The border between species with and without feelings

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Abstract. Animal protection makes only sense when animal suffering and welfare exist. Suffering and welfare require the existence of feelings in a species. The question “Which species possess feelings?” is, therefore, important. Scientists draw the line between species with and without feelings at different places in the animal kingdom. Reasons for laymen to assume or discard the existence of feelings in different species are considered. It is mentioned that science is fundamentally unable to draw this line. (A view often attacked under the influence of psychology that belongs to the humanities). It is also mentioned that science is able to make the presence of feelings in an animal species more, or less, convincing. The views of the different scientists are discussed. It is argued why, in my opinion, all animal species possess feelings. Although not all scientists share this view, many scientists are of opinion that at least farm animals possess feelings. Laypeople who are not influenced by economic or other interests mostly do not question this opinion. The protection of farm animals is justified to avoid suffering in case these farm animals possess feelings.

1. Introduction
Animal protection is based on the presence of animal suffering and welfare. “Animal welfare research includes the existence of feelings. Otherwise it would be comparable with: ‘How to handle a machine in order to make it neatly running’ or ‘What is wrong with a machine behaving in this way’ [1]. A definition of “feelings” is not necessary. Everybody knows by introspection what a feeling is. I believe that the distinction between affective and non-affective feelings is artificial. The presence of all feelings indicates the presence of a mind. The capability to feel a neutral touch implies, in my opinion, also the capability to feel a negatively experienced touch (“pain”). Also, a bacteria swims away of a puncture needle. An important question in relation with animal welfare is “Which species have feelings?” In other words: where do we draw the line between animal species which do have and species which do not have feelings? This seems at first sight a matter of personal taste.

2. Where do different scientists draw the line?
Different scientists draw the line between species with and without feelings on different places. I give some examples:

In 1992, Kennedy drew this line between man and all other animal species [2]. This author took an “uncompromisingly negative view of animal consciousness.” (p.32). Under the heading “Uniqueness of Homo sapiens sapiens” he attacked the most widely held view that there must be some consciousness in animals because of the Darwinian principle that evolution has been a continuous process (p.15). In his opinion are quantitative differences with the emergence of Homo sapiens sapiens “translated” into...
a qualitative effect. A phenomenon described by Geertz [3] (cited Kennedy 1992 [2]) “as when water reduced degree by degree without any loss of fluidity suddenly freezes at 0°C.”

Bermond drew the line between human beings, anthropoid apes and all other animal species, possibly with an exception for dolphins (Delphinidae sp.) etc [4]. He was of the opinion that the presence of a well-developed prefrontal cortex and a right neocortical hemisphere is necessary for a species to be able to experience suffering.

Wiepkema (1997), and others, drew the line between vertebrates and invertebrates, sometimes an exception was made for the octopus (e.g. Mather 1991) [5]. Wiepkema claimed that “apart from performing species-specific goal directed behaviour vertebrates show so-called emotional behaviours or expressions” [6]. In Wiepke’s opinion, vertebrates have emotions derived from the difference between what is and what should be and emotions corresponding to how well an organism trusts its means to restore or maintain its homeostasis [5].

Griffin (1976) seemed apt to draw the line lower than the insects [7]. In his chapter “The versatility of animal communication” he described the bee dances and the communication between fireflies and between spiders, suggesting that insects and spiders could have awareness.

Van Rooijen (2001) draws the line lower than the insects [8].

3. Reasons for people to assume or discard the existence of feelings in different species

Scientists are human beings. Normal human feelings will influence their judgement. Therefore, I will first discuss some reasons why human beings in general deny or accept the presence of feelings in different animal species.

3.1. Reasons to assume that a particular species has feelings

3.1.1. Simulation. We may imagine ourselves in the position of another organism and register the feelings that we should have. For instance, “I would feel cold when I, like that animal, was outside in the winter.” Or “I should miss my freedom when I was in a cage as that animal.” This method seems to tell us more about human beings than about animals. It may be misleading because of all the differences in sense organs and nervous system between us and the other organisms [9]. For instance, Icelandic ponies (Equus caballus) are adapted to a cold climate. They often prefer to stay outside in the winter.

3.1.2. Empathy. Other individuals may induce particular feelings in us

We may spontaneously get the feeling that we understand what goes on in the mind of another human being or animal. Certain brain regions are not only active when a person experiences a feeling (disgust, happiness, pain, etc.) but also when he sees another person (or animal) showing signs that seem to indicate similar feelings (e.g. [10]).

This spontaneous feeling may be less reliable, especially towards individuals of other species. For instance, Heinroth described a fight between a peacock (Pavo cristatus) and a turkey (Meleagris gallopavo) [11]. He also described the misunderstanding between both species during this fight. For us fish stimuli may be misleading because fish do not possess facial expressions for pain.

A special form of empathy is the empathy we feel for children. Stimuli that resemble the child stimuli of our own species are especially effective in our species to elicit a tendency to protect and take care [12]. This phenomenon is important in relation with our wish to protect animals. Many young animals of other species are able to elicit such feelings in individuals of our species. Even young scorpions (Scorpio sp.) are, in some degree, able to do so. Of course, not all species are equally effective in this respect. Piglets (Sus scrofa) resemble human babies in such a way that in some culture’s piglets are mouth to mouth fed as is done with the own babies [13]. Also, adult individuals of particular species may be attractive to us because they resemble human babies, for instance the round forms and relatively large head of brown bears (Ursus arctos) are very effective to make us want to pamper them. Not
surprisingly, Teddy bears are able to elicit parental care even in very young children. A round head silhouette, as in short-nosed dogs (Canis familiaris), is attractive to many of us; even in birds as parrots (Psittacus sp.), budgerigars (Melopsittacus undulatus), love birds (Agapornis sp.) and puffins (Fratercula sp.). Even the round form of turtles (Testudines sp.) and ladybirds (Coccinellidae sp.) induces positive feelings in many human beings.

Babies have relatively large eyes. Because of the black surrounding of the eyes of panda bears they seem even more baby-like than other bears. Most species have eyes at both sides of the head. Species with eyes in the front side have a “face”, as in owls (Strigidae sp.). Such animals are more human-like, and, therefore, more appealing to us.

We are fond of smiling babies. Therefore, we like the smiling face of the dolphin (Delphinidae sp.). We get enthusiastic when our babies develop hair on the top of their head. This explains the attractiveness of longer hair on the mammalian head, as in horses (Equus caballus) and male African lions (Panthera leo), or longer feathers on the head of birds, as in cacatoos (Cacatua sp.), Nicobar pigeons (Caloenas nicobarica), grey crowned cranes (Balearica regulorum), plumed guineafowl (Guttera plumifera), emperor penguins (Aptenodytes forsteri) and some breeds of domestic poultry (Gallus gallus). Also hanging ears in domestic goats (Capra aegagrus hircus), domestic rabbits (Oryctolagus cuniculus) and dogs (Canis familiaris) may give us the appearance of hanging hair.

Before babies start to crawl, they have a stage in which they lay on their belly with their head up. The normal posture of seals (Phoca vitulina), California sea lions (Zalophus californianus), etc. is very similar to this baby posture. This makes seals attractive for us, especially young seals. Young seals combine this attractive posture with large eyes and a crying that resembles the crying of a human baby. Many species with four legs move in a way that resembles the crawling of a young human infant. We are enthusiastic when a child starts to walk upright. This explains our enthusiastic reaction on species that adopt an upright posture like squirrels (Sciurus vulgaris), prairie dogs (Cynomys ludovicianus), meerkats (Suricata suricatta), kangaroos (Macropodidae sp.) and even seahorses (Hippocampus brevirostris). Especially the clumsy walking movements of penguins (Spheniscidae sp.) are very attractive to us.

We are also enthusiastic when a child starts to talk. Talking birds like parrots (Psittaciformes sp.) and Myna Birds (Gracula religiosa) charm us.

3.1.3. Familiarity. Personal experience with a species provides thorough knowledge of this species. Familiarity with individuals makes it easier for us to understand the needs and the behavioural and morphological stimuli of a species. When individuals of different species live close together they have a tendency for mutual adaptation. For example, domestic house cats (Felis catus) frequently make sounds that resemble sounds made by a human baby. The high frequency of these baby-like sounds is an adaptation to man. Among each other cats make these sounds much less frequently. Not surprisingly the frequency of these sounds lowers in cats that become feral. Wild cats hardly ever make such sounds [14]. Students considered the sounds of house cats as more friendly than the sounds of wild cats, suggesting an adaptation by house cats to human wishes [15]. Also dogs probably have developed barking as an adaptation to human talking. The wolf and wild dogs species bark much less than domestic dogs. Human beings, even people that did not live with a dog understood the meaning of different types of barking [16]. Industrial poultry keepers are less familiar with individual hens than fancy fowl keepers. Fancy fowl keepers generally understand hens (Gallus gallus) better than industrial farmers. This holds also for dog keepers in comparison to scientists: in general dog owners understand dogs (Canis vulgaris) better than behaviour scientists do [17]. Only recently the amazing learning abilities of dogs, already known for a long time among dog keepers, are recognised by science, see, for instance, [18]. Another example is the remarkable ability of dogs to react to human pointing [19]. These authors interpreted this finding by the assumption that dogs possess a ‘theory of mind’ This last assumption is questioned by [20].

Still another example is an experiment in which a dog was trained to lower a hanging stick with its paw in order to obtain a reward. Eighty-three percent of the dogs that, after observing this act, were
placed in the same situation, also used their paw to obtain the reward, and not the easier technique of
grabbing the stick with its mouth. Another group of dogs watched the same act. But now the
demonstrator dog had a ball in his mouth. In this case only 21 % of the dogs used their paws. In a control
group, that did not observe any act, 15 % used their paws. This showed that most dogs of the second
group had not learned the behavioural response but that they “understood” why the demonstrator dog
used his paw and not his mouth [21].

In zoos we may become familiar with more exotic species. A male chimpanzee always threw stones
to the public during his dominance display. During this display he was too aroused to collect stones. It
turned out that he started his day with the stone caching and the manufacture of discs from concrete. He
used these objects for his display, a few hours later. He kept his stone collection always at the visitor’s
side. He did not collect stones outside the visitor’s season [22]. This behaviour showed that this
chimpanzee found a, probably, individual solution to anticipate on his own future needs.

An increasing body of refined experiments reveals that animals are less different from human beings
then until recently assumed in science. For instance, New Caledonian crows (Corvus moneduloides) use
tools and are also able to manufacture them and show even an understanding of how tools can be
combined to reach a goal [23]. Also, the Kea (Nestor notabilis) turned out to be able to solve a problem
step by step with the help of tools [24].

Most people are most familiar with vertebrates. This is one of the reasons why most people take
the presence of feelings in vertebrates for granted (however, see III.2.1 and IV). It must also be stressed that
the presence of cognition is not a prerequisite for the presence of feelings. However, the presence of
cognition makes it easier for us to assume that also feelings are present. But then we use the degree of
similarity.

3.1.4. The degree of similarity. Similarity is important because stimuli may be misleading. Examples
are already mentioned under II.3.1. Another example that shows the unreliability of stimuli is an
experiment done by Krach (Aachen University) and Hegel [25]. These researchers made experimental
persons play a prisoner’s dilemma game against a computer, a machinelike robot, a human like robot
and a human. In all plays the answers were already determined on forehead.

The researchers established in a fMRI-scanner the activity of particular brain areas associated with
a “theory of mind.” They found that these areas were least active in humans while playing a prisoner’s
dilemma game against a computer. They became more active while playing against a machinelike robot
and even more active while playing against a human like robot. However, they were most active while
playing against a human being. Most fun was experienced in the play against the human being. The
human’s play was considered to be most intelligent. Although this play, as in the other ones, the answers
were already determined on forehead.

This experiment shows the importance of stimuli in our experience of the presence of a mind in our
opponent.

They also show how misleading stimuli may be. Only in the case of the human player a genuine
similarity with the experimental person was present. In all three other opponents (computer, machinelike
robot, human like robot) no genuine similarity with us was present.

The more similar a species is in relevant respects with our own species the more reason we have to
assume a similarity in feelings.

3.1.5. Evolutionary biology. Sometimes it is suggested that feelings are emerged during the evolution
because they have a function [26]. However not everything that emerged during the evolution has a
function [27].

3.2. Reasons to deny that a particular species has feelings

3.2.1. Unfamiliarity. A reason to deny that a particular species has feelings may be the unfamiliarity
with a species. For instance, many people are unfamiliar with the fact that ear wigs (Dermaptera sp.)
are caring mothers or that some species of cockroaches (Cryptocercus sp.) may stay together as a family for three years [28]. Also, behaviour biologists of the hunters’ type are unfamiliar with individual animals. Therefore, they are no animal protectionists but species protectionists. Further, they are accustomed to the cruelty frequently found in nature [29].

3.2.2. The absence of appealing stimuli. A reason to deny the existence of feelings may be that a species hardly has sign stimuli that resemble our own. Hobby fishermen often deny the presence of feelings in fish. Apart from their own interest in this denial it may play a role that fish have hardly sign stimuli that resemble the stimuli of our species: they have no legs, facial expression or gestures like our own. An exception is the seahorse (Hippocampus brevirostris) because of its upright position and parental care. Invertebrates hardly possess sign stimuli that resemble the stimuli of our own species. This absence of stimuli that resemble the stimuli of our species in invertebrates is an important reason for the denial of the existence of feelings in invertebrates.

3.2.3. The absence of stimuli that stimulate help. Some species have developed the capacity to help each other. They have also developed stimuli that may elicit the tendency to protect and take care in other individuals. Such species mostly more easily elicit such feelings in our own species. In many social species, however, it increases the fitness of an individual when it does not ask for help but is able to mask its bad condition as long as possible to prevent expulsion of the group, or worse. In hens a bad condition may result in cannibalism by flock mates.

3.2.4. Aversive stimuli. Great apes (Pongidae sp.) have much in common with us. Nevertheless, they often appear to be “ugly” to us. Their unattractiveness is perhaps the result of an inhibition by morphological and behavioural traits developed to prevent sexual contact. Ten million years ago the ancestors of man and chimpanzee (Pan troglodytes) belonged to the same species [30]. When two species adapt further to each own niche individuals resulting from crosses between two species in almost all cases get an increasingly lower fitness to the parental niches than the individuals of each original species in their own niche. Therefore, signals develop in such situations to prevent further gene exchange. Probably such signals have developed between Homo sapiens and great apes.

Other species possess incidentally stimuli that resemble stimuli that signal disease in our own species, e.g. toad (Bufonidae sp.) skin, bat (Chiroptera sp.) wing bones and skin. Still other species may pose a threat to our health. For instance, snakes, spiders, and insects. As adaptation to these threats the stimuli of such species have become aversive, even when these stimuli are present in a completely harmless species. During our evolution also darkness has been an indication of danger. Therefore, we have a tendency to consider nocturnal species, like bats and rats, as aversive.

Aversive stimuli make a species fit into an enemy image. We are apt to deny the existence of feelings in our enemies.

3.2.5. Economic advantage. The main reason for the denial of feelings in another species seems to be that it silences our conscience. Economic advantage seems a strong drive in this respect. It may be found among hunters, fishermen, industrial farmers and animal experimenters. However, this attitude seems largely absent among traditional hunters and farmers.

3.2.6. Lack of similarity. Another reason to deny the existence of feelings in a particular species may be that we are of opinion that the similarity with our own species is too limited. However, this may be a rationalization of an opinion based on emotional arguments.

Science may help us to establish the exact degree of similarity in morphology and behaviour. We may consider behaviour as a “part” of the body. Further I will sometimes refer to this combination as [body and behaviour]. Is science also able to establish the similarity in feelings between different species?

4. Is science able to help us to draw the line?
Van Rooijen pointed out that from epistemology we know that it is impossible to prove that a species has feelings and, thus, to prove that a species is capable of having feelings [27, 31]. Within science only models are acceptable as explanations for behaviour [32]. Opposition against this insight is mostly the result of the psychological influences on applied behaviour science [17]. However, this insight is strongly supported by the fact that until now nobody ever successfully performed an experiment that proved that a particular species has feelings. Otherwise, the majority of the scientific community would already agree on the presence of feelings in the investigated species.

However, scientific research is able to establish the relation between the feelings and bodily structures and/or behaviour in our own species (feelings/body and feelings/behaviour relation). Scientific research is also able to study the bodily structures and behaviour in other species. Van Rooijen suggested that the combination of both studies made [body and/or behaviour]/feelings speculations possible [33]. Similarities in relevant aspects could make the assumption that a particular species has feelings more convincing. Differences in relevant aspects could make the assumption that a particular species has feelings less convincing. This approach stimulates research.

For instance, in humans a bleeding wound is mostly connected with pain, a red painted spot mostly not (feelings/body relation). With the scientific method we are able to establish whether the red spot on the throat of a bleeding-heart pigeon (Gallicolumba luzonica) is caused by blood out of a wound or by red feathers. When a wound is present the presence of pain is likely, when no wound is present pain is unlikely (body/feelings speculation). The same holds for the throat of the cut throat finch (Amadina fasciata). It was a long time believed that the Dalmatian pelican (Pelecanus crispus) wounded itself to feed the young with its own blood. Scientific research has shown that these pelicans do not possess a wound but red breast feather and a red coloured bill tip. Therefore, it is assumed that they are not in pain (body/feelings speculation).

In humans a broken arm is mostly connected with pain (feelings/body relation). The ringed plover (Charadrius maticula) sometimes behaves as having a broken wing. This species sometimes performs a “broken wing display” to lure predators away from the eggs or chicks. By using the scientific method, we are also able to establish whether a bird really has a broken wing or is acting a broken wing display. Only when the bird really has a broken wing it seems reasonable to assume that these birds indeed experience a feeling of pain (body/feelings speculation).

Another example of such research is the application of choice and preference tests [34]. We make a choice for the alternative that seems the more rewarding or the less punishing to us (feelings/behaviour relation). Scientific research has indicated that pigs are able to make similar choices. The finding that pigs are able to make such choices makes the assumption that they possess feelings more convincing (behaviour/feelings speculation).

Humans are prepared to work to obtain a rewarding or to avoid a punishing factor, and to work more to obtain a more rewarding or to avoid a more punishing factor (feelings/behaviour relation). Also, pigs are prepared to work and to work harder for some items than for other [34]. This seems connected with the reward or punishment they expect to receive from this particular factor (behaviour/feelings speculation). This finding that pigs are able to show preferences also makes the assumption that pigs possess feelings more convincing.

Still another example of such research is described by Bateson [35]. From human psychology and psychiatry, it is known that a depressed person will classify a glass as half empty, whereas a happy person will classify the same glass as half full (feelings/behaviour relation).

It was shown that starlings (Sturnus vulgaris) that were recently moved from enriched cages to standard cages were more apt to interpret an ambiguous stimulus as non-rewarding, while starlings that remained housed in enriched cages were more apt to interpret these same ambiguous stimuli as rewarding.

The similarity between the behaviour of depressed people and the behaviour of the birds that recently experienced a decline in the quality of their housing conditions suggests that these birds also were depressed (behaviour/feelings speculation). The results of these scientific experiments also makes the assumption that starlings possess feelings more convincing.
Mendl performed similar comparisons between human feelings/behaviour relations and rat (Rattus norvegicus) behavior [36]. The resulting behaviour/feelings speculations made the assumption that rats possess feelings more convincingly.

Braithwaite described examples of research on the feelings-body relation in humans and the body-feelings relation in fish [37]. In the human brain the amygdala is a structure which processes emotional information. A similar structure is found in the fish brain. Lesions in this last structure impair escape- and avoidance learning in fish. We may assume that these lesions influence feelings in fish too ([body and behaviour]/feelings speculation).

In the human brain the hippocampus is a structure associated with learning and memory (feelings/[body and behaviour] relation). A structure comparable to this hippocampus is also found in the fish brain. Lesions in this last structure impair also in the fish spatial and temporal learning and memory tasks ([body and behaviour]/feelings speculation).

In human beings specialised receptors registrate pain (feelings/body relation). Similar receptors are found in the rainbow trout (Oncorynchus mykiss) [38]. These scientific findings suggest that at least particular fish species know pain (body/feelings speculation). This makes the presence of feelings more convincing.

In humans beings a local anaesthetic suppresses the pain (feelings/body relation). Elwood treated one antenna of glass prawns (Dendrobranchiata sp.) with a local anaesthetic, in the control prawns one antenna was treated with water [39]. The same antenna was then treated with a chemical abuse or water. Those receiving chemical abuse groomed the treated antenna more and rubbed it on the side of the tank. However, this response was reduced in the antenna that were pre-treated with a local anaesthetic instead of water. These results make the presence of pain perception in glass prawns more convincing (behaviour/feelings speculation).

These examples show that science is able to help us to draw the line. However, the title of Elwood’s contribution was “Pain and stress in crustaceans?” (Braithwaite’s contribution was called “Do fish feel pain?”) This implied that the question marks indeed remained. The decision whether a species has feelings or not remains in the end a matter of personal taste.

Although it is, within science, only possible to approach the proof that particular animal species have feelings (and other species not) we have to talk about feelings of farm animals for ethical reasons [9]. The protection of farm animals is justified to avoid suffering in case these farm animals possess feelings. I have to mention that this view is able to convince scientists that believe that no other animal species than man possesses feelings. Kennedy takes, according to himself, an “uncompromisingly negative view of animal consciousness.” [2]. Nevertheless, he described my opinion that it is impossible to prove that species possess feelings but that it nevertheless is possible to perform welfare research as “This would seem to be a realistic position to adopt” (p.115).

5. A short discussion of the views of different scientists

Kennedy is of opinion that man is a unique species [2]. Evidence for the assumption of the existence of feelings in other species is already elaborately mentioned in this article. Kennedy is probably right that Homo sapiens sapiens is “unique” because of its variety of rich cultures [2]. However, even culture did not emerge out of the blue. Bonner defined culture as the transfer of information by behavioural means [40]. Following this definition culture is common throughout the animal kingdom. Different groups of killer whales (Orca orca) developed different vocal and behavioural cultures of a high complexity [41]. Field studies have shown that also groups of wild chimpanzees (pan troglodytes) spontaneously developed locally different cultures of a high complexity [42]. Lycett et al. made a phylogenetic tree of chimpanzee cultures [43]. This tree did not coincide with the genetic relation between the different groups of chimpanzees. The reason for this distinction is that young adult females that migrate from one group to an adjacent group transfer their genes to this new group but not their culture: They conform themselves to the habits and traditions of their new social environment.

Whiten et al. were able to create experimentally two different traditions in two different groups of laboratory chimpanzees (pan troglodytes) [44]. In each of two groups of chimpanzees only the dominant
animal was trained to obtain food. Both dominant animals were trained to use another method to obtain the food. The other members of each group copied these strategies. After two months both groups still used only its own solution. In a third, control, group, without any trained animal, nobody found any solution.

Wild chimpanzees use sticks to “fish” termites out of their holes. Only wild chimpanzees in the Goualougo Triangle, Republic of Congo, applied, prior to fishing, a set of deliberately, distinguishable actions to modify herb stems into a brush-tipped probe. Experiments showed that such brush-tipped probes collect more insects [45].

Fiorito and Scotto presented two identical balls, but differing in colour, to octopuses (Octopus vulgaris) [46]. The octopuses were trained to attack only the ball with a particular colour. After training such attacks were observed by naïve octopuses. After isolation these observer octopuses attacked the same coloured ball. The result of this experiment was independent of the used colour. This could be called culture (in the sense of transfer of information by behavioural means).

Another example of culture is honey bees (Apis mellifera) scouts that with the “waggle dance” provide information about the location of potential nest sites. After some time, some dancers give up their own dance and join the dance of another dancer (they become “convinced” by this other dancer that she dances toward a better site). Within one-hour unanimity is reached and the group heads for the “democratically” chosen site [47].

However, the most important question, in this context, is not whether species possess culture but whether or not man is unique in the sense that man is the only species with feelings as suffering and pain. I do not belief that this is the case.

I disagree also with Bermond [4] that complex bodily structures as prefrontal cortex and a right neocortical hemisphere are necessary to be able to experience feelings as suffering or pain. Damasio (2010) mentioned that in humans sometimes children are born without a cerebral cortex, they only have a brain stem. Nevertheless, these children react with joy when they are tickled and they clearly prefer one piece of music over another one. According to Damasio [48] poses such children a “self”.

Tomer et al. already found a precursor of the cerebral cortex in bristle worms (Platynereis dumerilii) [49]. These worms possess mushroom-like brain structures, the corpora pedunculata, that process sensory information. These structures are probably developed to find food with help of smell. They are supposed to exist for about 600,000,000 years. Tomer et al. used “cellular profiling by image registration” to establish genexpression [49]. The expression of essential genes in corpora pedunculata resembles very much the expression in the pallium (the embryonic precursor of the cerebral cortex in vertebrates).

I consider suffering and pain as such basic feelings that complex bodily structures are not necessary. Locomotion in lower animals is also connected with other body structures than locomotion in man [50]. Although snails have no structures comparable with our legs, they are still able to move autonomously.

In humans’ feelings are processed in the limbic system. In a part of this limbic system, the amygdala, incoming information elicits especially negative feelings. This amygdala system is evolutionary much older than the prefrontal cortex. A precursor of this structure, as already mentioned above, is even present in fish. The prefrontal cortex has an inhibitory top-down control of amygdala function, resulting in, for humans, contextually appropriate “emotional” behaviour.

Subhuman animals perform predominantly behaviour that in humans is linked with feelings (emotions). For instance, parental, aggressive, flight and sexual behaviour. Behaviour that is linked with thinking (ratio) is rarer in subhuman animals, but not absent. For instance, Yerkes and Coburn stated that domestic pigs had “an approach to free ideas” that these researchers had not in any way expected [50]. Hunters ascribe to wild swine an “almost humanlike logical ability” [51]. Above is mentioned that naïve dogs that had observed a dog obtaining a reward by lowering a stick with its paw imitated this behaviour. However, when the demonstrator dog lowering the stick with his paw had a ball in its mouth the naïve dogs used their mouth. Then the naïve observer dogs apparently “understood” why the demonstrator dog used his paw [21]. This is an example of thinking.

Kaminski et al. described a case of reasoning by exclusion [18]. When a particular owner asked his border collie collect to an object while using a novel word the dog collected the novel toy, instead of
one of the familiar ones. Lorenz described animals, in terms derived from daily life, as “emotional people with little cognitive abilities” [52].

After 35 hours of sleep deprivation the prefrontal cortex does no longer function properly in experimental persons. Such people react more “emotional”: that means stimuli elicit more easily crying or attack behaviour [53]. Their behaviour has become more animal-like. This implies that the prefrontal cortex is less important for subhuman animals, especially not as substrate for feelings.

Morphological structures connected with the experience of feelings seem already present in species lower on the evolutionary scale than fish. In humans sexual behaviour is connected with a pleasant feeling (feelings/body relation). Snails (Helix sp.) learned to touch a rod in order to electrically stimulate an area in their own brain. This area is normally active during their sexual behaviour, and probably gives a pleasant feeling ([body and behaviour]/feelings speculation) [54].

In Wiepkema’s opinion, vertebrates have emotions derived from the difference between what is and what should be and emotions corresponding to how well an organism trusts its means to restore or maintain its homeostasis [5].

For a critique on Wiepkema’s ideas [5] about the relation between homeostasis mechanisms and feelings see Van Rooijen [55]. More important, within this context, is that also invertebrates possess homeostasis mechanisms.

Wiepkema claimed that vertebrates have emotions because they show so-called emotional behaviours or expressions [5]. This is an example of circular reasoning. When behaviours (expressions are also behaviours) in animals are labelled as “emotional” this does not prove the existence of animal emotions. However, one could argue that in humans particular behaviours are connected with emotions (feelings/behaviour relation). Therefore, one could speculate that similar behaviours in animals are also connected with emotions (behaviour/feelings speculation).

Further Wiepkema claimed that vertebrates perform species-specific goal directed behavior [5]. However, invertebrates also perform goal-directed behaviours. A well-known example of unicellular organisms that direct themselves towards a goal are sperm cells: they direct themselves toward egg cells. This implies that the presence of such goal-directed behaviours in vertebrates are no reason to restrict the presence of feelings to vertebrates only.

The decision whether a species has a feeling or not remains in the end a matter of personal taste. Because of my research with crab spiders and with fruit flies I have some familiarity with spiders and insects. Above (III.1.3) I have mentioned the importance of familiarity for our tendency to accept the presence of feelings in a particular species. My familiarity is one of the reasons why I have the conviction that spiders and insects have feelings. I have defended this conviction at a workshop at the International Ethological Conference in 1999 in Bangalore, India. Probably to test this view Sherwin performed an elaborate study of publications on invertebrates as cockroaches, flies and slugs [56]. These species turned out to have short- and long-term memory, age effects on memory, complex spatial, associative and social learning and were able to perform appropriately in preference tests and demand studies, and to exhibit behavioural and physiological responses indicative of pain, and to experience learned helplessness. This author concluded: “This indicates that we should either be more cautious when using argument-by-analogy, or remain open-minded in the possibility that invertebrates are capable of suffering in a similar way as vertebrates.”

Even Lady Slippers (paramecium caudatum) are able, by using a voltage as a reinforcement, to learn to discriminate between different brightness levels [57]. This means that scientific results strengthened my conviction that all animal species possess feelings. One has to realize that even in the case of primates the assumption that they possess feelings is in the end a matter of personal taste.

6. Conclusion.

Scientists vary in their opinion about the border between species with and without feelings. In my opinion it is reasonable to assume that all animal species possess feelings. Further research is not able to prove this opinion. It is only able to approach, or leave, this proof by making this opinion more, or less, convincing. Although not all scientists share the view that all animal species possess feelings, many
scientists are of the opinion that at least farm animals possess feelings. Laypeople that are not influenced by economic or other interests mostly do not question this opinion. The protection of farm animals is justified to avoid suffering because the possibility exist that these animals possess feelings.

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