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Development of the Concepts of Living and Animal in the Child

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From Piaget's research down to the most recent work of Carey and Wellman, it has been attempted to describe the development of basic concepts such as living and animal in the child. There have been less frequent attempts to draw from the results of these investigations suitable teachings for correct scientific education at school. The educational system continues to make proposals which clash clearly with the indications of research.

The aim of our research is to bridge the gap between these two needs, as well as to study the development of the concept of living and animal in seven to twelve-year-olds and to draw the necessary educational conclusions. In particular, we have investigated how these concepts are modified at the various ages, between boys and girls and between country dwellers, who have a direct experience of animals, and town dwellers, who do not. The results are on the one hand in agreement with those of international research, adding information concerning the variables sex and direct experience, hitherto relatively uninvestigated; on the other, they provide definite indications as to the succession of contents to offer in a science syllabus, to the advisability of taking into account the considerable difference between boys and girls, and to the need to enhance the role of practical experience of exploring and laboratory work in studying natural science.

Introduction

Piaget (1929), and Laurendau and Pinard (1962) have asserted the existence of an animistic tendency in younger children, which is linked to the fact that young children cannot yet discern between animate and inanimate objects. According to Piaget the formation of the concept of life — living goes through four stages characterized by being dominated by different aspects of the concept:

1. activity;
2. movement;
3. spontaneous movement;
4. limitation of life to plants and animals — adult concept.

The latter coincides with the attainment of concrete operative thought.

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The distinction between living and non-living, between animals and plants, between natural objects and artefacts is instead, according to Keil (1979, 1990), an ontological category, i.e. a fundamental category of thought which represents a primary division of reality performed in early childhood. Also Gelman, Spelke and Meck (1983) claim that even small children are capable of distinguishing between inanimate and animate objects. According to Carey (1985) our understanding of the concept of life is linked both to semantic development and to the growth of biological knowledge. More in general Carey (1985), together with the MIT school (Wellman, 1990), claim that children, like adults, have systematic theories (although, in the case of children, these are known as «intuitive theories») on which the understanding and the time evolution of the individual concepts depends. Every change in theory brings with it a conceptual change (Wellman, 1990).

Carey in particular declared that the child's concept of animal goes from being framed in a theoretical system based on behavioural principles to a theoretical system based on biological principles:

> «*Five-year olds think that membership of a category is determined by appearance and behaviour; for nine-year olds it is determined by more profound and specific considerations*»(Carey 1985, p. 185).

From the point of view of the organization of concepts, the first category identity to establish is the «basic» one (cat, dog), while the superordinate identity (the cat is an animal) and the subordinate one (the Siamese is a cat) take longer to elaborate (Rosch, 1978). Many have described a definite developmental tendency in the way in which children define objects: the younger ones refer only to the sensory properties, of a perceptual and above all functional nature («it moves, it makes a noise»). Later, at the age of about seven, they begin systematically to include the superordinate term in their definitions and to indicate defining characteristics («it breathes, it feeds, it reproduces») (Keil & Batterman, 1984; Carey, 1985; Benelli, 1990).

By developing and in a sense superseding the Piagetian hypotheses, it appears that the current studies are in substantial agreement in describing the development of the concepts in the child, on the one hand, as a process guaranteed by several cognitive bases found very early and, on the other, as a continuous journey away from the near to the far, from the concrete to the abstract, from the sensory to the logical. With respect to this development education has the important functions of encouraging comparison among the subjects, meditation about one's own skills and the building up of increasingly sophisticated levels of conceptualization. According to recent studies, also practical experience can play an important part in the cognitive development of school children: the raising of small animals over long periods of time seems to be capable of building up a considerable amount of biological knowledge and the capacity to draw inferences and make analogies concerning animals (Inagaki, 1990). A thorough knowledge of the raised animals allows the children to draw inferences and make analogies also about animals they are not familiar with.

However, while it seems possible to agree upon these points, our psychopaedagogical concern still remains. Practically all the research cited stems from an essentially psychological concern. The cognitive sectors examined are usually extremely narrow and isolated from their context. They are unlikely to be identified by the educationalist, who is always faced with simultaneously present knowledge, behaviours and skills. The results obtained are discussed with reference to cognitive theory and almost never with respect to the educational consequences. The educationalist is unlikely to have the tools needed to carry out this translation and application operation. It may happen that the paths of the researcher and the educationalist meet, that the educationalist for instance may have access to scientific information which is usually conveyed through exclusive channels, and hard to find and understand (and not only because of the language used) but this meeting usually does not take place.

The errors of the school

In its daily routine, the school, despite the recent progressive reforms of the syllabus,

seems totally unaware of these studies and results, which are now shared by researchers and educationalists alike. It takes no account either of the existence of the children's capacity to make intuitive theories, or of the progressive development of their knowledge from concrete to abstract, from near to far, from perceptual and functional properties to defining ones.

What is proposed by the school general starts off with a distinction between the kingdoms, and by a study of the plant kingdom, which is considered «easier», safer and manageable. The animal is presented as an object of abstract study («the dog is a four-legged animal»). From the earliest years the aim is to present a schematic and systematic knowledge of the animal, i.e. going from the study of the classes and families to that of the parts, the organs and the systems. The lack of science laboratories, the fact that small animals are never raised in schools, means that this study is carried out almost exclusively through the relationship of the teacher who explains — the text book — the child who listens and studies. A visit to the zoo, which exists in only a small number of cities and is always of extremely poor quality, is often the only true experience of animals offered by the school.

The animal disappears from the child's experience

Today, city children — especially those in big cities — have a strange and difficult relationship with animals. Direct experience of farmyard, transport and breeding animals has disappeared along with wild animals from the insect to the hare. This leaves pets (dogs, cats and cagebirds), which have increasingly assumed contradictory roles as playthings and as substitutes for the affection and company that city life makes so difficult to obtain from one's own kind. The disappearance of real animals is increasingly made up for by more lifelike toys (e.g. life-size plush animals capable of producing sound or movement), by more abundantly illustrated books, or by television, which has devoted a great deal of space to ecology and animal life in recent years. The only alternative to all this is the real animal held captive and alienated behind the bars of the zoo.

Aims of the research

Our research is intended as a mediation between the needs of the researcher and those of the educationalist. In other words, it sets out to study the child's spontaneous knowledge about the concepts of living and animal in such a way that the research data can be converted into operative indications that can be applied in education. To reach this compromise it was thus decided not to restrict the scope too much and to expose the child to a wide range of stimuli and requests[1]. In this way the data are more likely to point to educational behaviour. We used a sample divided up according to school level in order to confirm our hypotheses concerning educational errors, with special reference to the succession of knowledge and the relationship between cognitive development and school syllabus. Boys' behaviour was compared with that of girls, on the assumption that concepts such as these are affected by cultural differences and the different opportunities offered to males and females with reference to these contents.

Methods

Questionnaire

The study involved the use of a questionnaire-interview carried out individually at school in separate rooms. The interviews were conducted by Section personnel (research workers and teachers on full-time assignment) whose behaviour had previously been homogenized during a trial period of pairwork with frequent rotation and discussions. During this trial period

the questionnaire was also modified and put into its final form, which consisted of 15 questions designed to investigate five main areas:

1. Which animals do you know? (Questions 1, 6, 7, 8, 9);
2. Which animals do you like most, which do you like least? (2, 3, 4, 5);
3. Are men animals? (10, 11);
4. What does it mean to be «living»? (12, 13);
5. What does it mean to be an animal? (14, 15).

Points 4 and 5 were investigated by getting the children to play with 25 cards showing schematic representations of 7 objects, 7 plants, and 11 animals. The objects included a *stone* and a *stool* together with lightning, a *helicopter*, a burning *light-bulb*, a *robot* and a *television*, i.e. objects which «do» or «can do» something resembling the behaviour of living creatures and especially animals, such as speaking, moving or flying. Possible elements of conflict included among the plants were *cherries* plucked from the branch and a *mushroom*; a *starfish*, a *shell* and a *man* represented similar elements among the animals.

The interview lasted about 20-30 minutes and was conducted by the adult, who asked the questions, elicited responses, and filled in the answer sheet.

Subjects

The survey was carried out on a stratified sample from an urban primary school composed as follows: 5 boys and 5 girls picked on random criteria from each class (of 20-25 pupils) to form nuclei of 10 boys and 10 girls for each sample cell, which formed a level ranging from the 1st to the 5th primary class. The schools involved were located in the center and suburbs of Rome. It was decided to double the sample in order to allow for the variable of the normal timetable (4 hours of school 6 days a week) as against the full-time (8 hours, including lunch, 5 days a week). This variable revealed no significant differences and will not therefore be considered separately in the following discussion of the data.

Two groups were then set up for comparison, one from secondary-school children and the other from children living in the country. The secondary-school group was formed from two second classes from a secondary school in the center of Rome, the aim being to examine evolutionary trends after primary school. The purpose of the rural group was to examine the weight of direct experience in the knowledge of animals, it being possible to regard the effects of school and the influence of television as much the same. This group was composed of all the children in the second and fifth years of schools in a large area of the upper Metauro valley in the Marches province of Italy living on farms where farmyard and work animals are raised. There were 19 boys instead of 20 in the second-year class.

Table 1
Experimental sample

			City center		Suburbs		Country	
	Class	Age	FT	NT	FT	NT	TN	
Primary school	1	6	20	20	20	20		
	2	7	20	20	20	20	19	
	3	8	20	20	20	20		
	4	9	20	20	20	20		
	5	10	20	20	20	20	20	
Secondary	2	12	20					
Total			120	100	100	100	39	459

Note. FT = Full-time; NT = Normal time.

Results

Which animals do you know?

In the first question child was asked to list all the animals he could think of. The animals mentioned, the order in which they were referred to, the zoological classes recalled, and those omitted give a projection of the child's image of the animal, or at least of the image elicited by this type of stimulation.

The total number of animals mentioned was 8,614, with an average of 18 for the sample as a whole. The 354 species referred to are subdivided as follows: 125 Mammals, 72 Birds, 26 Reptiles, 5 Amphibians, 49 Fish, 36 Insects, 32 other Invertebrates, and 9 extinct animals.

Table 2
Distribution of references

	Primary school								*Secondary school*			*Primary*	
	City					Country			City			City	Country
	C	S	B	G	TOT	B	G	TOT	B	G	TOT	Class 2+5	Class 2+5
Mammals	11.8	10.5	11.8	10.3	11.0	11.7	9.5	10.7	18.5	17.4	17.9	12.6	10.7
Birds	2.7	2.6	3.0	2.4	2.7	6.1	5.6	5.9	5.6	3.9	4.8	3.1	5.9
Reptiles	1.5	1.2	1.7	1.2	1.4	1.1	.8	.7	1.7	2.3	2.0	1.6	.7
Amphibians	.2	.3	.3	.3	.3	.2	.1	.1	.3	.1	.2	.3	.1
Fish	.9	.8	1.2	.6	.9	.6	.2	.4	2.1	.8	1.5	1.1	.4
Insects	1.2	1.3	1.4	1.1	1.3	1.1	1.4	1.3	4.6	3.9	4.3	1.4	1.3
Other Invert.	.4	.4	.6	.3	.4	.1	.3	.2	.8	1.2	1.0	.5	.2
Total	18.7	17.1	20.0	16.2	18.0	20.9	17.9	19.3	33.6	29.6	31.5	20.6	19.3

Note. C = Center; S = Suburbs; B = Boys; G = Girls.

The number of animals mentioned increases regularly according to age (from an average of 13.4 in the first year of primary school to 25.1 in the fifth and 31.7 in the second year of secondary school), to sex (16.1 for girls and 20.0 for boys), and to location (17.1 in the suburbs and 18.7 in the center). This trend appears to confirm a strong link between such knowledge and scholastic development and, as regards the difference between girls and boys, the latter's greater interest in the animal world — due in great part to their greater freedom of movement facilitating their relationship with animals. This hypothesis is confirmed by the higher number of references to birds and amphibians made by the suburban boys and, in a far more striking and significant way, of references to birds by the rural group.

It is interesting to observe that the distribution of these frequencies — which has a maximum of about 14-15 references has a second peak of 25 subjects at 25, i.e. at the end of the first column of the answer sheet (which allowed for a maximum of 50). It is clear that the children, who were present while the adult was writing down their answers, tended to make an effort to reach the end of the column (see Table 2).

Table 3 clearly shows that the child's idea of an animal is closely bound up with large quadrupeds and that fish, insects, amphibians and invertebrates play little part. The percentage of mammals is constantly high and varies from 63% in the first year of primary school to 57% in secondary school. In the country group, on the other hand, it goes down to 54.4%.

Table 3
Distinctions between animals referred to in the various zoological classes

	Primary school				Secondary	
	City		Country		City	
	Total	%	Total	%	Total	%
Mammals	4,405	61.0	412	54.5	359	56.7
Birds	1,069	14.8	227	30.0	95	15.0
Reptiles	559	7.7	37	4.9	40	6.3
Amphibians	96	1.3	5	.7	3	.5
Fishes	359	5.0	15	2.0	29	4.6
Insects	498	6.9	49	6.5	85	13.4
Other invert.	167	2.3	8	1.0	20	3.2
Strange	72	1.0	3	.4	2	.3
Total	7,225	100	756	100	633	100

Table 4
Distribution of references, given as mean values, with respect to the environment in which the animals live

	Primary school								Secondary school			Primary school	
	City center					Country			City			City	Country
	C	S	B	G	TOT	B	G	TOT	B	G	TOT	Class 2+5	Class 2+5
Exotic-Zoo-TV	10.3	7.4	10.0	7.2	8.4	5.7	4.3	4.9	14.7	12.8	13.7	9.7	4.9
National fauna	4.3	4.0	4.6	3.8	4.2	6.0	5.0	5.5	12.1	9.5	10.8	4.6	5.5
Farmyard animals	2.4	2.5	2.6	2.3	2.5	7.3	6.6	6.9	4.4	3.6	4.0	2.9	6.9

Table 5
Distribution of animals referred to with respect to the different environments in which they live

	Primary school				Secondary	
	City		Country		City	
	Total	%	Total	%	Total	%
Exotic-Zoo-TV	3,372	49.8	191	25.3	269	43.2
Farmyard animals	1,570	23.3	213	28.2	216	34.7
Pets	977	14.5	269	35.6	80	12.9
Prehistoric	46	.6	2	.3	2	.1
Total	6,765*	100	755	100	623	100

Note. * The total does not correspond to the table 3 as some of the animals mentioned cannot be fitted into these cathegories.

The arrangement of the animals mentioned into zoological classes was intended to illustrate the child's dominant image or prototype animal, its relationship with zoological classification, and how this representation varies with age, sex and environmental conditions. In order to evaluate the relationship between knowledge and personal experience more fully, the animals mentioned were subdivided on the basis of the environments in which they live and with which the children presumably associate them.

The most important aspect of the two Tables is the significant difference between the urban and rural samples with regard to exotic and farmyard animals, which also emerges with respect to the national fauna mentioned. Of interest is also the marked difference in the Italian fauna mentioned by boys from the city and especially the suburbs. Among the girls there emerges a subsequently confirmed trend towards an increase in the number of pets mentioned.

As a whole, these differences confirm the importance of direct experience as against purely scholastic information (text books, lessons, etc.) or that provided by the media.

Examination of the animals mentioned first in the children's lists, which probably best represent the child's stereotype animal, bears out the differences found between city and country and between girls and boys.

The animals most frequently mentioned first by the city group are: lion (17.5%), dog (13.5%), tiger (8.7%), elephant (8%), giraffe (6.3%), cat (6%), horse (5.2%). In the country group we have: hen (17.9%), cow (15.4%), horse (12.8%), rabbit (10.3%), dog (7.7%) and cat (7.7%). It is interesting to observe that in the urban group references to exotic animals tend to decrease gradually as the children grow older and to disappear at the end of primary school and in secondary school, while references to such pets as cats and dogs increase.

As regards the difference between boys and girls, comparison of the pets or tame animals (dog, cat, horse, giraffe) mentioned first as against aggressive animals (lion, tiger, bear) gives 35.2% for boys and 64.8% for girls as regards the former and 56.5% and 43.5% respectively for the latter.

Smaller animals. Questions 6, 7, 8 and 9 refer to the knowledge of smaller animals than those first mentioned — reared at home and used for food — and are intended to investigate how far the animal stereotype is independent of the child's actual knowledge of the animal world. Question 6 — «*Do you know any animals smaller than the ones you have mentioned so far?*» — was specifically intended to test the hypothesis that children have two differentiated categories of «animals» and «little animals». In fact, 11 species of previously unmentioned insects and other invertebrates were thus added to 354 animal species.

In-depth analysis was carried out on a random sample to see how far each child's reference to smaller animals was original with respect to the first question, and obtained the following results: 32 children drawn from all class levels and from both urban and rural environments mention an overall total of 605 animals in response to question 1. Their answers to question 6 mention 116 animals not referred to in the previous list, over 70% of these being insects or small invertebrates. Most of the other animals mentioned are the young of large animals, this type of response being almost always given in the first year of primary school and in the suburbs. Microbes are mentioned predominantly by boys and in the city center. Finally, it is of interest to note that the number of small animals added in the responses to question 6 is much higher in the city than in the country. The second-year primary-school children in the city mentioned 54 animals for question 1 and added 15 (28%) for question 6. The country group mentioned 71 for 1 — much more than in the city — but only 8 (11%) for 6.

These data confirm that — as will also be brought out by the use of cards in the following questions and by our conclusions — the concept of the animal is formed very precociously in the child and covers practically all animals — not forgetting insects, spiders and other small animals. In fact, with sufficient prompting the child will produce lists including also the zoological classes of the Invertebrates. However, during its gradual formation the concept remains for many years most closely linked to the fur-covered, four-footed mammal. This is the animal first mentioned and this the image triggered off in the child — but probably also in most

adults — by the word «*animal*». The focussing of the kernel of the concept on this stereotype is strongest among city children, whose knowledge of animals is fundamentally bound up with cultural data and their experiences of zoos, while in the country first-hand experience sees to it that small animals are also included in the first list and, one may say, within the concept of the animal.

Which animal do you like most, and which least?

In question 2 the child was asked to indicate the animal he or she liked most.

Table 6
References to the animals most frequently mentioned as «the animal I like best» (as a percentage)

	Secondary School						Primary school		
	City			Country			City		
	B	G	TOT	B	G	TOT	B	G	TOT
Dog	15.0	23.0	19.0	36.8	20.0	28.2	30.0	10.0	20.0
Cat	9.0	17.5	13.2	5.3	30.0	18.0	10.0	20.0	15.0
Horse	9.0	11.0	10.2	36.8	30.0	33.3	10.0	10.0	10.0
Lion	14.5	4.5	9.2		5.0	2.5	20.0		10.0
Tiger	10.0	3.5	6.7			10.0	10.0	10.0	
Monkey	6.0	2.5	4.0			10.0		5.0	
Squirrel	5.0	2.0	3.5						

This list undergoes considerable modifications when comparisons are made between girls and boys and between city and country. In particular, city boys predominantly mention aggressive animals and city girls pets. Aggregation of the animals most frequently mentioned in the two categories gives the following results for the city sample: aggressive animals — lion, tiger, jaguar, leopard, panther and eagle — are mentioned by 33% of boys and 13% of girls; docile animals — dog, cat, horse and rabbit — are mentioned by 34% of boys and 57% of girls.

In the rural sample exotic animals are not mentioned and the differences between boys and girls are reduced. The favourite animal of both sexes is the horse.

Table 7
Reasons for choice of favourite animal given by primary-school girls and boys from the city and the country (percentages).

Urban primary school			
Boys		Girls	
Reasons	%	Reasons	%
Behaviour	36.5	Relationship with man	31.5
Form	26.5	Affective-emotive	24.5
Relationship with man	23.5	Form	24.5
Affective-emotive	15.5	Behaviour	21.5
Aesthetic	15.5	Aesthetic	12.5

▶

Table 7 (cont)
Reasons for choice of favourite animal given by primary-school girls and boys from the city and the country (percentages).

Rural primary school			
Boys		Girls	
Reasons	%	Reasons	%
Relationship with man	57.8	Relationship with man	50.0
Behaviour	15.8	Behaviour	25.0
Aesthetic	15.8	Affective-emotive	15.0
Form	10.5	Aesthetic	10.0
Affective-emotive	5.2	Form	5.0

Question 4 asked the children to give reasons for their preferences. These reasons were arranged in the following 5 categories (Table 7):

1. *Appearance* (shape, colour, big, small ...)
2. *Aesthetic* (beautiful, nice colours ...)
3. *Behaviour* (intelligent, strong, does things ...)
4. *Affective-emotive* (nice, soft, I'd like one ...)
5. *Relationship with man* (It obeys me, I can do this with it, It does this for me ...)

Analysis of the reasons given by the sample as a whole under these headings gives the following results: behaviour 29%, relationship with man 27.5%, form 25.5%, affective-emotive 18.5%, aesthetic 14%.

Responses from the rural sample, on the other hand, easily put the relationship with man first (53.8%).

With regard to sex, while significant differences do not appear in the country group, the city sample produces two quite different lists. It may be observed that the boys appreciate the animal more for what it is, what it does and its physical appearance, whereas the girls are more influenced by considerations of relationships and affective factors. This difference is almost imperceptible in the country group but becomes striking in the city sample. The boys' greater interest in this sector again leads them to «technical competence», while the girls develop a «relational competence».

The most significant item as regards the center-suburbs variable is the more frequent reference to considerations involving relationships with man among suburban children (32% as against 23%). As far as age is concerned, considerations of appearance and aesthetic reasons tend to diminish and relationships with man and affective considerations to increase.

Question 3 asked the child which animal he liked least. The data are more scattered than in the list of the favourite animals (92 animals mentioned as against 64) and show great differences between city and country and between center and suburbs. There are no significant differences between girls and boys. In particular, the country group makes no mention of insects, dogs or cats, but refers most frequently to hens, pigs and foxes. In comparison with the center, the suburban group refers more often to more generally known animals (and to ones already mentioned in the list of favourites), such as the dog, the cat and the lion. The center group refers more to snakes and insects, i.e. to animals more traditionally and culturally linked to fear and loathing (see Table 8).

These data are confirmed by further observations made by us on the behaviour and attitudes of children *vis-à-vis* animals and which center around the meaning children attach to the word

Table 8
Citations of animals most frequently mentioned as «animal liked least» (as a percentage)

	Secondary School						Primary school		
	City			Country			City		
	B	G	TOT	B	G	TOT	B	G	TOT
Snake	9.5	10.0	9.7	26.3	20.0	23.0		10.0	5.0
Cat	6.0	10.0	8.0						
Lion	7.5	8.0	7.7						
Mouse	8.8	7.0	7.7		5.0	2.5			
Insect-spider	8.0	6.0	7.7			30.3	20.0	25.0	
Dog	5.0	6.0	5.5				10.0	5.0	
Pig								20.0	10.0
Fox	3.0	2.0	1.5	10.5	5.0	7.7			
Hen	1.0	.5	.7	16.0		7.7			

«disgusting» as referred to animals and around the animals they consider the most disgusting. The animals most referred to are reptiles, especially snakes, insects, and small invertebrates, including a considerable number of slimy animals. Although this study has not yet produced data for a rural sample, children from an experimental school on the outskirts of Rome where various animals are bred and used in different class activities give responses similar to those of our own rural group, i.e. fewer insects and more hens and pigs (Caravita et al., 1986).

Question 5 asked for the reasons for this aversion. The answers were grouped under the same categories used for question 3. Analysis of the data for the sample as a whole gives us 38.1% behaviour, 32.2% relationship with man, 20.5% appearance, 13.7% affective-emotive, and 7.8% aesthetic.

Table 9
Reason for rejecting the animal liked least, as indicated by boys and girls from city and country primary schools (as a percentage)

Urban primary school			
Boys		Girls	
Reasons	%	Reasons	%
Behaviour	40.0	Relationship with man	38.0
Relationship with man	28.0	Behaviour	37.5
Form	21.5	Form	20.0
Affective-emotive	10.5	Affective-emotive	15.0
Aesthetic	5.5	Aesthetic	10.0
Rural primary school			
Behaviour	36.8	Affective-emotive	40.0
Relationship with man	36.8	Behaviour	25.0
Form	15.8	Relationship with man	20.0
Aesthetic	5.3	Form	15.0
Affective-emotive		Aesthetic	10.0

While there are no large differences between city and country, those between girls and boys remain relevant, again particularly in the city. As age increases, appearance is mentioned less, behaviour remains the dominant factor, and there is an increase in references to relationships with man and in affective-emotive reasons. The animal's appearance becomes less important with regard to its rejection and increased weight is given to its behaviour and its possible relationship (danger, loathing, etc.) with the subject.

Is man an animal?

Question 10 asked: «*Are men and women animals?*»

Table 10
Percentages of answers to question 10

	Primary school							Sec.					
	City					Country		City	Total				
	1	2	3	4	5	2	5	2	Cent.	Sub.	M	F	Total
Yes	5.0	17.5	26.3	28.8	58.8		45.0	90.0	36.0	18.5	32.7	26.5	29.6
No	93.8	82.5	73.8	71.3	40.0	100	50.0	10.0	64.0	80.5	66.8	72.6	69.7
Don't K.	1.3		.7		1.3	5.0		1.0			1.0		

The answers in Table 10 generally indicate great reluctance to recognize man as belonging to the animal kingdom (even in the 4th year almost 70% gave negative answers) in spite of the increasingly frequent use made in schools of evolutionary-type explanations, especially in the third year of primary school (to explain the origin of the world and the beginning of man's history). The pupils' beliefs appear to change in an overall process of development which reaches its critical stage about the age of ten (see also Carey, 1985). In particular, a progressive and constant increase in affirmative answers is observed as the children grow older, with a considerable jump between the 4th and 5th years (9-10 years of age). More affirmative answers were obtained from boys than girls and from city-center children than those in the suburbs. The number of affirmative answers obtained for the country group was again lower than for the center and was much the same as for the suburbs.

Question 11 asked the children the reasons for their answer to question 10. These reasons were grouped in various categories, the most numerous of which turned out to be:

1. *Physical-behavioural reasons* (what man does and can do: walk, talk, etc.) 26.6%.
2. *Evolutionary reasons* (correctly referred to zoological classification) 25%.
3. *Physical-structural reasons* (physical appearance) 22.2%.
4. *Tautological reasons* (they are human beings, men, etc.) 12.2%.
5. *Cultural reasons* (they are not herbivorous, they do not live like animals, they are written with a capital letter) 8.9%.

Among the other, less frequent categories are those indicating a general difference (7.5%) and religious reasons (God made us like this, etc.) 3.8%.

While it is interesting to note the differing frequencies of the categories of reasons most frequently given at the different age levels, no significant differences emerged between girls and boys, center and suburbs, or city and country.

Table 11
Percentages of reasons indicated for the answer to question 10

	Primary school							Secondary
	City					Country		City
	1	2	3	4	5	2	5	2
Tautological	21.1	17.5	10.0	6.2	5.0	15.8	10.0	10.0
Cultural	3.7	6.2	3.7	2.5	15.8		5.0	
Physical-behavioural	12.5	10.0	27.5	18.7	21.0	30.0	35.0	
Physical-structural	32.5	20.0	15.0	15.0	5.0	36.8	15.09	
Evolutionary	3.7	11.2	22.5	23.7	58.7		25.0	45.0

The number of evolutionary reasons given increases with age and is certainly influenced by schooling; reasons of the physical or structural type tend to disappear gradually. This corresponds to the results to be presented with regard to the final questions and, in more general terms, with the passing in cognitive development from a level of perceptual and sectorial description («Men haven't got four legs or fur», «We've got two legs, feet, hair», etc.) to more general and functional explanations («Apart from intelligence, man has nothing that the other animals haven't got», «Man has a structure like the animals, is descended from the apes», etc.).

Living beings and animals

Questions 12, 13, 14 and 15 referred to the recognition of living beings and animals. The child made his choice by thumbing through a pack of 25 cards showing pictures of 11 animals (including man), 7 plants and 8 inanimate objects (including lightning). The first task was to make two piles, one of the «living» (things that live) and one of the «non-living». The second was to divide the cards of the living into «animals» and «non-animals».

The following results were obtained for question 12 (the recognition of living things). In all classes (including the rural sample) the greatest difficulties arose over plants (which are regarded as non-living). While some 40% made mistakes in the first year of primary school, the percentage gradually decreased to zero in the last year of schools in the city center and the second year of secondary school. After plants, the most frequent mistakes occurred —

Table 12
Wrong answers to question 12: Non-living regarded as living (percentages)

	Primary school				Secondary
	City			Country	City
Class	Center	Suburbs	Total		
1	25.8	45.8	35.8		
2	20.0	37.8	28.9	28.7	
3	13.6	15.8	14.7		
4	10.8	17.5	14.2		
5	9.7	11.1	10.4	10.0	
2					4.4

as expected — with regard to the shell and the starfish, which in fact show no immediately obvious signs of being animal. Significant differences were not found between girls and boys but between different age levels and between the center and the suburbs (see Table 12).

The number of mistakes made by suburban children is consistently and significantly higher than in the city center; percentages for the rural group are similar to the urban averages. Mistakes constantly decrease as the age level rises and practically disappear in the secondary school. It is worthwhile analysing in greater depth the mistakes made as to non-living things and those erroneously regarded as living.

Table 13
Most frequent mistakes in answers to question 12: Non-living regarded as living (percentages)

	Primary school							Secondary
	City					Country		City
	1	2	3	4	5	2	5	2
Helicopter	50.0	31.2				36.8		
Lightning	37.5	33.7	26.2	17.5	16.2	31.6	15.0	
Stone	35.0	26.2				21.0		
Robot	32.5	27.5	17.5	22.5	15.5	21.0	15.5	
Cherry	32.5	31.2	32.5	36.2	42.5	42.0	75.0	30.0
Light-bulb	31.2				31.6			

Table 13 presents the most frequent mistakes and shows first of all that while lightning and the robot are the object of erroneous choices that constantly decrease but disappear only in the secondary school, the helicopter, stone and light-bulb are regarded as living by a very high percentage but only in the first two years of primary school. The trend of errors with regard to the card depicting two cherries plucked from the branch is anomalous. The percentage of mistakes is constant in the first 3 years at about 32% but then, instead of decreasing, rises in the 4th and 5th years to 42% (75% in the country) and is still as high as 30% in the secondary school. It is probable that schooling, greater knowledge of plants, and first-hand experience (see the rural sample) increase doubts as to whether a fruit whose seeds could still grow is to be considered living or not.

Question 13 asked the child to explain his or her choice: «Explain why you can say that they are all living beings, what they have in common». The answers were classified into 6 categories, which are by and large comparable to those used by Carey (1985, p. 30).

1. *Tautological*, refusal to answer («They are alive», «I know», «I can see them»).
2. *Biologically irrelevant* («We are created by God», «They never die», «They don't break», «They belong to nature», «You can do things with them»).
3. *Anthropomorphic characteristics* — comparison with man («They speak», «They are like us», «They are different from us»).
4. *Animal characteristics* (indication of functions and organs characteristic only of the animal world — «They move, eat drink» — references to organs and apparatus).
5. *Animal and vegetable* (real explanations with regard to the two worlds, without generalizations such as: «Plants have roots to feed themselves»).
6. *Characteristics of living beings* (all definitions which are biologically correct and may thus be correctly applied to all living beings, such as: «They breathe», «They feed», «They are born», «They grow, reproduce and die»).

Table 14
Answers to question 13 arranged in 6 categories (percentages)

	Primary school							Secondary
	City					Country		City
	1	2	3	4	5	2	5	2
1. Tautological — don't know	22.0	28.7	6.0	16.0	3.7	10.0	5.0	
2. Biologically irrelevant	27.5	23.0	20.0	12.0	15.0	36.0	10.0	10.0
3. Anthropomorphic characteristics	8.0	10.0	16.0	5.0	6.0			
4. Animal characteristics	28.7	32.5	42.5	37.5	31.0	31.0	40.0	45.0
5. Animal and vegetable	2.5	1.2	5.0	7.5	12.5	5.0	5.0	
6. Characteristics of living beings	10.0	4.0	10.0	21.0	31.0	35.0	45.0	

The table presents the aggregate data and ignores the insignificant difference between boys and girls. It is interesting to observe that, in spite of the differences in the answers to the previous questions, these have no effect on conceptualization. Analysis of the data makes it possible to observe that:

— The category 1 (no answer or a tautological answer given) or category 2 (biologically irrelevant) explanations constantly decrease as age and school level rise, while there is an increase in the category 6 type (biologically correct characteristics of living beings). An almost constant trend is found for category 4 explanations (animal characteristics).
— While no significant differences are found between city and country, the explanations given by suburban children are consistently lower to those in the city center, i.e. there is a higher percentage of category 1 (18% as against 13%) and 2 (24% as against 16%) explanations and a significantly lower percentage in categories 4 (32% —37%) and 6 (9% to 21%).
— The most frequent explanations are of category 4 type, i.e. those which attribute life to characteristics typical of animals alone. These are followed by biologically irrelevant ones (2), those regarding the characteristics of living beings (6) and finally by tautological explanations.

These data — with some differences due to the characteristics of the study and modalities of analysis — generally bear out those obtained by Carey. Our study assigned the explanations (at times articulated) of each subject to the single category regarded as dominant. The smaller number of anthropomorphic answers is probably due to the inclusion of such explanations as the possession of legs, heart, body and so on to category 4, whereas Carey classifies them in the anthropomorphic category.

We share certain of Carey's views, namely that the concept of a living being is modified with the child's development and the growth of his biological understanding, which do not correspond to the notions of biology included by schools in the syllabuses of the various classes. Evidence for these views is provided by the following points:

— The smaller children — in numbers which, while not very high, are by no means negligible — regard the stool and the stone as living on the grounds that they cannot die or get broken, almost as though the adjective «living» were applicable only to those things which «will be» forever, without changing or losing their characteristics.
— The smaller children regard objects such as the helicopter, robot, light-bulb etc., as living because they are «able» to do things which living beings are also capable of, or can, in any case, «do» things, are capable of producing activity. The helicopter flies, the robot walks, the bulb makes light, the television speaks, and so on.

— The problem of the cherry's possible inclusion among living beings in that, although separated from the tree, it is potentially capable of germination is faced only gradually and only by the older children.

The concept of the living being requires a systematic set of notions which must be activated as a whole. Otherwise the definition is only partial, is applied only sporadically, and is therefore incapable either of including all living beings or of excluding all the non-living. This condition — which is common to both the child and the incompetent adult is thus above all bound up with general cognitive development and specific biological education. As previously mentioned, the data presented above indicate a higher level of competence in central urban schools than in suburban and no significant difference between city and country or girls and boys. Unlike the results of other questions examined above (fear, knowledge, etc.), this would indicate that direct experience or opportunities for contact with animals are of little importance as regards cognitive elaboration. Individual examination of the explanations given shows that the most frequent are:

Table 15
Explanation of «living» (percentages)

		Primary school		Secondary
		City	Country	City
Explanation	Cat	%	%	%
They live	1	10.5	5.2	35.0
They've got a mouth etc.	4	7.5	10.2	5.0
They eat	4	9.0	7.7	
They walk	4	4.2	12.8	
They move	4	10.7	17.9	35.0
They breathe	6	3.2		
They are born, grow	6	3.7		15.5

The sequence of the frequencies of the attributes indicated as characteristic of living beings substantially corresponds to the findings of Richards and Siegler (1986), i.e. that in the same age group as the one examined here, the most significant attributes are movement and eating. In our case, the frequencies with which the answers recur are usually lower than found by them, while tautological attributes or ones referring to parts of the body are present; we think this is due to the wider range of our sample and, above all, to the different experimental procedure followed. In the Richards-Siegler survey, the subject responded to direct questions whereas in the present study he or she was required to justify a previously made selection of cards. In such a situation it is easy to find answers like «Because they're alive» or, referring to individual cards, «The frog because it jumps», «The plant because it has flowers», «The cricket's got eyes». Finally, we agree with their observation concerning the consistently high frequency with which the attribute «movement» is used to describe living beings even when the subject also gives biologically correct definitions applicable to all living beings. Movement was still found to be the most frequent answer even at the end of primary and the beginning of secondary school.

Using the procedure described above, question 14 asked the child to divide the cards selected as living beings into «animals» and «non-animals».

Table 16
Correct answers to question 14: Animals recognized (percentages)

	Primary school				Secondary
	City			Country	City
Class	Center	Suburbs	Total		
1	77.5	68.0	71.6		
2	83.9	71.4	77.6	68.9	
3	79.8	80.5	80.1		
4	83.2	81.8	82.5		
5	88.2	88.4	88.3	84.5	
2				94.1	

The data of table 16 show that the concept of the animal is acquired earlier than that of the living being. At the age of six, the children are already close to the maximum of correct answers. In primary schools in the center we go from 77.5% in the first year to 88.2% in the fifth. The difference is significantly greater in the suburban schools, where the initial percentage is much lower. This difference is probably connected with the fact that the correct classification of «difficult» cards (e.g. *the shell, starfish and centipede*) depends more on knowledge of the animal world than on direct experience (which is difficult to obtain for these animals and is, in any case, not related to the greater freedom of play that suburban children may enjoy).

Table 17
Most frequent mistakes in answer to question 14: Animals not recognized as such (percentages)

	Primary school							Secondary
	City					Country		City
	1	2	3	4	5	2	5	2
Man	90.0	90.0	90.0	81.3	56.3	94.8	60.0	20.0
Starfish	47.5	41.3	48.8	41.3	25.0	58.0	25.0	20.0
Shell	48.8	52.5	52.5	43.8	32.5	58.0	30.0	25.0
Caterpillar		21.3	11.3	6.3	1.3	5.0	31.6	15.0

Table 17 shows the most frequent mistakes. The first place is occupied by the very high percentage (90%) of errors made in refusing to consider man an animal. This remains constant through the first four years and falls in the fifth, but only to 53.3%, which is higher than for any of the «difficult» animals mentioned above (starfish, shell and, to a far smaller extent, centipede). These data bear out and accentuate the findings indicated in Table 10. The stronger refusal to regard man as an animal is probably linked to the reason given above in discussing the Richards-Siegler study: the image of man and the comparison with the images of the other animals represented create greater resistance than a question alone, which may easily activate solely scholastic knowledge.

The last question on the questionnaire was: «*Why can you say that they are all animals, what have they got in common?*». The answers were grouped on three different criteria:

1. The relationship indicated between animals, man, plants and objects.
2. The analytic or synthetic nature of the answer.
3. The biological value (greater or lesser degree of correctness and generalizability) of the explanations given.

The only interesting fact brought out by the groupings obtained on the first two criteria is that man is by far the most common term of reference used, and that the definition of what is animal is thus given in terms of similarity to or difference from man (Carey, 1985).

Table 18
Answers to question 14 grouped according to their value from the biological point of view (percentages)

	Primary school							Secondary
	City					Country		City
	1	2	3	4	5	2	5	2
Appearance	46.3	50.2	44.9	51.3	40.3	47.4	50.0	55.0
What they do	16.3	17.5	35.9	39.7	17.7	36.8	35.0	5.0
They eat	3.8	12.5	14.1	6.4	8.9	5.3	15.0	
They move	2.5	10.0	14.1	23.1	30.4	5.3	60.0	45.0
They breathe	2.5	1.2	3.7	5.0			6.5	
They reproduce		1.2	5.0		12.5			15.0

The biologically relevant criteria used by children to justify inclusion in or omission from the animal category are listed in Table 18, together with the percentage frequency with which they appear in the answers:

1. *Physical appearance* (all the explanations concerned with shape, number of legs, covering, horns etc., i.e. the external characteristics of a few animals — generally mammals — which cannot be applied to the whole of the animal world).
2. *What they do* (all the explanations concerned with behaviour, such as characteristic sounds, swimming, playing etc.).
3. *They eat.*
4. *They move* (a characteristic probably common to all the animals known by children but not applicable to the whole of the animal world).
5. *They breathe* (refers to animals and plants).
6. *They reproduce* (are born, grow, and die — to be regarded as the most complete and correct answer from the biological point of view).

The last two explanations are more closely linked to the biological concept and are applicable to the whole animal world. They are what Keil and Batterman (1984) call *defining features.*

Our data do not make it possible to observe the evident transition from formal, external characteristics to predominantly biological and «defining» features. This was possible with

the data obtained by Mintzes and Trowbridge (1987), but their sample covered a far greater age span, extending as far as adults. An increase in biologically correct answers is, however, observed as the age level rises along with a constant and appreciable increase in explanations concerned with movement and a consistently high percentage referring to outward appearance. The answers of the lowest two levels of the Mintzes-Trowbridge sample show trends similar to (homogeneous with) those encountered in the higher levels of our own.

Discussion

Piaget had the undeniable merit of being the first scientist to observe the existence of thought in children using the revolutionary method of getting the child to talk, i.e. of getting to know the child through the child itself. The method used thus faithfully reflected the underlying theory: if the child thinks, we can therefore use his answers to study him. However, in the light of our current knowledge it almost seems that Piaget was unable or unwilling to follow his thinking through to its logical conclusion: even though the child has its own thought system, the parameter used to measure it remains adult thought, indeed Thought in absolute, not that of people but that of formal logic. The child grows up to the extent to which he or she moves in the direction of formal logic (child as pure potentiality in the Rousseauian sense?) and his answers describe the stages by which he or she moves. This inability or reluctance to proceed further is clearly revealed in the clinical method used by Piaget, which has been clearly described in his works and by his co-workers: the questions were suspended after the first answers; no further investigation was envisaged, nor any testing of the child's words for different, perhaps unexpected meanings.

Starting from Piaget's early research and, we want to stress, because of it, research has been increasingly focused on studying the child's thought. The original Piagetian results were superseded and it was attempted to clothe in meaning what have been variously termed mental representations, misconceptions, naive thinking. In recent studies (Carey, 1985; Wellman, 1990), one has even gone so far as to acknowledge that the child makes use of actual theories, although these are justifiably defined as «naive», «spontaneous», in order to distinguish them from adult, scientific theories.

Some of the data emerging from our investigation seem to confirm this hypothesis. When smaller children say «*The stone is alive*» or «*The stool is alive*», they are showing that they possess a clear concept of what is living, only that, for them, living is not the opposite of non living, which is an abstract concept and hard to test, but of dead or broken, of which they have frequent, direct experience. They in fact explain that «*The stone is alive because it never dies*», «*The stool is alive because it doesn't get broken*». The crisis in these spontaneous theories and their superseding comes about through the simultaneous presence of two factors: on the one hand, the child grows out of his egocentric state and starts engaging in increasingly complex and demanding interchange with others; on the other, there is an increase in his or her skills and knowledge. As Carey states this process is based on subjective perceptual experiences and, through the semantic development and the growth of biological knowledge, it evolves towards increasing objectivity and scientificalness. Starting with basic concepts like *dog, horse*, the children gradually learn to cope with superordinate concepts, mammals, animals, and with subordinate concepts, *dog, wolf, bay horse* (Rosch, 1978). In the course of this slow and complex evolution, the concept of living which, in its spontaneous or ontological form, is present as the basis and a guarantee of the child's subsequent cognitive research, is attributed first to living and non living beings that do something, then to animals because they move, and finally to those being which correspond to the defining characteristics of being born, growing, feeding, reproducing, dying. Along this continuous pathway, which does not correspond to any definite stages of development of logical structures, the child is present and actively participates with his thought. Through the various educational, school and extra-scholastic experiences, the latter will ultimately develop into scientific thought. This interpretation of

the child's cognitive evolution emerges as an extremely useful and fertile basis for a proper educational project.

We shall therefore try to discuss our results with this developmental and educational concern in mind.

The development of the concepts of the animal and the living being

The concept of animal. With respect to the concept of the living being, the concept of the animal appears to be simpler, closer to the child, and thus acquired earlier. It is correctly defined by quite a high percentage of children even in the lowest levels examined in our study, assuming that explanations referring to movement are regarded as correct and «defining». While movement does not, from the biological point of view, characterize all animals, the few not covered are extremely remote from the child's possible knowledge or experience. It is thus a question not so much of incapacity as of an unexplored and unforeseeable sector of the animal world. This is shown by the fact that children of the higher social classes make fewer mistakes probably because they are involved in more intense information exchanges.

In any case, even the youngest children have very little trouble in recognizing the cards representing animals and have no difficulty in identifying as such Insects, Amphibians and Fish as well as Mammals. As we have seen, lasting difficulties arise only with the two objectively problematic and ambiguous cards: the *starfish* and the *shell* which represent animals further away from the categorial representativeness mentioned by Rosch (1976).

This fact apparently clashes with what was observed with regard to the answers to the first items on the questionnaire. When asked not to recognize but to list all the animals that come to mind, the smaller children's answers are essentially confined to four-footed Mammals. The other zoological classes are hardly mentioned at first but are referred to more as the age rises (for our total sample, references to Mammals accounted for 60% of all references). As authors such as Bell and Baker (1982) have pointed out, the child's image of the animal is for many years bound up with that of the four-footed, fur-covered mammal. Our data make it possible to add that for the first few years the child's image of the «animal» is different from that of the «little animal»: when asked to list smaller animals, the children mentioned small Invertebrates as well as small Mammals.

It is therefore possible to state that while the child knows and distinguishes animals as such independently of zoological class at a very early age, the mental image and hence the concept of the animal formed earliest has typically Mammal characteristics (Bell, 1981; Bell & Baker, 1982). There are various possible explanations of this predominance — taking one's own body as a model, the frequent and exclusive presence of mammals in the house (dogs, cats, hamsters etc.), plush toys representing bears, dogs etc., and the animal heroes of the cinema and television (horses, dogs, tigers etc.) (Mintzes, 1987).

The last source of strong resistance is the recognition of man as an animal. This point gives rise to a great deal of conflict. On the one hand, the child's whole upbringing is characterized by stress on distinguishing oneself from animals — «Don't eat like an animal», «You look like a pig», «He's an animal, not a man». On the other, the school attempts to teach that man belongs to the animal world in accordance with evolutionary theory. Marked progress occurs only at about 9-10 years of age (as has been pointed out by many studies, e.g. Carey, 1985; Keil & Batterman, 1984) and man's animal nature is first acknowledged.

The concept of the living being. The concept of the living being unquestionably causes the child more problems. It is developed much later and requires a more articulated and complex cognitive basis. It is a superordinate concept whose acquisition depends upon the knowledge of such concepts as animal, plant, biological cycle, inanimate object etc., and upon the capacity to bear them in mind simultaneously. For this reason the development of the concept is closely bound up with general cognitive and semantic development and schooling, especially biological knowledge (Carey, 1985). The pupils of schools in the city center do better than those in the

suburbs, the older than the younger. The factor of sex causes no particular differences (although, as we shall see, it is of considerable importance with regard to the knowledge of animals) and the direct experience of animals enjoyed by the rural sample is either no advantage or — more probably — fails to offset the general cultural disadvantages of the isolation and low cultural level in which the children live.

Consideration of the formation of the concept of the living being from the evolutionary point of view as illustrated by the data presented above leads to the following observations.

a) The smaller children tend to give the word «living» a different meaning from adults and one which is biologically incorrect. «Living» is not opposed to «inanimate» but to «dead», which helps explain why the stone and stool are described as living objects: they never die. «Living» also includes things that do not break, that do not go bad, that exist (Carey, 1985; Richard & Siegler, 1986).

b) Apart from this different semantic usage, the smaller children — but with greater resistance at later levels — attribute the adjective to objects which «do» something: the TV speaks; the helicopter flies; lightning is strong; robots walk. The functions shared with living beings serve to «animate» objects (Carey, 1985).

c) The explanations most frequently given by the sample as a whole are those which define living beings in terms of typically animal characteristics such as movement, the possession of animal organs, and so on. And this happens both when the plant cards are excluded from the initial subdivision (for the smaller children) and when they are included.

d) Subsequently, albeit to a small degree, definitions of living beings begin to be produced which are composed of both animal and vegetable characteristics (e.g. animals move and plants feed through their roots).

e) Only in the highest classes examined — starting again from the age of 9-10 — did the subjects offer defining features, i.e. those peculiar to all living beings, such as breathing, feeding, birth, growth, reproduction and death.

From another point of view, it may be noted that the children progress from definitions linked to features which are external, partial, or typical of some members of a set but cannot be generalized to the whole, towards increasingly «defining» features. This observation is already to be found in the literature (Keil & Batterman, 1984; Richards & Siegler, 1986) and is also borne out by other experimental activities carried out by our Section with regard to the knowledge and use found in children of different ages of the *structure-function* relationship in the animal world.

One of the tests required the child to list the parts of a bicycle regarded as essential and to explain their function. This was then repeated for the parts of the human body. For the bicycle, the parts most mentioned are the handlebars and saddle; the light and bell are also frequently indicated; the wheels, chain and pedals are less often referred to. The parts of the human body most mentioned are by far the organs of sense and the hands; the internal organs are referred to much less. The number of references increases with age but the hierarchy of answers changes little between the ages of 7 and 12: the elements closest to personal experience are mentioned the most and greater importance is given to what one knows better, to what one «feels» is closest (Caravita, Tonucci, Consoli, Giuliani, & Rusca, 1988). Likewise, another test asked for three definitions of three given animals — *hen, frog* and *kangaroo* — such as would enable a person reading them to guess the animal in question. For the hen, the smaller children (7 year-olds) gave the answer «It's white» in fourth place (19.4%) out of 52 different types of answer after «It lays eggs» (47.8%), «It's got a crest» (32.8%), and «It's got a beak» (29.8%). In the older age group, the definition «It's white» practically disappears (1.2%), and the most common are «It lays eggs» (58.8%), «It's got two claws» (35.3%), and «It's got feathers» (28.2%). Similar results were obtained by Keil in his experiments with modified animals and objects. He noted that the smaller children judge whether objects

or animals belong to a category more on the basis of their appearance than of their essential nature, and that a radical change takes place at about 9 years of age (Keil, 1986).

How sex and living in the country modify the mental representation of animals

Our study was also intended to investigate some aspects which neither Carey nor most of the other writers referred to had considered, i.e. whether the fact of being male or female may modify attitudes towards and knowledge of animals, or whether these are modified by the environment in which one lives — living in the city center or suburbs, or in the country, in a farming family and in real contact with animals.

Male and female. It was considered worthwhile to investigate how much the traditionally greater interest of boys in the animal world had been changed in recent years by the increased information available — mainly from the TV — and by a hypothetically greater degree of homogeneity in the upbringing of the two sexes. The boys' greater freedom outside the home led to their interest in the animal world both as a possible field for play (often of a cruel nature) and as a field of experimentation, understanding, and real affective relationships. On the other hand, the girls imitated their mothers and precociously developed an attitude of rejection towards the animal world, which aroused disgust, fear, or merely indifference.

The data obtained and presented above show that there has been no substantial change in the last few years, which have also been characterized by widespread feminist debate.

While the girls in the age group examined show a higher average level of scholastic performance than the boys, they have less knowledge of the animal world. They mention fewer animals, know a smaller range of classes, and are less willing to recognize that man is an animal (Kellert, 1987). As stated above, it is only with regard to the more strictly conceptual definitions of animal and living being that there are no appreciable and constant differences. Far more docile animals (dog, cat, horse and giraffe) are mentioned first by girls than by boys (64% as against 35%) and fewer aggressive ones (lion, tiger and bear) (43% as against 56%). This trend is accentuated in the responses to the question of which animal is liked the most. 57% of girls mentioned docile animals as against 34% of boys and only 13% aggressive ones, as against 33% of boys. In explaining their choices, the girls usually referred to reasons connected with relationships with man and affective considerations, while the boys more frequently mentioned the animal's behaviour or appearance. The girls thus showed greater emotional involvement and participation respect to the boys' greater curiosity and detachement.

The conditions of differentiation between girls and boys are probably still unchanged, especially in the city, and the subject of «animals» is still of less interest to the former. When it does not become rejection, this lower degree of interest naturally gives rise to marked dishomogeneity in both behaviour and learning. It is therefore our view that consideration of such subjects should always pay particular attention to this variable and to the ways it can exert its effect.

City and country. Interest in this variable was largely related to the hypothesis that nowadays the more significant information tends to come more through the mass media than from first-hand experience. Television is viewed for a similarly high number of hours in the city and in the country and has devoted a large number of high-quality afternoon and evening programmes to the life of animals. A reasonable hypothesis was therefore that answers to the questionnaire would be similar. The interest in testing this hypothesis obviously went beyond the strictly sociological aspect to constitute an important point of reference for subsequent discussion of upbringing. The data obtained clearly show that, in our society and on such a subject, direct experience leads to a profound modification in attitudes and understanding, thus confirming also the conclusions reached by other authors (Inagaki, 1990).

The city children mentioned exotic animals known through zoos, books and especially TV twice as often as the rural sample (an average of 9.7 as against 4.9). Farmyard animals

were referred to twice as often by the latter as by the former (an average of 6.9 as against 2.9). Confirmation of the importance of experience is provided by the suburban boys, who mentioned more Amphibians and Birds than those from the city center. In the suburbs of Rome it is, in fact, common for boys to play in the fields or ponds. Equally significant is the very high number of Bird species mentioned by country children, also because a very common pastime of their fathers is hunting.

The fact of living in the country also produces considerable and interesting differences with regard to the question of the animals liked most and least. The disappearance of the exotic animals characteristically mentioned by city boys leads to a tendency to the differences between the sexes to disappear as well. The favourite animal of both is the horse. As regards the animals rejected, references to insects (and other Invertebrates) disappear in the rural sample while they were second only to snakes for the city group. Country children know insects, know them to be harmless, and thus neither fear nor reject them. The children, especially city girls, who have less first-hand experience, reject them largely for cultural reasons — because grasshoppers, spiders and the like have always been regarded with disgust and fear, especially by women.

Notes on education and science teaching

It is our view that the data and discussion presented above allow some useful conclusions to be drawn with regard for children's upbringing in general and for school education in particular.

The child knows how to know. In accordance with his own modalities and criteria, the child has a logic of his own. This fact has long been affirmed by pedagogues and psychologists (Dewey, Montessori, Piaget, etc.) and has recently been assumed in drawing up new primary-school syllabuses in Italy, but is still practically unknown and, in any case, little exploited by schools. The claim that the child is capable of knowing both overturns the traditional terms of educational discourse — which can no longer start from predetermined programmes or levels — and makes possible two operations of considerable psycho-pedagogical value, which is the aspect we are most interested in.

— By asking (and enabling) the children to express their knowledge, their mental representations, the teacher can get to know his pupils at a level of depth and intimacy scarcely attainable with other methods.

— Making his knowledge explicit enables the child to begin the process of learning with a secure basis, a correctly constructive attitude, and the highest possible guarantee that he is to play the leading role in the development of his own knowledge (Pope & Gilbert, 1983; Driver, 1983; Osborne & Wittrock, 1985).

The child's knowledge tends to differ and is unpredictable. An adult would have found it difficult to foresee that the child's choice of cards in response to the question on living beings would include the *stone* and the *stool.* It would have been easy to censor this choice and suggest the «correct» one. The child would probably not have understood, but he would have learn. He would have continued to regard the stone and the stool as living beings because they can neither die nor get broken, but he would have learnt to give the teacher the answer «animals and plants». To believe that children have their own thought system and theories means adopting an attitude of listening to them and of being willing to consider their knowledge as the starting point for the educational work.

In our school system scientific education begins at around the age of eight with the study of plants. Plants are probably perceived by teachers as cognitively simpler and less «worrying» from the functional and emotional points of view: they have no internal organs, they do not move, they are not disgusting, and are easy to grow; their death is not especially upsetting

for the children. However, together with those of other authors (Stavy & Wax, 1989), our results show that a high percentage of eight-nine year olds consider plants as non living. This means that for these children the teacher's proposals are unlikely to be understood. However, the most disconcerting aspect is the fact that the reasons used by the teacher to justify the priority given to the plant kingdom over the animal kingdom are themselves scientifically inexact and somewhat infantile. On the other hand animals are discovered early by children, on whom they exert a strong emotional attraction. However, «animal» here mainly means a four-legged animal, a mammal. It would thus be important for the educational approach to be based on these certainties and to lead the children to «meet» significant animals. For the same reasons raising animals in the classroom takes on a considerable educational significance, but this will be discussed below.

For many years (up to 9-10 years of age) most subjects reply that man is not an animal. From the third year of primary school — and sometimes even earlier — they have studied the origin of man according to Darwinian theory. If questioned at school by their own teachers, the same children would probably have answered that man is an animal because, according to Darwin's theory, he comes from the apes... On seeing the results of the questionnaire, some teachers expressed real disappointment at the uselessness of their classwork on the theory of evolution. All this means that the knowledge possessed by children — and by man in general is resistant (i.e. it will change only when recognized to be inadequate and replaced by newly constructed knowledge regarded as adequate). Failure to allow for this and for the capacity for knowledge mentioned above often leads the school into its most common and most dangerous mistake: the creation of parallel knowledge in the child (Pines & West, 1986). By this we mean knowledge that the child has not constructed for himself as necessary for solving his problems, but that he has learnt because the teacher wanted him to. The child's great adaptive capacity enables him to conserve two forms of knowledge: his own, which he uses to live and to solve his problems, and a scholastic knowledge that he needs to gain approval at school. The splitting of the two naturally annuls the effect of schoolwork, which should aim at expanding the child's knowledge to the highest possible levels of profundity and abstraction. Of course, this does not mean that instead of an evolutionary theory the younger children should be confronted with a creationist theory. What it does mean is that children of this age do not possess the means of incorporating notions like these actively and constructively in their own theories. This is a further indication of how important it is not to be overhasty, not to try and follow external, artificially pre-set syllabuses, but rather to build upon existing knowledge.

Boys and girls. The evidence indicates that, with respect to the development of the concepts of living and animal, there are no significant differences between boys and girls. However, important differences are found in the way one becomes acquainted with animals and in attitudes towards them. These differences, if not realized and taken into consideration, introduce into the educational experience imbalances that may easily be attributed to factors that are not directly responsible, such as motivation or aptitude, or even intelligence. The fact that in country children the differences between boys and girls decreases considerably gives us useful pointers as to how to modify the teaching approach.

Experience, attitudes and concepts. The possible relationship between direct experience of animals, attitudes towards them, and conceptual development appears the most interesting aspect to be examined in view of its bearing on education.

The data presented above show that there is no relationship between experience and conceptual elaboration, especially at the more complex levels of the concept of the living being. However, our study compares rural schools — which are generally characterized by a poor level of teaching, frequent changes of teachers, and pupils living in near isolation with families of a very low cultural level — with schools in the city centre, whose pupils often enjoy advantageous conditions at home and at school.

On the other hand, the country children show a knowledge of the animals of their territory which enables them to make up for the differences between the sexes and not to fear harmless animals. The city children probably know only a lot of names and shapes of animals seen in cages or on the screen, and their view of these unknown animals as strong and beautiful or ugly and disgusting retains all the prejudices of popular culture. Girls and boys choose according to the stereotypes characterizing them still today: the former docile and homeloving, the latter aggressive and adventurous.

We therefore regard it as important that city children should also have a direct, positive and real knowledge of animals and of nature. By this we mean the simple experience of breeding small animals (small mammals, amphibians or insects) at school or at home; cultivating the school garden or playground; the organization of protected urban and suburban areas to provide the city dwellers with a natural point of contact with nature; active science museums; and children's zoos where it is possible to touch the farmyard animals, to see the hen lay eggs or the cow give milk. We maintain that, when embodied in an overall educational programme, such experiences can make a useful contribution towards modifying the attitudes mentioned above, to reducing the differences between the sexes, and to a critical re-examination of one's own preferences and fears. The previously mentioned study carried out by our Section found that when a young research worker carried the «disgusting» animal — toad, newt, earthworm, stick insect or snake — in her hands, very few out of the hundreds of children invited to touch it refused.

We are convinced that if these experiences and the modification of these attitudes is taken as a starting point, the more strictly scholastic work of elaborating and developing concepts will have a more secure and more homogeneous basis for the different children and will certainly make it possible to reach higher levels of abstraction and generalization.

It is, of course, necessary at the same time to guarantee children from the country the highest possible level of schooling to make up for their socio-cultural handicaps of belonging and so that the important experiences available to them should not be wasted.

Possible developments of this research

As mentioned in the introduction, the aim of the research was to provide our group with basic knowledge concerning children's representations with reference to the biologico-naturalistic topics of our education-orientated work. The results seem to indicate that further work should follow several different directions:

- As far as cultural factors are concerned, to check whether different results are obtained in different cultural contexts. See, for example, the work of Ochiai (1989), who found that a high percentage of adults consider as living the sun (50%), robots (18%) and stones (15%), while in our sample these attributions disappear at the age of about 12; he attributed these differences to cultural and religious factors.

- As far as the differences between boys and girls are concerned, it is worth checking whether and, if so, to what extent differences in the interest shown in animals affects the learning of natural science and how many difficulties they put in the path of teachers, most of whom are nowadays women at the lower school levels.

- As far as methodology is concerned, we deem it of interest to take separate aspects of children's knowledge and representations of the animal world and investigate them using different languages and working methods (individual and group) in order to minimize the effect of the non familiarity and novelty of the task, as well as that of the limited scope and selectivity of the language used.

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