MwJ & Language
Vot 3 No. *3 Autuum* **1988**

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Article
Conceptual Differences Between Children and Adults

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1. An Anecdote

In a talk in which I described an extended case study of the young child's acquisition of biological knowledge (Carey 1985), 1 claimed that the preschool child's concepts animal and *baby* differ from our adult concepts.' One source of evidence for this claim is that 4- and 5-year-olds typically do not realize that all animals have babies, indicating a concept *linirnal* without reproduction as a core property, and a concept *baby* not tied to the young of each animal species. A few days after the talk I received a letter from Barbara Dosher, reporting a conversation with her 4-yeirr-old son. Doubting my claim, she had asked him whether pigeons havei baby pigeons. He had replied, 'Sure, and dogs have baby dogs; cows have baby cows; cats have baby cats...'. At this point, her doubts confirme(she asked 'and what about worms; do worms have baby worms? He stopped dead in his tracks, thought for a long time, and finally replied, slppwly, 'No ...worms have *short* worms.' Being an articulate youngster, he jcould explain perfectly the difference between baby animals and short w~.Mns. The essence of his account: babies are small, helpless, versions of t igger creatures, who because of their behavioural limitations, require the rigger ones to take care of them. As he explained, baby birds cannot *tlyk* and need their parents to bring them worms; baby cats and dogs do not have their eyes open, and cannot walk; and *baby* people, the archetypical baby creatures, are useless-they can't talk, walk, play, eat by themselve$, use

' In this paper I will use 'concept x' and 'meaning of the term "x"' mlerchai .'14y In bulk cases, I refer to mentally represented concepts and meanings. fn *Carey* I't15 both linguistic and nonlinguistic methods were employed to diagnose the young 0111d'$ concepts and meanings In every case that I found a difference in meaning of *r* terni 'x' between the child's lexicon and the adult's, there was a corresponding drlterence ¡n the concept x, as revealed by patterns of inductive projection, sorting tasks, and other tasks riot requiring the use of the term.

the toilet or anything. His idea seems to be that worms are so behaviourally bankrupt that there is no way for the small ones to have a limited repertoire relative to the bigger ones. Therefore, you would not want to call them 'babies'. When pressed by his mother whether you could think of short worms as baby worms, he replied that you could if you wanted to, but then you might as well think of small rocks as baby rocks.

This anecdote illustrates that properties of animals which are embedded in a biological context in the adult's conceptual system are not so embedded in the,' conceptual system of the preschool child (see Section 4 below). Further, the child's drawing the distinction between 'baby' mammals and birds, on the one hand, and 'short' worms, on the other, is consistent with my claim that he has a different concept baby than do you or 1. But just what does that claim come to? First of all, having different concepts is to be dis inguished from holding different beliefs. Nobody would doubt that children hold different beliefs from adults. Holding different beliefs about worms, animals and babies might well lead to asserting that worms do not hive baby worms. Thus, the anecdote above certainly is consistent with a less radical claim than that the child's concepts baby and *animal* differ from the adult's. Concepts may differ along many dimensions; no doubt there is no single sense of 'different concept' to be defended. I assume that there is a continuum of degrees of conceptual differences, at the ey treme end of which are concepts embedded in incommensurable conce itual systems. In this paper I wish td explore the possibility that in some ccases the child's conceptual system may be incommensurable with that oif the adult's, in Kuhn's (1982) sense of local incommensurability. It is to the notion of local incommensurability that I now turn.

2. *Local* ***Incommensurability***

2.1 Mismatch of Referential Potential

In his contribution in this issue, Kitcher outlines (and endorses) Kuhn's thesis that there are episodes in the history of science at the beginnings and ends of which practitioners of the same field of endeavor speak languages that are not mutually translatable. That is, the beliefs, laws, explanations statable in the terminology at the beginning, in language l (LI), cannot be expressed in terms of the terminology at the end, in language 2 (L2). As he explicates Kuhn's thesis, Kitcher focuses on the referential potential of terms. He points out that there are multiple methods for fixing the reference of any given term: definitions, descriptions, theory-relative similarity to particular exemplars. Each theory presupposes that for each term, its multiple methods of reference fixing pick out a single referent. Incommensurability arises when an LI set of methods of reference fixing for some term are seen by L2 to pick out two or more distinct entities. In the most extreme cases, the perspective of L2 dictates that some

of [.I's methods fail to provide any referent for the term at all, whereas others provide different referents from each other. For example, the definition of 'phlogiston' as 'the principle given off during combustion', by our lights, fails to provide any referent for 'phlogiston' at all. However, as Kitcher points out, in other uses of 'phlogiston', where reference is fixed by the description of the production of some chemical, it *is* perfectly possible for us to understand what chemicals are being talked about- For example, in various descriptions of how to produce 'dephlogisticated air', the referent of the phrase can be identified as either oxygen, or oxygen enriched air.

As Kitchens hypothetical conversation between Priestley and Cavendish is meant to show, even contemporaries who speak incommensurable languages can communicate, since communication is ensured if one can figure out what the other is referring to. This is possible, ev 2n in cases of mismatched methods of reference fixing, for two reasons. First, even in cases of language change between LI and L2, the methods of reference fixing for many terms that appear in both languages remain entirely constant.[2] Further, even for the terms for which there is mismatch, there is still some overlap, so that in many contexts the terms will refer to the same entities. Second, communication is possible because the two speakers can learn each others' language, including mastering the other's methods of reference fixing.

2.2 Beyond Reference

If speakers of putatively incommensurable languages can, in some circumstances, understand each other, and if we can, for analogous reasons, understand texts written in a language putatively incommensurable with our own, why do we want to say that the two languages are incommensurable? In answering this question, Kuhn moves beyond the referential aspect of language. To figure out what a text is referring to is not the same as to provide a translation for the text. In a translation, we replace sentences in LI with sentences in L2 that have the same meaning. Even if expressions in LI can be replaced with coreferential expressions in L2, we are not guaranteed a translation. This is because such a process of replacement will typically replace a LI term with one L2 term in some contexts and other L2 terms in other contexts. But it matters to the meaning of **the** LI text that a single LI term was used. For example, it mattered to Priestley that all of the cases of 'dephlogisticated' were so designated; his language expressed a theory in which all dephlogisticated substances shared an essential property that explained derivative properties. The process of

[7] Kuhn's doctrine of local incommensurability differs, then, from the radical incomrnensurabilily doctrine of Feyerabend 1962, which holds that the meaning of all terms, even observation terms, is determined by the theory in which *they* are embedded, so that theory change entails incommensurability of all terms.

replacing some uses of 'dephlogisticated' with 'oxygen'; others with 'oxygen enriched', arid still others with other phrases, yields what Kuhn describes as 'a disjointed text'; one cart see no reason that these sentences are juxtaposed. A good translation not only preserves reference; if a text made sense in Ll, a good translation of it into L2 will make sense in L2.

That the history of science is possible is often offered as *prima facie* refutation of the doctrine of incommensurability. If earlier theories are expressed in languages incommensurable with our own, the argument goes, how can the historian understand those theories, and describe them to us so that we understand them? Part of the answer to this challenge has already been sketched above. While parts of Ll and L2 are incommensurable, much stays the same, enabling speakers of the two languages to figure out what each other must be saying. What one does in this process is not translation, but rather *interpretation* and language *learning.* The historian of science, like the anthropologist, interprets, and does not merely translate. Once the historian has learned L1, he or she can teach it to us, and then we can understand the earlier theory as well.

On Kuhn's view, local incommensurability arises because a language community learns a whole set of terms together, which together describe natural phenomena and express theories. Across different languages, these sets of terms can, and often do, cut up the world in incompatible ways. To continue with the phlogiston theory example, one reason that we cannot express claims about phlogiston in our language is that we do not share the phlogiston theory's concepts *principle* and *element.* The phlogiston theory's 'element' encompassed many things we do not consider elements, and, as an example of the extreme case, modern chemistry has no concept at all that corresponds to phlogiston theory's *principle.* But we cannot express the phlogiston theory's understanding of combustion, acids, airs, *etc.,* without using the concepts *principle,* element, phlogiston, fur these concepts are all interdefined. We cannot translate sentences containing 'phlogiston' into pure 20th century language, because when it comes to using words like 'principle' and 'element' we are forced to choose one of two options, neither of which leads to a real translation:

1. We use 'principle' and 'element', but provide a translator's gloss before the text. Rather than providing a translation, we are changing L.2 for the purposes of rendering the text. The translator's gloss is the method for teaching speakers of L2 the new language.
2. We replace each of these terms with different terms and phrases in different contexts, preserving reference, but thereby produce a 'disjointed text'. Such a text is not a translation, because it does not make sense as a whole.

2.3 Conceptual Differentiation

if two successive langua,,;es are incommensurable, then typically change at the level of individual concepts has occurred in the transition from one

to the other. There are several types of conceptual change--different ations (as in Galileo's differentiation of average *velocity* from *instantaneous velocity;* **see** Kuhn 1977), coalescences (as when Aristotle's distinction between natural and *violent* motion was seen to be a distinction Without a difference, and the two were collapsed into a single notion), and simple properties being reanalyzed as relations (as in the concept weight *before* and after Newton.)

Characterizing change at the level of individual concepts is no simple matter. We face problems both of analysis and of evidence. To explore these problems, let us consider just one type of conceptual change-conceptual differentiation. The cases of differentiation that involve local incoCnmensurability are those in which the undifferentiated parent concept from L1 plays no role in L2. Not all cases in which distinctions previously undrawn come to be drawn imply incommensurability. The 2-year-old may not distinguish Collies, German Shepherds, Cocker Spaniels and Poodles, and therefore have an undifferentiated concept *dog* relative to adults, but the concept dog could well play the same role in both the 2-year-old's and the adult's conceptual system.'

Consider McKie and Heathcote's (1935) claim that before Black *heat* arid *temperature* were not differentiated. This would require that thermal theories before Black represented a single concept, fusing our concepts *heat* and *temperature.* Note that in the language of our current theories, there is no superordinate term that encompasses both of these meanings. Indeed, by our lights there could be no concept for such a term to express. Heat and temperature are two entirely different types of physical magnitudes; heat is an extensive quantity, while temperature an intensive quantity. Extensive quantities, such as the amount of heat in a body (e.g. 1 cup of water), are additive-the total amount of heat in two cups of water is the sum of that in each. Intensive quantities are ratios and therefore not additive-if 1 cup of water at 80 degrees F is added to 1 cup at 100 degrees F, the resultant temperature is 90 degrees F, not 180 degrees F. Furthermore, heat and temperature are interdefined-e.g. a calorie is the amount of heat required to raise the temperature of I gram of water 1 degree centigrade.

To make sense of McKic and Heathcote's claim, then, we must be able to conceive how it might be possible for there to be a single undifferentiated concept fusing heat and *temperature* and we must understand what evidence would support the claim. Often purely linguistic evidence is offered; 1.1 contains only one term, where L2 contains two. However, more than one representational alternative could underlie any case of undifferentiated language. Lack of differentiation between heat and *temperature* is surely representationally different from mere absence of the concept *heat,* even though languages expressing conceptual systems with either sets of ther-

' Carey 1985 argues that the 2-year-old's concept *dog* differs from the adult's, but not because it is undifferentiated relative to the **adult's.**

mal concepts might have only one word, 'hot'. A second representational state of affairs that might mimic nondifferentiation is the false belief that two qu ntities are perfectly correlated. For example, perhaps before Black's discoveries of specific and latent heat, scientists believed that adding a fixed a nount of heat to a fixed mass always led to a fixed increase in temperature. Such a belief could lead scientists to use one quantity as a rough end ready stand-in for the other, which might produce texts that would 'suggest that the two were undifferentiated.

The only way to distinguish these two alternative representational states of affairs (false belief in perfect correlation, absence of one or the other concept) from conceptual nondifferentiation is to analyze the role the concepts played in the theories in which they were embedded. Wiser and C$rey 1983 analyzed the concept *heat* in the thermal theory of the seventeenth-century Academy of Florence, the first group to systematically study thermal, phenomena. We found evidence supporting McKie and Heathcote's claim of nondifferentiation. The Academy's *heat* had both causal strength and qualitative intensity-that is, aspects of both modern *heat* and *temperature.* The Experimenters (their own self-designation) did not separately quantify heat and temperature, and unlike Black, did not seek to study the relations between the two. Furthermore, they *did* relate a singe thermal variable to mechanical phenomena, *degree of heat,* which by analyzing contexts we now see sometimes referred to temperature and sometimes to amount of heat. Therefore, we can be confident in ascribing a single undifferentiated concept that conflated *heat* and *temperature* to these 'seventeenth-century scientists. No such concept plays any role in any theory after Black.

2.4 Summary

When we ask whether the language of children (Ll) and conceptual system it expresses (C1) might sometimes be incommensurable with the language (1.2) and conceptual system (C2) of adults, where C1 and C2 encompass the same domain of nature, we are asking whether there is a set of concepts at the core of C1 that cannot be expressed in terms of *C2,* and vice-versa. We are asking whether L1 can be translated into L2 without a translator's gloss. Incommensurability arises when there are simultaneous differentiations and coalescences between C1 and C2, such that the undifferentiated concepts in CI no longer play any role in C2 and the coalesced concepts played no role in C1.

3. Four Reasons to Doubt Incommensurability Between Children and Adults

I have encountered four reasons to doubt that children's conceptual systerns would ever be incommensurable with adults':

1. Ac ults communicate with preschool ch ldren just fine.
2. *Ps,'c*hologists who study cognitive development depict children's conceptualizations in the adult language.
3. Where's the body? Granted children cannot express all of the adult conceptual system in their language, but this is because L1 is a subset of *L2,* not because the two are incommensurable. Incommensurability requires that *L2* not be able to express *L1* as well as *L1* not being able to express *L2.* Where does children's conceptual systems provide any phenomena like those of the phlogiston theory? Where is a preschool child's 'phlogiston' or 'principle'?
4. There is no way that incommensurability could arise. Children learn their language from the adult culture. How could children establish sets of terms that are interrelated differently from adult interrelations?

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Those who offer one or more of the above objections share the intuition that while the young child's conceptual system may not be able to express all that the adult's can, the adult can represent the child's ideas. Cognitive development, on this view, consists of enrichment of the child's conceptual system, until it matches that of the adult.

3.1 Adults and Preschool Children Communicate

The answer to this objection has two parts. First, as stressed above, local incommensurability does not require complete lack of communication. Locally incommensurable conceptual systems may overlap considerably on totally common ground. Second, as the anecdote about the concept *baby* indicates, it is an empirical question just how perfectly adults understand preschool children. Had it not been fo. the question of whether worms have baby worms, B. Dosher would not have realized that her son meant something different by his claim that dogs have baby dogs than what she would mean.

3.2 Developmental Psychologists Must Express Children's Beliefs in the Adult Language; Otherwise, How is the Study of Cognitive Development Possible?

This question is analogous to that discussed in Section *2.2,* namely, how is it possible for the historian of science to express in today's language an earlier theory that was expressed in a putatively incommensurable language? And the answer is also analogous, again coming in two parts. First, to the degree that the child's language is incommensurable with the adults, the adult does not express the child's beliefs in our language. Rather, the adult interprets the child's language, learns it, and teaches it to us. Second, this is possible because of the considerable overlap between the two,

enabling the psychologist, like the historian, to be interpreter and language learner.

3.3 Where's the Body?

The most convincing cases of local incommensurability from the history of science exemplify the extremes sketched above, such as the incommensurability of the phlogiston theory and modern chemistry. In such cases, mismatches of methods of reference sometimes lead to uses of terms where in the lights of L2, a term of Ll has no referent at all. Also, in such cases the sets of interdefined terms in Ll contain members with no corresponding terms at all in 1.2, such as 'phlogiston' and 'principle'. The 'body' being sought is such a case where the child Ll contains terms that are absent from the adult 1?, and cannot be defined in L2. Let me admit now that I know of no such example--1 cannot produce the body required. However, local incommensurability does not require these extremes. Newtonian mechanics is incommensurable with Einsteinian mechanics, but Newton's system contains no bodies in this sense. Similarly, the Florentine Experimenters' source-recipient theory of thermal phenomena is incommensurable with the caloric theory, but contains no such bodies. In these cases, incommensurability arises from **sets** of core concepts being interrelated in different ways, and from several simultaneous differentiations and coalescences. Thus, while there may be no bodies such as 'phlogiston' or 'principle' in the child's language, it is still an empirical questicn whether cases of incommensurable conceptual systems between children and adults **are** to be found.

3.4 How Would Incommensurability Arise?

Presumably, the reason that there are no bodies as sought in Section 3.3, at least in the case of L1, is that the child learns language from the adult culture. E.g. the child learning chemistry and the explanation for combustion would never learn a word like 'principle'. When Kuhn speaks of the sets of interrelated terms that shift in meaning between incommensurable systems, he invariably speaks of these as 'being learned together' when one learns the language. Being learned together is necessary, since each term cannot be understood in isolation. But the language being spoken to the child is L2; why would the child construct a L1 incommensurable with L2?

While children learn language from adults, they are not blank slates as regards their conceptual system. As they learn the terms of their language, they must map these onto the concepts they have available to them. Their conceptual system provides the hypotheses concerning word meanings. Thus, the language they actually construct is constrained both by the language they are hearing and the conceptualization of the world they have already constructed. Local incommensurability could arise when this

conceptualization is incommensurable with the C2 that L2 expresses.

In this section I have countered four arguments that we should not expect incommensurability between young children's and adult's conceptual systems. Of course I have not shown that such incommensurability actually ever obtains. That is the task of the next section.

4. The Evidence

I have carried. out case studies of children's conceptualization- of two domains of nature, and in both cases the child's concepts are Locally incommensurable with the adult's. One domain encompasses the child's concepts *matter, material kind, weight, density* (Smith, Carey and Wiser, *1985;* **see** also Piaget and Inhelder *1941).* The other domain, more extensively studied, encompasses the child's concepts *animal, plant, alive, person, death, growth, baby, eat, breathe, sleep,* etc. Here I will draw my examples from the second case. Space allows the sketchiest treatment; see Carey *1985* for a full account of empirical data drawn from interviews with children on death, reproduction, the human *body,* as well as data drawn from patterns of attribution of various biological properties to animals, plants and inanimate objects, from pattern of inductive projection, as well as other experimental paradigms. I argue that conceptual changje occurs between the age of 4 and 10.

The central phenomenon diagnosing developmental cases of incpmmensurability is the same as that diagnosing historical cases as well: the child seems to hold beliefs that are inexplicable to the adult, such as irawing the distinction between *baby* mammals and birds and *short* wirms, or claiming that buttons are alive because they hold one's pants up. Of course, such phenomena merely raise the possibility of local incommensurability, since it is possible that they result from no more than the child's holding different beliefs from the adult, different beliefs formula ed over the same conceptual base. The only way to tell is to analyze the 4hole set of concepts and beliefs which underly them. Before giving a Ilavór of such an analysis, I will present an overview of the preschoo child's conceptualization of animals.

4.1 An Overview-The Preschool Child's Concept Animal

At the core of preschool children's conception of animals is the capacity of animals to act. An animal's action is explained in terms of intentional causation; i.e. an animal's behaviors are understood in terms of its wants and beliefs, just as are a person's behaviors. The child thinks of people's and animals' bodies as the physical support for action-legs are for walking, mouths for making noises and eating, eyes for seeing, etc. Thus the important conceptual contrast for the child is between things capable of self-generated behavior, on the one hand, and inert objects which can only

move through the agency of an external cause. Carey 1985 characterized the preschool child's theory of animals as a 'naive psychology' because of its focus on action, but it could also be dubbed a 'vitalist biology' because of its focus on internally generated activity as the core property of animals. At any rate, this theory differs from the 'mechanistic biology' of the 10-year-old (or biologically unsophisticated adult) in two major respects. First, preschool children do not understand that each animal species must solve such' universal biological problems as reproduction and obtaining food. *therefore, they do not realize that all animals share certain aspects of* the solutions to these problems, while each species is simultaneously characterized by some unique aspects of its solutions. Relatedly, they do not understand eating, breathing, the circulatory system, the nervous system, etc., as constituting interrelated bodily systems, the teleological goal of which is to maintain and support the bodily machine. Ten-year-olds have constructed a mechanistic biology in both of these respects.

4.2 The Child's Conception of Death

To get a feel for the evidence for this characterization, a good place to start is with the child's concept, death, since it exemplifies non-differentiation, and ;its interpretation requires the interpretation of many interrelated conceptions, including *alive* and internal *body parts* and *bodily functions.* Beca ise of the importance of the concept *death* to psychoanalytic theory, them have been many studies of the young child's concept, mostly relying on irterviews or on case studies of the authors' own children (cf. Anthony 1940 Koocher 1974; Nagy 1948; or Von Hug-Hellmuth 1964, for typical exan ples). All of these sources agree that the characterization of the presch o I child's concept *death* is nonbiological. At this age the essence of cleat is the separation from the dead. According to the child's understanding, the dead live on, in altered circumstances (under the ground, for example). Death is seen as avoidable and reversible, as a special *type* of sleet.

Ta lie 1 lists bits of conversations between my own preschool daughter and yself that are typical of the material in the case studies and interviews cone'rning death. Vignette 1 shows her first understanding of death as entailing the absence of the dead person-'it's sad because you can't talk to him'. That the dead still exist, living on in altered circumstances, is shown in Vignette 4, in which she wonders how dead people go to the bathroom. I show these vignettes, however, because *they* make a point not mentioned in the literature on the child's conception of death, and that ~s that death is, for the child, part of an undifferentiated concept that ncludes *unreal,* nonexistent, inanimate, and other features not part of our aduli conception. The basic nondifferentiation is between two senses of 'not à live', namely 'dead', as in the sense that George Washington is not alive and 'inanimate', in the sense that a table is not alive. This single non(#ifferentiated notion plays no role in our adult conceptual system, and

it gets the child into conceptual difficulties (from our point of view), as shown in vignettes 3 and 5. In Vignette 5 Eliza wonders why, if statues are not alive, one can still see them, since her Grandpa is dead and you can't se,_ him. My attempts to explain the difference between 'inanimate' and 'dead' only increase her puzzlement, adding the problem of *why you* can see tables and chairs, since they are not alive. In Vignette 3, Eliza gets tied up as to the status of her stuffed bear, concludes that she (the bear) is middle-sized, between alive and dead, and maintains that the bear moves sometimes.

The lack of differentiation of two senses of 'not alive'-dead and inanimate-results from, and plays a role in, the child's concept alive.

4.3 The Child's Conception *6f Life*

That the child's concept of life differs from the adult's is suggested by the robust phenomenon of childhood animism, first described by Piaget 1929. Piaget showed that children under age 6 or 7, when interviewed about what it is for something to be alive, maintain that active, useful, things are alive, and say that one or more of the sun, bicycles, cars, the moon, wind, and fire are alive. This phenomenon has now been replicated hundreds of times (see Chapter 1 of Carey 1985, for a review). Two sets of data show the relation between childhood animism and the nondifferentiation of *dead* and inanimate. In the animism interview, the child is being asked to judge whether each of a list of animals, plants, and inanimate objects is, or is not, alive. Preceding the interview, if asked to give some examples of things that are not alive, preschool children answer 'George Washington', 'my grandfather', 'monsters', 'fairies', 'pictures', 'movies...' (Carey 1985). What preschool children do not offer as examples of things that are not alive are inanimate objects such as tables and chairs. Thus, when preschool children are deciding whether the sun is alive or not, they are not answering the question we think we are putting, namely, whether the sun is animate or inanimate, because they cannot even entertain that *question, not having differentiated inanimate from dead. Rather, they are* deciding whether the sun is *active, real,* existent, present, on the one hand, or *dead, imaginary,* nonexistent, *a mere representation,* on the other,

The second set of data showing the interrelation between the phenomenon of childhood animism and the nondifferentiation of *inanimate* from *dead* is from the first replication of Piaget's animism studies in English. Russell and Dennis 1940, posed the question to their subjects as follows:

> You know what it means to be alive. A cat is alive, but if it gets run over it is dead. Now, is a car alive or dead? Is the sun alive or dead? Is a tree alive or dead?...

To us, the question of whether a car is alive or dead involves a category mistake; the very question presupposes that a car is the kind of thing that

Table I

One preschooler's struggle with the concept of death

Vignette 1 (2:6)
Eliza first became interested in the concept of death at about 2:6 when she was told that her grandfather, Eli, had died before she was bom. Out of a long explanation she gathered that when somebody is dead you can't talk to them. For several months, she would bring up the tact that her grandpa was dead and that was sad because you couldn't talk to him.

Vignette 2 (3:6)
W, arching a TV prograr; whcre sotviebody was shot, she said excitedly, 'lie's dead-I can left because he's not moving.'

Vignette 3 (around 3:6)
S. What do you have in you?
E. Skin.
S. htiside?
E. bones.
S. Anything else?
E, blood.
S. Does *your* bear have bones and blood inside her?
E. No, because she's not a big, real person.
S. Are you?
E. Yes, well, not very big-she can never die, she'll *always* be alive)
S. is she alive?
E. No-she's dead. HOW CAN THAT BE?
S. Is she alive or dead?
E. Dead.
S. Did she used to he alive?
E. No, she's middle-sized-in between alive and dead. She moves sometimes.

Vignette 4 (around 3:6)
E. How do dead people go to the bathroom?
S. What?
E. Maybe they have bathrooms under the ground.
S. Dead people don't have to go to the bathroom. They don't do anything; they just lie there. They don't eat or drink, so they don't have to go to the bathroom.
S. But they ate or drank before they died-they have to go to the bathroom from just before they died (triumphant at having found a flaw in my argument).

Vignette 5 (around 3:8)
E. Isn't it funny-statues aren't alive but you can still see them?
S. What's funny about that?
E. Grandpa's dead and you can't see him.
S. Oh, I see. Well, you know, people and animals can be alive and dead--first they are alive and then when they die, they're dead. but other things, like chairs-they aren't ever alive, so *they* can't die.
S. That's right. Tables and chairs are not alive arid they're not dead and you can still see them. Isn't that funny, they're not alive, but you can still see them.

could be dead. Nonetheless, this replication yielded data indistinguishable from the standard Piagetian interview, in which the question ìs pu 'Is a car alive or not alive?' But this should now come as no surprise. We have already seen that for the preschool child, the question of whether an bject is alive or inanimate is the same question as whether an object is alive or dead, although not the same *as either of* these questions as put *by* an adult.

For both children and adults, the concepts *death* and *life* are interrelated, albeit in different ways. For preschool children, they are merely opposites: 'dead' is 'not alive'. Both 'alive' and 'dead' are nonbiological concepts for the preschool child, and both are part of larger undifferentiated (from the adult point *of* view) concepts. For adults, death is not simply the negation of life. Rather, death is a biological necessity, the inevitable breakdown of the bodily machine, and the end of the life cycle of every living organism. Preschool children could not possibly have this biological conception of death, for they lack the notion of the bodily machine.

4.4 The Human Body

Preschool children are largely ignorant of the organs found inside the human body. As Eliza answered when asked what was inside her, (Table 1, Vignette 3), most typically children of this age know only of blood and bones-what comes out if you cut your skin and what you can feel. Insofar as they know internal organs, they assign functions to them on the principle: one organ, one function. The stomach is for food, the heart for making blood, the brain is for thinking, etc., just as the eyes are for seeing and the legs for walking. At this age the child knows no interrelations between such processes as eating and breathing, nor between bodily systems such as the circulatory and digestive systems. Rather, *they* conceptualize processes such as eating and breathing in terms of the behavior of the whole person, and not in terms of the functioning of internal body parts. Eating, for example, is a process of the same sort as playing, bathing, and talking. Important facts about eating include when one is allowed to eat candy, the difference between breakfast, lunch and dinner, that eating makes you feel better if you are hungry. Children of this age may know such regularities as that if you don't eat healthy food you will get sick, and that *if you* don't eat a' . 11 you may die, but as of *yet* they know of no bodily mechanisms ui.. eilying such regularities. One indication that processes such as breathing and eating are not *yet* seen as supporting life is that preschool children do not realize that all animals eat and breathe, just as *they* do not realize that all animals have babies.

By age 10 this picture no longer holds. Now children know many internal body parts, and they have constructed a crude mechanistic biology *theory* that encompasses all animals. This theory, dubbed by Crider 1981 'the container theory', states that certain crucial substances (e.g., food, air) must be delivered to all parts of the body to support growth and activity. The

body has major containers for each substance, the lungs for air, the stomach for food, and the circulatory system delivers these substances all around. And as' the studies of the child's concept *death* universally show, it is at the age~ ~that children have this mechanistic theory that they first conceive of death death tliologically, as resulting from the breakdown of bodily functioning. Asked lie causes of death, an articulate child with this type of understanding re lied, 'When the heart stops, blood stops circulating, you stop breathi ig, and that's it...Well, there's lots of ways it can get started, but that's hat really happens' (Koocher *1974).*

5. Are the Preschool Child's and the Adult's Concepts Inconrinensurahle7

I submit that the preschool child's concept *animal* and the adult's are embedded in locally incommensurable conceptual systems. Here I have attempted to support my contention by showing that the child's conceptual system includes undifferentiated concepts that no longer play any role in the adult conceptual system. Coalescences also occur. For the preschool child, tnimals and plants are totally different types of things-animals, as we ha'e seen, are fundamentally behaving beings, while plants are non-active ;natural kinds, like rocks. Preschool children consider it a category mistake to attribute animal properties like eating, breathing, or having babies to plants (Keil *1983). By* age 10, the concepts *animal* and *plant* have been coalesced into the single biological concept *living thing,* the latter playing no role whatsoever in the conceptual system of the preschool child (see Chapters 1, 5 and 6 of (arey *1985)*

These simultaneous differentiations and coalescences yield mismatch of referential potential between the language of preschool children and adults, and also ensure that the child's beliefs cannot be expressed in the adult language without a translator's gloss. I have sketched such a gloss for the child's, terms 'alive', 'not alive', and 'dead'; Carey *1985* does a more thorough job, and also glosses 'mother, father, baby, eat, breathe, grow', and a host, of additional interrelated terms. In the course of the emergence of an intuitive biological theory in the years before age 10, all of these concepts are simultaneously adjusted. Returning to the anecdote concerning 'short worms', this analysis reveals that the child's concepts *baby* and *animal* are different from the adult's, in the strong sense of being part of locally incommensurable conceptual systems.

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