THE SOCIAL RELEVANCE OF PUPILS' RESPONSES TO CUES FROM THE NATURAL WORLD

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ABSTRACT

Data collected from interviews in which photographic, drawing and oral probes were used to illicit children's understandings of eight objects in the natural world using samples of children aged 6, 11 and 14 years old have been analysed for references to social relevance. The data categorised from each school case study is used to describe what children say about social relevance at different ages and in two cultural situations. The results demonstrate the nature of the connections that children feel with the environment, the sources of the understandings that they draw upon, and how they relate to the common objects that they encounter.

INVESTIGATING PUPILS' RESPONSES TO CUES FROM THE NATURAL WORLD

The research was designed to investigate pupils' responses to cues from the natural world and focused on the methodological aspects of interviewing children using probes. It investigated the effect of presenting photographic, drawing and oral (i.e. spoken) probes in interviews to elicit the expressed models of pupils of a series of eight objects (daisy, grass, oak tree (or *Amendoeira* tree), ant, squirrel (or monkey), pigeon, pond, clouds). These objects were chosen as they are commonly found in the natural world in our two field sites: southern England and the outskirts of Rio de

Janeiro, Brazil. We collected data before the visit (pre-visit interviews), when the same groups of pupils were in the presence of these objects on out-of-school visits to zoos, museums, botanic gardens and field centres (visit interviews) and after the visits (post-visit interviews).

THE ANALYSIS OF HUMAN FEATURES

We realised that the transcripts from the interviews contained evidence of emotions, experiences from media and learning with other people as well as concerns about the effect on natural objects of human beings. We termed this domain *human features* and it is this that is our particular focus in this paper. That pupils of all ages bring to their learning the knowledge they have gained in such social milieus as their homes and society more generally is hardly a startling premise. And yet we would argue that school science education all too often still pays at best lip service to such extra-school knowledge about science. Further, when teachers of school science have been encouraged by educational theorists to take account of children's prior learning in science, the motive is too often one based on an assumption, implicit or otherwise, that all that such children bring are their misconceptions. The aim then becomes merely one of ascertaining what children misunderstand so that such knowledge can be eradicated. In our view this is not a very enabling model of education and may even contribute to the widely acknowledged tailing off of interest in science as pupils pass through their schooling (see Osborne *et al.,* 2003).

In this paper we look more closely at the depth of understanding evident in some of our case studies using this analysis of human features to illustrate the depth of relevance to human beings shown in the transcripts. This will provide some pointers to the pattern of understandings that pupils of different ages and from different cultures and in different situations express about the social relevance of these objects. We have chosen cases from our data of 17 schools (14 in southern England and 3 in Rio de Janeiro, Brazil; see Figure 1). All names are pseudonyms.

RESEARCH QUESTIONS AND SELECTED CASE STUDIES

How do 9/10 year-old pupils shown a photographic or word probe express their depth of understanding of human features?

Here we have taken the data from the pre-visit interviews for 9/10 year-olds in a primary school in southern England, Meadvale, in which the pupils were presented with photographic probes of the objects in interview, and then looked at Poplar Junior where pupils were presented with words in interview.

	Natural History Museum	Zoo	Kew Gardens	Field Centre
Year 1 5/6 year-olds	*Honeylane Infants* **Drawings probe in pre-visit**	*Argyl Moor Infants* **Words probe in pre-visit**	*Lion School* **Drawings probe in pre-visit** *Poplar Infants* **Photographs probe in pre-visit**	*Hawthorns School* **Photographs probe in pre-visit**
Year 5 9/10 year-olds	*Poplar Junior* **Words probe in pre-visit**	*Meadvale* **Photographs probe in pre-visit**	*Lion School* **Drawings probe in pre-visit**	*Street High* **Drawings probe in pre-visit**
Year 9 13/14 year-olds	*Robglen* **Photographs probe in pre-visit**	*Greenacres* **Drawings probe in pre-visit**	*GreenLyn* **Words probe in pre-visit**	*Ninelands* **Words probe in pre-visit**

Figure 1: Chart showing the sample schools in England.

Do pupils at different ages have different patterns?

For this comparison we used data from a year 1 (5/6 year-olds) class from Argyl Moor, a year 5 (9/10 year-olds) class from Poplar Junior (the class used for the preceding question) and a year 9 class of 13/14 year-olds, from GreenLyn School. All these classes had words only used in the pre-visit interviews.

Do pupils in a different culture express different patterns?

For this question we compared results from Meadvale pupils with a similar class of 10 year-olds in Rio de Janeiro, Brazil at Gaya School. In both cases photographic probes of the objects were used.

All the above case studies take interviews from six sample children in each school before they went on any out-of-school visit. The backgrounds of the children in the schools cannot be exactly matched nor can their experience of being taught in school, so the comparisons, rather than being conclusive, give us pointers and indications of the richness of pupils' expressed understandings of the human features they associate with each object and allow us to suggest possible reasons for the findings.

CATEGORIES FOR ANALYSIS OF HUMAN FEATURES

The transcripts were subjected to a repeated re-reading and categories were allowed to arise from the data. As analysis proceeded, categories were combined, added and refined in the appropriate manner for the production of categories using grounded theory. The categories which arose are presented in Table 1. Each transcript was coded for each pupil and each object and the resulting charts gave an overview of the features of each case for use in comparisons. The particular statements for each category across the class were collected and listed and all the examples noted.

Table 1: Definitions for codings of human features analysis

Feature	Code	Definition
Location	**l**	Place where the object lives, grows or is found. Location is often linked to human influence (see below) and then would be coded for both. *" Grows on grass", "Seen in the garden", "Walk on the football pitch"*
Source of knowledge	**k**	Where information had been obtained from. *"My Dad told me", "I watched this video"*
Feelings	**f**	An emotion or emotive opinion. *"It isn't very nice", "Really cute and cuddly"*
Human influence/ action	**h**	Any activity of humans that affects the natural world. *"Pick the flowers", "Cut the grass"*
Personal experience	**e**	Any statement that indicates that the child knows about this from their own first-hand experience. *"Saw one in my garden"*
Cultural	**c**	Words / phrases that indicate a particular culture. *"In India", "In England", "Queen Elizabeth the First sat under this tree"*
Anthropocentric	**a**	Animal or plant influence/ effect on humans. *"Poisonous", "It bit me", "Can kill you"*

We do not make the claim that these categories are exhaustive nor that they arise from any systematic theoretical stance. Rather, as with any approach incorporating elements of grounded theory (Strauss & Corbin, 1998), the categories manifest their validity and usefulness by their faithfulness to the data collected and the richness of interpretation that they allow. We are grateful to Professor John Gilbert for pointing out to us that *post hoc* examination of these categories suggests that they can be combined into three superordinate (i.e. overarching) categories:

- the location of the object (categories l and c)
- the acquisition of knowledge by the respondent (categories k and e)
- the perception of consequences for the respondent (categories f, h and a).

RESULTS FROM THE CASE STUDIES

How do 9/10 year-old pupils shown a photographic probe express their depth of understanding of human features?

The pre-visit interviews for the six Meadvale 9/10 year-olds when they were shown photographs and asked to tell what they knew about the objects elicited a total of 239 comments classed as *human features* (Appendix 1). Of these, the clouds probe gave rise to much the lowest total (12). The other objects produced responses that ranged in number from 24 (squirrel) to 39 (daisy). The most common categories were human influence/action (58) and personal experience (58) with anthropocentric having the fewest (6). From these totals we can say that for these pupils the effect of human beings on the natural world and their own direct experience of the animals, plants and other objects are highly important. The source of this knowledge (41) and the place where the objects are found (43) are also personally very significant. In addition the following trends within each category were noted:

- All pupils mention the location where each object is found, usually human settlements, although some wild places are mentioned. Most often these places are connected to their home and family. Sometimes other countries are mentioned especially if the child has lived there. School grounds are often mentioned.
- Most report that they have actually seen the object, usually with other family members but also from TV, films and books. Most refer to the photographic probe directly. Physical contact with the natural world is important to them.
- Appearance and touch were mentioned in relation to emotions. Children were upset by trees being cut down, pigeons being chased, biting ants and dirty ponds. They loved clouds for their patterns in the sky and they loved the colours in flowers.
- Human influence and action are mainly expressed within domesticated places like gardens, parks and towns, and in activities such as fishing
- All children tell of direct experience of the objects in a wide variety of settings and also recount episodes from books, TV and films.
- Children whose country of origin is outside England mention their home country for almost every object and use these experiences to compare with subsequent ones in England.
- Human beings are seen as at the centre of the environment that exists for humans who have control over it. Oak trees, for example, are seen as sources of oxygen for us and ponds as places for men to fish.

The results from the Poplar Juniors where words were used show few differences when using the different probe though there were slight differences in what the pupils said within each category which were not considered relevant for this paper.

Do pupils at different ages have different patterns?

If we take interviews where words were used with year 1, year 5 and year 9 pupils in the pre-visits (Argyl Moor, Poplar Junior and GreenLyn) we can make a comparison between ages and see if there are any category differences. The results show similar numbers of comments at each age (see Appendix 2) and some notable features.

- The place where the object lives (its location) was commented on many times at similar frequencies in all three case studies with slightly fewer comments at year 9.
- The proportion of comments on the source of the knowledge expressed by the pupils in year 1 was low and increased in years 5 and 9. Most comments were elicited from the pigeon probe for years 1 and 5 and from the ant probe for year 9.
- The feelings expressed by pupils in each age group was low, increasing slightly in year 9.
- The human influences and actions were expressed at a similar high frequency at all ages with most comments arising from the grass probe.
- The proportion of comments in the category of personal experience was high in years 1 and 5 and much lower in year 9. The daisy and squirrel probes gave rise to the most comments in years 1 and 5.
- Cultural comments were few at all ages increasing with age. At year 9 most of the cultural comments concerned the squirrel probe.
- Anthropocentric comments were infrequent at all ages, being most often elicited by the ant probe.

The location and the human influences each draw around a quarter of all comments at each age demonstrating a strong interest in how humans use these natural objects and where they occur. The high number of times that direct experience of the objects is mentioned at year 1 and 5 shows how motivated these pupils are to tell the interviewer about their encounters with these objects in the natural world. This appears to drop dramatically for year 9. At the older age children talk more about their sources of knowledge usually school knowledge.

Do pupils in a different culture express different patterns?

In the Gaya school in Rio de Janeiro, Brazil the pupils were shown the same photographs as in England except for a monkey (golden lion tamarin) which substituted for the squirrel and the *Amendoeira* tree which substituted for the oak tree. Both the golden lion monkey and the *Amendoeira* tree are common organisms in suburban Rio. We can compare the case of the year 5 Rio class with the year 5 English class (in Meadvale) that was shown photographs, described at the start of this paper (Appendix 1).

Appendix 1 reveals some interesting differences. More comments are coded for human features in Brazil (309 as opposed to 239) and in some categories there are considerable differences. The most noticeable difference for the scores is the high number of times that the monkey (golden lion tamarin) is mentioned (90) in relation to human features. It is also the case that for the Brazilian pupils there are more human feature comments for animals than for plants which is not the case with the English pupils. It should be pointed out that one researcher worked on the analysis in both UK and Brazil and the codings for both countries were checked by another researcher.

- In the Brazilian sample there is more talk about wild places as locations than in the English sample.
- As in the English sample, most Brazilian pupils report that they have observed the object often with their family and also state that physical contact with many of the objects has been important for them in some way.
- Many more feelings were expressed by the Brazilian children, who were upset by pigeons being kept in cages and causing disease.
- Brazilian children see human influences on the animals used in this study primarily through capturing, hunting and killing them, and in how such animals are fed and looked after.
- Brazilian children express more direct experience of touching animals and are introduced to that experience through the extended family. They also tell of experience gained through TV – we suspect of the same programme in the UK and Brazil!
- Brazilian pupils make stronger references to their own culture with regard to animals than do English pupils.
- Although in both England and Brazil human beings are seen as being at the centre of the environment which exists for them with humans having control over it, Brazilian pupils focused on pets e.g. monkeys and pigeons as transmitters of disease.

To summarise the differences, Brazilian children have more emotional views. They are more anthropocentric, although on both sides of the Atlantic students see humans as firmly at the centre of the environment. English children see human influences as being primarily through domesticated places such as gardens, parks and towns and activities like fishing. Brazilian children see human influences primarily through captured, hunted and killed animals and how animals are fed and looked after by people.

DISCUSSION AND IMPLICATIONS

In any research project that collects a considerable amount of data, there are various ways of analysing and interpreting these data. In this paper we are interested in what some would characterise as the non-scientific meanings that children bring with them to their science lessons. We have not undertaken a systematic analysis of the place of natural objects in the English and Brazilian science teaching (as manifested by the official curricula, pupil textbooks and so on) but there is no doubt that school science teaching focuses on a very narrow segment of what it is that pupils associate with each of these objects. Thus, for example, trees are seen scientifically as sites of photosynthesis, as objects at the base of food chains / webs, as part of the carbon cycle and so on, whereas for pupils they are seen much more broadly. Here we attempt to summarise our interpretations and relate them to the literature.

There is a widespread view at the start of the 21st Century that people are cut off from the natural world; indeed, zoos, botanic gardens and field centres see as one of their major missions a need to connect their visitors, and hence the community, with the great outdoors. It might be suggested that with increasing urbanisation and suburbinisation most people have no connection with the wild, open spaces. However, the research findings from the project are hopeful. The children with whom we worked were in touch with their environment. They observed and interpreted what they saw. They were aided in this interpretation by children's books, by TV and video and by the general public understanding of the phenomena they witnessed which they gleaned from their families, friends and school.

Children have a considerable knowledge of the living world around them from first-hand observations. From our research the English pupils had generally used sight in their observations; in Brazil they had done more touching. In both countries they experienced many of the objects through their families and through school. Especially in England, school grounds came across as important influences in a number of the interviews. In recent research in which children were interviewed in the presence of whole, live plant specimens and then preserved, whole, animal specimens (Tunnicliffe & Reiss, 1999; 2000b) it was also evident that home influences were most important in providing the children with their understandings of the organisms.

One striking conclusion from the research reported here was the importance of myth in the children's knowledge. The myths that children had about many of the objects had clearly been strongly influenced by books, TV programmes and feature films such as *Bugs Life* and *Antz* (Walt Disney). Children's media seem to play a very important part in the development of children's knowledge about certain phenomenon, such as ants for example. However, in scientific terms the information which is purveyed is both anthropomorphic in nature and often scientifically incorrect. For example, the ants in *Antz* are represented as walking upright with only four legs and breathing, not through spiracles like 'real' insects' but through an opening on their head, like terrestrial vertebrates. We do not though mean though only to use 'myth' pejoratively to mean 'scientifically inaccurate accounts'. We are struck by the power of the narrative and visual imagery in such films. They tell a strong story and as researchers we feel that this is an area ripe for further work, especially with regard to cartoon films which seem to be particularly influential for children.

The results of the research reported here show that the expression of feelings occurs when interviews with probes are conducted in school rather than in the presence of the life-size, three-dimensional representations (stuffed specimens and dioramas) of a natural history museum or the presence of real animals (Tunnicliffe & Reiss, 2000a), but that the frequency with which feelings are expressed is low. However, the cultural comparison showed a much higher level of feelings being expressed in Rio. The feelings that children have about objects in the natural world are important to them and given the opportunity they will talk about these. We would suggest that the acknowledgement of these feelings is an important aspect of the engagement of children with the natural world.

Our pupils also put human beings at the centre when they described the ways in which the various objects were used or interacted with human beings. This category of comments was a large and rich one and bears comparison with the study of a field trip by Tunnicliffe (2000). Perhaps as teachers we should pay more attention to producing school activities that draw on this rich knowledge of how humans interact with the natural world. The revealed importance of gardens and school grounds to English children and captured and cared for animals in Brazil points up the need for research in cultural differences in this field. It also suggests that teachers in England should be alert to the interests that many pupils still have in horticulture and gardening.

Most pupils described where the objects whose representations we presented to them could be found. These places were in general places of social interaction for human beings, not isolated wildernesses. Thus, parks, gardens, botanic gardens and football pitches were amongst the places mentioned. This suggests that visits to out-of-school venues do not need to be to distant 'pristine' habitats to be memorable to children. In fact, linking school science with pupil memories of local places may be an important way to start to focus on biological learning, either inside the classroom or when planning visits (cf. Simmons, 1994).

CONCLUSION

What is clear from our research is that schooling does not have such a great influence on how children understand objects in the natural environment as perhaps we might think. More could learnt by listening to pupils – listening to what they have experienced in their own worlds, what interests them and what aspects of the natural world they have learnt about through the media of books and other vehicles of popular culture. The public understanding of the natural world is worth thinking about. This should perhaps be the basis for our teaching as these ideas are the foundations on which we have to build.

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Appendix 1

	School Year 5 Poplar Jun (words/UK)									School Year 5 Meadvale (photographs/UK)									School Year 5 Ga (photographs/ Ri			
Object	l	k	f	h	e	c	a			l	k	f	h	e	c	a			l	k	f	h
Daisy	10	2	2	9	7	4	0	**34**		9	4	3	12	8	2	1	**39**		6	8	1	5
Grass	9	1	2	12	2	2	0	**28**		8	5	1	12	10	2	0	**38**		10	6	0	4
Oak tree/ Amendoeira	4	4	0	7	8	0	1	**24**		5	8	3	7	6	3	0	**33**		8	10	2	5
Pigeon	10	11	2	11	5	2	0	**41**		9	5	3	8	4	2	1	**32**		17	6	5	4
Squirrel/ monkey	4	2	0	4	8	1	0	**19**		3	4	0	5	8	3	1	**24**		14	15	13	15
Ant	8	2	0	9	9	0	1	**29**		5	7	0	8	9	3	3	**35**		14	5	2	7
Pond	6	1	0	9	6	1	0	**23**		4	3	2	9	7	1	0	**26**		8	4	0	13
Cloud	0	2	0	0	8	0	0	**10**		0	5	0	0	6	1	0	**12**		4	4	6	2
Location l	**51**									**43**									**81**			
Knowledge source k		**23**									**41**									**58**		
Feelings f			**6**									**12**									**29**	
Human influences h				**54**									**62**									**55**
Direct experience e					**53**									**58**								
Culture c						**10**									**17**							
Anthro-pocentric a							**2**									**6**						
	Total: 199									**Total: 239**									**Total: 309**			

Appendix 1: Human features analysis for pre-visits in interviews
Figures in each box are totals for the six interviewed pupils

Appendix 2

	Argyl Moor Year 1									Poplar Junior Year 5									Green Lyn Year 9						
Object	l	k	f	h	e	c	a			l	k	f	h	e	c	a			l	k	f	h	e	c	**a**
Daisy	9	2	0	9	8	0	0	**29**		10	2	2	9	7	4	0	**34**		4	3	3	7	2	1	0
Grass	9	1	1	11	8	0	0	**30**		9	1	2	12	2	2	0	**28**		5	6	1	8	0	3	2
Oak tree	6	0	0	7	7	1	0	**21**		4	4	0	7	8	0	0	**23**		4	3	2	6	1	3	0
Pigeon	4	4	0	3	5	0	0	**16**		10	11	2	11	5	2	0	**41**		6	5	2	7	1	3	1
Squirrel	4	2	1	5	9	0	0	**21**		4	2	0	4	8	1	0	**19**		4	7	1	5	0	7	0
Ant	8	1	2	8	3	0	4	**27**		8	2	0	9	9	0	1	**29**		6	11	2	3	1	1	2
Pond	7	2	0	8	7	0	0	**24**		6	1	0	9	6	1	0	**23**		0	5	0	6	1	1	0
Clouds	1	1	0	0	8	4	0	**14**		0	2	0	0	8	0	0	**10**		6	5	0	1	1	0	0
Location l	**48**									**51**									**35**						
Source of knowledge k		**13**									**23**									**45**					
Feelings f			**4**									**6**									**11**				
Human influence/ action h				**51**									**54**									**43**			
Personal experience e					**57**									**53**									**7**		
Cultural c						**5**									**10**									**19**	
Anthropo-centric a							**4**									**2**									**5**
	Total:182									**Total: 199**									**Total:165**						

Appendix 2 : Human features analysis for pre-visits in interviews
Figures in each box are totals for the six interviewed pupils