phase corresponds to the first surge of social aggressivity identified by Pageat.

The *second phase* of hierarchization, *puberty*, is *sexual, social and zonal-spatial*. The young dog develops an interest for the opposite sex and for areas occupied by the dominant members, who react by pushing the adolescent to the fringe of the group. The process is complex: sexual pheromones are awakened at puberty, activating "desire" (Vincent, 1986), the dog exhibits courting behavior and is rejected outright by the dominant member of the same sex, the only one of the group with the right to exhibit his/her sexuality openly. The adolescent is pushed from areas occupied by the dominant members (high-placed positions, controlling passages, preferential sleeping areas, etc.). It no longer has the right to greetings, licking and other social attentions given by the other dogs. This is why this phase is social, spatial and sexual.

This phase is generally accompanied by territorial defense behavior. In some breeds it occurs earlier, appearing from 2 months. In females, progesterone favors territorial defense behavior, just as it favors whelping and pseudocyesis.

A *third phase of hierarchization* occurs at *maturity* (adulthood), an age that varies in dogs depending on the breed (from 8 months to 3 years). It reproduces the same characteristics as the second phase, only this time with all the weapons, strength and passions of a mature adult.

#### Risk factors:

If adolescent dogs do not undergo hierarchization-satellisation, they gain hierarchy - access to the privileges of the dominant member. The dog's relation with its master thus becomes ambivalent, with *conflicting messages*: demands (dominance) - tolerance (submission). The lack of comprehensible appeasement rituals favors attitudes of competitive aggression (sociopathy) or substituting behavior (sometimes self-directed).

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## Discussion and conclusions

No quantitative studies have been made on intra-breed variability, and inter-breed studies have only concerned a few family lines in selected breeds. It is thus impossible to form

conclusions based on breed in view of the number of dog breeds identified up to now (more than 200).

Furthermore, the studies we have cited have never been conducted on a large number of animals. The results mentioned are thus qualitative and speculative, as are the dates and periods.

Nevertheless, a dog's ethogenesis evolves in (at least) three overlapping phases, each related to a particular system: the *neuro-vegetative* (neuro-glandular) - 1 to 7 weeks, the *emotional* (limbic) system -  $3 \pm \frac{1}{2}$  to  $12 \pm 5$  weeks, and the *cognitive* system (cortex) -  $5 \pm 1$  to  $18 \pm 10$  months).

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## ***The different phases of development***

### **Neuro-vegetative**

from -4 (before birth) to +7 weeks

### **Imprinting-Identification**

from  $3 \pm \frac{1}{2}$  to  $12 \pm 5$  weeks

Filial, fraternal and sexual imprinting

### **Intraspecific sociability**

### **Emotional-Relational**

from  $3 \pm \frac{1}{2}$  to  $12 \pm 2$  weeks

Socialization - Thymostasis - Conditioning, etc.

### **Cognitive**

$5 \pm 1$  to  $18 \pm 10$  months

Hierarchization - Rationalization - Territorialisation

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Each phase presents a series of risks that can undermine the dog-dog and dog-human relationship. A dog's epigenesis engenders multiple temperaments that can be partially foreseen by controlling its environmental stimuli. One factor favorable to emotional and relational well-balance of a dog that must live with humans in a city context is enrichment in the breeding environment.

It is the *breeder's role* is to ensure temperamental selection and to enrich the development environment (under veterinary guidance).

The role of the *veterinarian* is essential because he/she sees the animal from 6 to 16 weeks for its vaccinations. He/she thus theoretically has several occasions to assess the puppies' early emotional and behavioral development and can recommend preventive measures and training techniques.

The *media* can also play a role in educating potential dog owners to adapt their relational needs to the dog's ecological and social reality, rather than their own personal wishes.

The *trainer* must not only inculcate the bases for instrumental learning, he/she must also take advantage of having a group of dogs to continue their socialization and avoid de-socialization, both towards other dogs and towards humans.

*Dog owners* must find adequate counseling to prevent multiple relational (systemic) and behavioral dysfunctions in their dogs. But they must first be aware of the problem and know where to go for advice. It is up to the *veterinarian* to inform them!

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## Key words

Attachment, cognitive, conditioning, detachment, development, domestication, emotion, elimination, epigenesis, ethogenesis, expectancy posture, feeding, hierarchy, homeostasis, identification, imprinting, learning, ontogenesis, play-fighting, sensitive period, socialization, thymostasis, vocalization.

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©Dr Joël Dehasse  
Behaviorist veterinarian

2004-01-19