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The scope of teleological thinking in preschool children

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Abstract

These studies explore the scope of young children's teleological tendency to view entities as 'designed for purposes'. One view ('Selective Teleology') argues that teleology is an innate, basic mode of thinking that, throughout development, is selectively applied by children and adults to artifacts and biological properties. An alternative proposal ('Promiscuous Teleology') argues that teleological reasoning derives from children's knowledge of intentionality and is not restricted to any particular category of phenomena until later in development. Two studies explored the predictions of these two hypotheses regarding the scope of children's functional intuitions. Using different methods, both studies found that, unlike adults, preschoolers tend to attribute functions to all kinds of objects – clocks, tigers, clouds and their parts. A third study then explored this finding further by examining whether the developmental effect was due to differences in children's and adults' concept of function. It found that both children and adults predominantly view an object's function as the activity it was designed to perform. Possible explanations for the developmental differences found in the first two studies, and implications for notions of a teleological stance are discussed.

Keywords: Teleology; Function; Intention

1. Introduction

Within the contemporary study of cognitive development much interest has focused on two areas: young children's ability to adopt the 'intentional stance' and construe others as rational agents and their 'essentialist' intuitions about the

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underlying nature of natural kinds. In relation to the intentional stance, between 9 and 18 months of age, babies demonstrate an active knowledge of others' intentions and internal states (e.g. Premack, 1990; Leslie, 1994; Gopnik and Meltzoff, 1997). They are sensitive to the fact that agents act in goal-directed ways (Gergely et al., 1995) and can use a person's line-of-regard to infer referential intent (Baldwin, 1993). By 3- or 4- years of age, children's 'naive psychology' is such that they can competently explain others' behavior in terms of mental states such as beliefs and desires (e.g. Gopnik and Astington, 1988; Bartsch and Wellman, 1989; Leslie, 1994). In relation to essentialism, young children show an early bias to believe that natural kinds have core properties that determine their appearance, identity and category membership. They understand, for example, that although two entities may look very similar, they can belong to entirely different classes of entities and that altering natural objects in superficial ways does not affect their kind (Keil, 1989; Gelman et al., 1994).

An area that is closely related to both these lines of research concerns teleological reasoning – reasoning based on the assumption of goal, purpose or function. Like essentialist and intentional reasoning, such thinking is a central component of adults' everyday psychological and biological thought. When reasoning about others' behavior, adults make the teleological assumption that people's actions are directed towards certain goals. Similarly they presume that human artifacts, such as chairs and coats, are designed by their creators to fulfill some intended purpose. Biological structures are also construed in terms of teleological function; people view noses as *existing to* smell odors and hearts as *for* pumping blood. These kinds of intuitions about purpose play an important part in constraining adults' interpretations of why events or objects occur and why objects have the properties that they do (see Dennett, 1987). However, there is still relatively little known about children's teleological intuitions. This article focuses on one aspect of children's teleological understanding – the extent to which preschool children tend to view objects as existing to perform functions. One proposal is that from early on, children, like adults, restrict their functional intuitions to considerations of biological traits and artifacts. This article explores an alternative view which suggests that young children may have much broader tendencies than adults to view all kinds of entities as existing for a purpose. Several studies were conducted to explore this issue. The implications of their results for both views are discussed.

1.1. Selective Teleology

To date much of the work on children's teleological thought has occurred in the context of the debate on whether children have an intuitive theory of biology from very early on in life. A prominent claim is that until the elementary school years, young children do not possess an understanding of biological processes that is independent of their naive psychology (Carey, 1985, 1995; Solomon, 1995). In response to this, several researchers have argued that young children do have biology-specific conceptions and that an innate teleological stance – a tendency to construe objects as 'designed for a purpose' – lies at the core of this understanding.

More precisely, it is argued that, like adults, young children intuitively interpret biological parts, such as ears, as existing to perform biological functions. There are several accounts of why this is the case. One proposal is that these biological insights result because the teleological stance evolved as part of a mental module committed to categorizing living things. According to this view, adults come to view human-made artifacts such as chairs in teleological terms by drawing analogies to biological structures (Atran, 1994, 1995a). Another proposal is that the teleological stance is a general mode of construal which, while not innately tied to any object kinds, is triggered more successfully by biological traits and artifacts because their discrete physical parts act as perceptual cues to functional reasoning (Keil, 1992).

Despite their differences, these alternative characterizations of the teleological stance overlap in at least two ways. First, both agree that the teleological stance is innate and is a primary aspect of cognitive architecture that exists independently of the physical or intentional stances. Second – and more critically for the topic of this paper – the scope of young children's and adults' teleological intuitions is thought to be restricted (hence the labeling 'Selective Teleology' (ST)). The teleological stance applies to biological traits, artifacts, and their parts because such objects obviously exist to perform functions. However, the stance is less engaged when considering natural kinds such as mountains and their parts, either because such objects do not fall within the scope of the living thing module, or are not functional in any obvious sense. The latter theory also implies that while children and adults may intuitively view a biological structure such as a giraffe's neck in functional terms, the giraffe itself may be an unlikely candidate for teleological construal since it does not serve any directly perceivable purpose[1].

In a study by Keil (1992, 1994a,b, 1995a), the proposal that children limit their teleological intuitions about the natural world to biological properties was directly addressed. Kindergarten and second grade children were shown either emeralds or plants and asked to choose between two explanations for their green appearance. The first was functional ('they are green because it helps there to be more of them') and the second was physical ('they are green because tiny parts mix together to give them a green color'). As predicted, second graders preferred functional explanations for plants and physical explanations for emeralds. Kindergartners showed no preference. These findings are seen as supporting the existence of a intuitive bias to think about living rather than non-living natural objects in teleological terms.

However, while the results from this study are suggestive, there are difficulties with interpretation. The absence of a clear finding with kindergarten children, while perhaps a result of the rather abstract descriptions used, is problematic for the claim that, from early on, the teleological stance demarcates biology from other natural domains. A further difficulty is that the teleological statements were worded using phrases such as 'p *helps* there be more q', 'it is *better for* p to have q'. These are phrases which adults do not tend to use when referring to non-living things even if,

[1]It is less clear whether the modular view also implies this: whole organisms obviously fall within the scope of the living thing module. However, descriptions of this module suggest that it is biological structures, not biological wholes, that trigger an automatic teleological construal of living things (see Atran, 1995a).

as in the case of artifacts, they are talking about them in teleological terms. As a result, children may have preferred these kinds of statements with plants because they associate this kind of language with living things, not because they were responding to teleological content.

1.2. Promiscuous Teleology

Another hypothesis, 'Promiscuous Teleology' (PT) provides an alternative account of the origin of the teleological stance and makes different predictions about the scope of children's functional construal. First, it argues that rather than being a basic bias, the teleological stance derives from children's understanding of agency and intentional object-directed behavior and may never become entirely autonomous from the intentional domain. Second, PT suggests that due to these origins the teleological stance is applied broadly rather than selectively early in development: Infants may start out generally assuming that objects exist to be used by agents in some way and subsequently, in lieu of alternative explanations, develop the teleological belief that virtually all sorts of living and non-living entities are intentionally caused for a purpose. Children may only begin to revise and restrict this belief once they begin to assimilate more formal scientific ideas, both indirectly, through hearing the way adults talk about different phenomena, and directly, through schooling. It is the second proposal – that children are promiscuously teleological – that is addressed by the present studies, but I will briefly outline the motivation for both claims and the developmental account linking them first (a fuller description is provided in Kelemen, 1996, 1999).

Why argue that the teleological stance originates as part of the intentional domain? One reason is that there is a close link between *adults'* reasoning about function and their intuitions about intention. The clearest case of this is with artifacts: My oven is *for* cooking rather than hiding dirty dishes because, while it performs both activities equally well, it was intentionally created to do the former not the latter (see Wright, 1973; Keil, 1989; Millikan, 1989; Neander, 1991; Kelemen, 1996, for discussion). Much to the chagrin of biology educators, similar intuitions often guide adult thinking about biological function (see Brumby, 1985). Natural selection is generally misconceived of as a process akin to intentional design. Thus, hearts exist to pump blood because nature, with foresight and purpose, made them that way for the good of the species (Brumby, 1985; Dawkins, 1986).

Of course, beliefs about the connection between intent and biological function have often run even deeper. Before mechanistic scientific theories, such as Darwinism, became widespread in Western culture, people customarily assumed that entities such as eyes and noses were beneficial artifacts purposefully contrived by gods (Paley, 1880; Hurlbutt, 1985; Livingstone, 1993). Furthermore, this construal was not limited to biological structures. As Livingstone (1993) and others have noted, throughout history, non-living natural objects have also been considered in such terms (see also Glacken, 1967; Corey, 1993). The earth, its climates, landforms, water sources, and elements, were seen as intentionally designed to create a habitat for, and meet the needs of, people. In other words, natural objects of all kinds –

particularly those fulfilling a significant function in people's lives – were candidates for construal as quasi-artifacts. This is not to say that people holding such beliefs did not draw important distinctions between natural objects such as rivers, and artifacts such as houses. It is, however, to suggest that conceptually, teleological intuitions may have been less central to that discrimination than other factors.

These kinds of general intention-based teleological ideas in adults provide a motivation for questioning whether preschool children selectively view only biological traits and artifacts teleologically. Research suggests that, like adults, children have a default tendency to reason in intentional terms in the absence of knowledge (see Piaget, 1929 on children's physics; Carey, 1985 on children's biology; Gelman and Kremer, 1991 on children's beliefs about non-living natural objects). While young children know that natural objects are not *human-made* (e.g. Gelman, 1988; Keil, 1989), without other explanations, they may nevertheless view them – as many adults have done under similar conditions – as purposefully caused by some non-human agent (see Piaget, 1929 for an alternative perspective). Although the details of such an agent might be under-specified, this notion would act as a useful theoretical placeholder until children's causal-explanatory ideas become further elaborated.

More specifically, the development of a promiscuous teleology might occur as follows. Findings described earlier indicate that children are sensitive to intentional cues and causality from very early in life. Given that this is the case the intention-based teleological assumption that intentional agents act to achieve future goals appears to be one of the first aspects of that understanding to develop: Between 6 and 9 months, babies construe animate objects as goal-directed agents (Premack, 1990; Leslie, 1994; Gergely et al., 1995) and by 12-months, infants use this mode of construal to predict a novel object's future behavior (Gergely et al., 1995). This rudimentary teleological stance is then rapidly embellished as children notice that agents' goal-directed activities are often focused upon objects that are employed as a means to an end. As a consequence, by 12 months, children demonstrate an active knowledge of familiar artifacts such as brushes and spoons (Abravenel and Gingold, 1985; see Leslie, 1994) and also begin to categorize objects according to functional properties (e.g. Kolstad and Baillargeon, 1991; Madole et al., 1993). In short, from early on, infants' attention to agents' object-centered behavior may lead them to construe all kinds of objects in teleological terms, since from the child's perspective, entities exist in their environment to achieve specific purposes (see Piaget, 1929).

How does the proposal that teleological intuitions originate in this way lead to the claim that young children develop a general view of entities as intentionally caused for a purpose? Preliminary findings suggest that, in addition to their early grasp of intentional causality, children probably possess a general 'causal determinist' bias to seek explanations for their experience (Bullock et al., 1982; Brown, 1989; see Gelman et al., 1994 and Gopnik and Meltzoff, 1997 for discussion). With a desire to explain, and an absence of knowledge, children may draw on their understanding of goal-directed behavior to conclude that all kinds of objects are intentionally caused for a purpose. Indeed, recent research suggests that young children do indeed incline towards such a belief. Evans (1994) has found that, regardless of whether they come

from a Fundamentalist or Darwinist background, 6-year-olds have a strong tendency to endorse the idea that all kinds of natural entities are made by God. Similar results have been obtained by Petrovich (1993) (see also Gelman and Kremer, 1991 in relation to children's reasoning about non-living natural objects).

In summary, what I have presented here is an account suggesting that young children may possess a promiscuous tendency to view artifacts, living, and non-living natural entities, and their parts, as existing for a purpose. I have argued that such a tendency might develop as part of the ability to reason in intentional goal-directed terms – a capacity that humans seem predisposed to acquire (Leslie, 1994; Baron-Cohen, 1995; Kelemen, 1996, 1999). This view contrasts with Selective Teleology which proposes that, from early in development if not from the outset, children, like adults, possess selective teleological intuitions focused largely on artifacts and biological traits[2].

Two studies explored these differing predictions about the scope of teleological intuitions by examining children's and adults' attribution of function to a variety of different kinds of entities. Both studies used children in the 4- and 5-year-old age range for several reasons. First, they have largely untutored formal scientific beliefs. Second, they can express themselves proficiently. Finally, this age range has been a focus of previous investigators research on children's teleological thought and conceptual differences between children and adults (e.g. Carey, 1985; Keil, 1989).

2. Study 1

In Study 1, adults and 4- and 5-year-olds were shown photographs of a broad range of living things, artifacts and non-living natural objects. They were asked what they thought the objects and their physical parts were 'for' while being given the explicit option of saying that they were not *for* anything.

To recap, both ST and PT predict that children and adults will assign functions to whole artifacts and their parts as well as to biological parts. In other words, both children and adults will view a whole artifact such as a clock, an artifact part such as a clock hand, and a biological part such as a tiger paw, as having a function. However, PT differs from ST in claiming that, unlike adults, children's broad teleological stance will also lead them to assign functions to non-living natural objects

[2]Keil's proposals about the teleological stance have been discussed in the context of Selective Teleology given the focus of his empirical research described earlier. However, in more recent work, Keil has suggested that the teleological stance may become specialized to biological traits and artifacts through a general learning process rather than through anything akin to a perceptual triggering mechanism or spontaneous sensitivity (Keil, 1995a,b; see also Atran, 1995b). Consistent with Promiscuous Teleology then, such an account implies that early in development, young children may view all kinds of objects in teleological terms. This prediction has not been explicitly stated by Keil, but it is worth noting that if this is his view then the disagreement with Promiscuous Teleology would concern the origins of the general functional construal rather than its scope – something the present studies do not directly address. (For further discussion of the origins of the teleological stance and an evaluation of each of these accounts from an evolutionary perspective, see Kelemen (1999); also Atran (1995b) and Keil (1995b).

and their parts and whole biological organisms. In other words, children, and not adults, will view whole tigers, mountains, and parts of mountains, as existing for a function.

In addition, to these major hypotheses, some minor hypotheses were also generated about responses to particular sub-classes of living things and artifacts[3]. First, although ST and PT both suggest that adults will not generally tend to assign functions to living things, it was predicted that adults might be as teleological as preschoolers about baby animals and domestic animals. This is because the former lend themselves to ecological construal as 'species perpetuators' while the latter are, in some sense, intentionally-bred human artifacts. Second, since PT predicts that children will generally view objects as 'for something', some unfamiliar artifacts were included to monitor children's ability to withhold functional responses. It was predicted that children tendency to give non-functional 'I don't know' responses to the unfamiliar artifacts would lead them assign fewer functions to these items than other artifact types.

2.1. Method

2.1.1. Subjects

Sixteen 4- and 5-year old children, from several daycare centers representing a broad range of SES, participated in the study (seven girls and nine boys; mean age = 4 years, 10 months, age range = 4 years, 4 months to 5 years, 5 months, SD: 4 months), along with 16 university undergraduates.

2.1.2. Materials

Each subject saw 22 magazine photographs of familiar and unfamiliar objects; six artifacts (e.g. a clock), 14 biological organisms (e.g. a lion), and two natural objects (e.g. a cloud). To get an overview of subjects' responses to a broad variety of object types, the artifact and living things items broke down into a number of sub-categories including several unfamiliar items. A full list of items appears in Table 1. The two unfamiliar artifacts and their parts were assigned novel names; an elaborate compass was referred to as a 'tryogaster' and its part was labeled as a 'truscle', and a surveyors instrument was labeled as a 'myometer' and its part was called a 'dorfle'. Two further cards (a dog and a snowy mountain) were used in a practice session.

2.1.3. Procedure

Subjects were tested individually over two sessions that were each approximately 20 min long. In session one, subjects were introduced to 'King Puppet' and told that his favorite game was to ask questions about pictures of different things. In a whispered aside, the experimenter then told the subjects that as King Puppet wasn't

[3]Living things were the largest category of items represented in this study due to several minor predictions regarding adults' teleological construal of various sub-classes of biological kinds. Since these predictions are not central to the main point of the study, only those regarding adults' responses to domestic and baby animals are noted here. More detail on these hypotheses and their results is provided in Kelemen (1996).

Table 1
Items and categories for study 1 (object parts are given in brackets)

Living things		Artifacts	Natural objects
Adult humans	*Domestic animals*	*Common artifacts*	
Woman (hand)	Cow (udder)	Clock (hand)	Mountain (protuberance)
Man (ear)	Cat (paw)	Jeans (pocket)	Cloud (trail)
Baby humans	*Baby animals*	*Ornimental artifacts*	
Baby (toes)	Baby bird (beak)	Ring (stone)	
Little girl (fingers)	Puppy (mouth)	Statue (arm)	
Wild animal	*Exotic animals*	*Unfamiliar artifacts*	
Lion (leg)	Binturong (tail)	Myometer (dorfle)	
Tiger (tooth)	Palm Civet (eye)	Tryogaster (truscle)	
Plants			
Plant (leaf)			
Tree (trunk)			

very smart, he sometimes asked 'silly' questions; 'questions that seem silly to even ask because they don't have an answer'. They were told that if they thought King Puppet was asking something silly, they had to be sure to tell him or he would never know. An identical protocol was used for both children and adults. Adults were told before all studies that the procedures were designed for young children and might seem childish.

2.1.4. Practice Session

Subjects first rehearsed what to say to King Puppet if they did not know the answer to a question ('I don't know') or if they thought they were being asked a question that did not have an answer ('that's a silly question'). They were then trained on the methodology using two pictures (a snowy mountain and a dog) and question–answer scenarios that included clearly silly questions ('where do you switch the dog on?') and reasonable questions ('where does the dog like to play?'). Throughout the training, there was discussion about the answers and the distinction between 'silly' and 'reasonable' questions. Three children who appeared not to grasp the distinction between the question types, did not proceed to the main part of the study and were replaced. Those children who did grasp the difference were asked to look at some more pictures with King Puppet and to remember to tell him if he asked something 'silly' or if they did not know the answer to a question.

2.1.5. Main Study

During both of the testing sessions, subjects were shown the 22 photographs in random order. As each picture was presented, the experimenter stated, 'See this? This is a picture of an X.' King Puppet then pointed and asked: 'What's the X for?' about either the object or a part of the object (e.g. 'What's the tiger for?' or 'What's the tooth for?'). Subjects received a whole and a part question about every item but

were never asked both questions about an item within the same session. There was random assignment to one of two counterbalancing groups which controlled the order in which subjects received part and whole questions across the testing sessions. Instructions and training were repeated before the second testing session.

2.2. Results

Two people (one of them blind to the predictions) coded the data into four exhaustive categories. Responses were coded as 'functional' when subjects answered the question 'What's the X for?' by stating some kind of activity or usage for the object or part (e.g. What's the clock for? Telling time). They were coded as 'silly' when subjects said that the question was 'silly' or the entity was 'not for anything'. A category was also created for 'don't know' responses. Finally uncodable answers were coded as 'other'. Agreement between the two coders was over 85%. Disagreements were resolved by a third coder who was unaware of the predictions.

To compare children's and adults' tendency to offer functional responses for each kind of entity type, a 2×6 repeated measures ANOVA was conducted. The dependent variable was the number of times subjects gave a functional response to the question 'What's the X for?'. The between subjects factor was age (children vs. adults) and the within subjects variable was entity type (artifacts vs. artifact parts vs. biological wholes vs. biological parts vs. natural objects vs. natural object parts). To control for the different number of items in each entity category, functional responses were expressed as a proportion of the total number of items in each category type. Preliminary analyses indicated no effect of counterbalancing group and so this variable was dropped from statistics. All post-hoc comparisons were conducted using Scheffe *F*-tests unless otherwise stated.

The analysis found a marginal main effect of age ($F(1,30) = 3.94$, $P < 0.06$). Children more frequently gave functional answers than adults (68% vs. 55%). There was also a main effect of entity type ($F(5,30) = 28.57$, $P < 0.01$) and an age by entity type interaction ($F(5,30) = 8.17$, $P < 0.01$). Paired comparisons indicated that the effect of entity type occurred because there was a greater number of functional responses to objects such as ears, clocks and clock hands than to tigers, mountains and mountain peaks. The only exception to this was the whole natural objects and whole artifacts. These did not differ from each other because the level of functional responding to the artifacts was decreased by subjects' tendency to give 'don't know' responses to the unfamiliar machines while functional responses to the non-living natural objects were increased by children's tendency to ascribe functions to these items.

Analyses of the interaction indicated that children also assigned functions to other entity types that were non-functional to adults. Specifically, while children and adults were equally likely to state functions for biological parts, artifacts, and artifact parts, children were significantly more likely than adults to also ascribe functions to natural objects, natural object parts, and biological wholes. However, the age difference for the last entity type was marginal ($P < 0.07$, two-tailed *t*-test), due to the

fact that adults did not differ from preschoolers in generating functions for domestic animals (children: 57% vs. adults: 53%) and baby animals (children: 56% vs. adults: 47%). Adults were also highly functional about plants which they tended to view in ecological terms as 'oxygen producers' (children: 58% vs. adults: 66%) (all Scheffe *F*-tests, $P > 0.05$).

Fig. 1 presents the mean percentage of functional responses that subjects gave for the artifacts, artifact parts and biological parts; entities for which ST and PT predict no age differences. Fig. 2 presents the mean percentage of functional responses for the living things, natural objects, and natural object parts; entities for which PT predicts age effects and ST predicts no functional response. Significant age differences are indicated by the presence of an arrow and marginal differences are indicated by the presence of a line. Table 2 presents a sample of children's function statements about entities that are non-functional for adults.

Although, as Figs. 1 and 2 suggest, children assigned functions across all entity types, further post-hoc analyses explored whether, within each age group, children and adults were more likely to state functions for the biological parts, artifact parts, and artifact wholes (items for which ST predicts a high level of functional response) than the living things and natural object wholes and parts (items for which ST predicts a low level of functional response). Scheffe tests indicated that this pattern held true for adults, but, for children, the only difference to occur between ST 'high function' and ST 'low function' entity types was between the whole biological entities (56%) and the biological parts (87%). Thus, preschoolers did not generally differentiate between entity types when assigning functions, with the exception that

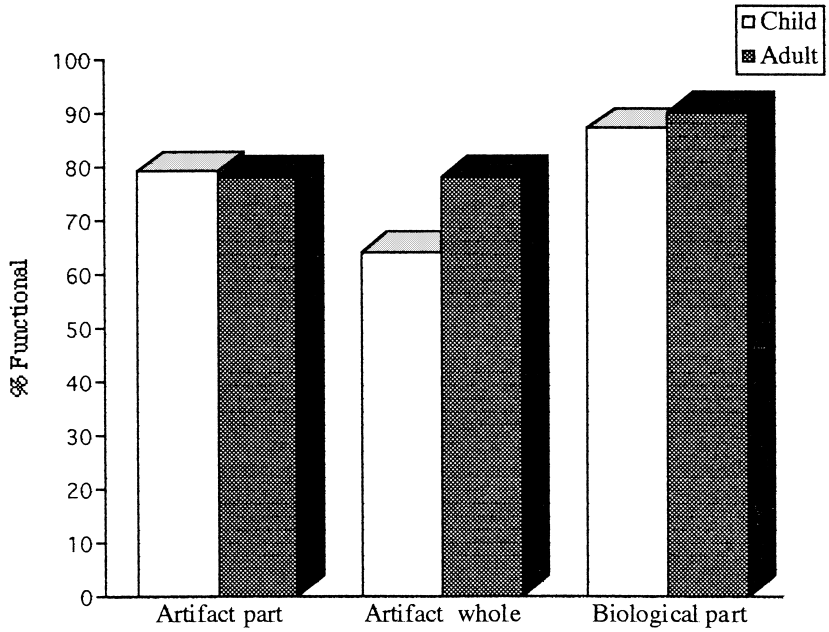

Fig. 1. Domains where both PT and ST predict that children and adults will be the same.

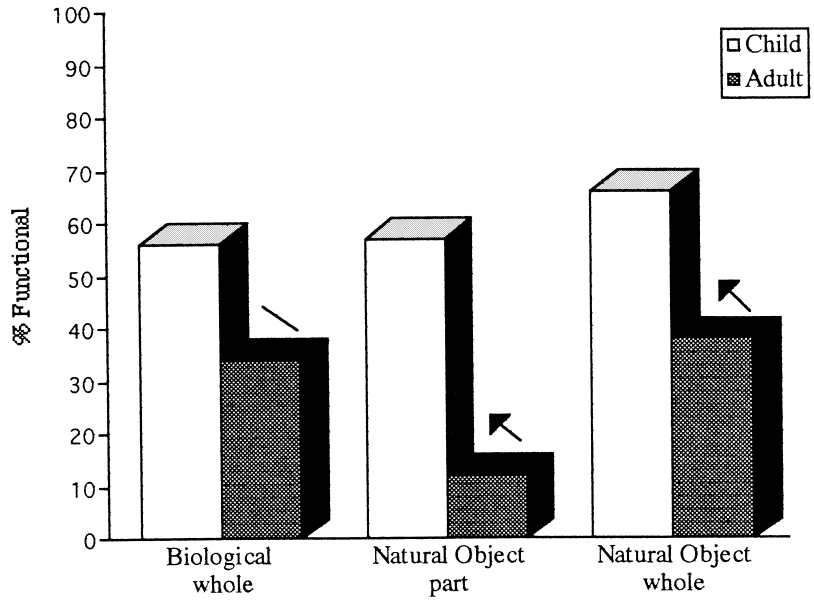

Fig. 2. Domains where PT predicts children and adults will be different and ST predicts no functional response.

they were significantly more likely to assign functions to objects such as eyes (87%) than objects such as birds (56%) (For further analyses on content differences in function statements for different entity types, see Kelemen, 1996).

An analysis on individual items to see which had been most likely to elicit non-functional answers from the children found that the greatest number of 'don't know' responses occurred with the unfamiliar artifacts (myometer: 44%, tryogaster: 38%, myometer part: 31%). In general, children gave significantly fewer functional responses to the unfamiliar artifacts (31%) and the unfamiliar artifact parts (65%)

Table 2
Samples of children's functional responses to entities that are not functional for adults

Biological whole (√) = most frequent answer
Man: 'to walk around' (√), 'for being happy for somebody', 'to make money'
Lion: 'for walking' (√), 'to eat', 'to look at', 'to go in the zoo'
Palm Civet: 'I don't know' (√), 'to play around and stuff', 'to see at the zoo'
Baby Bird: 'to fly' (√), 'to eat and grow'
Plant: 'to grow' (√), 'for the flowers', 'for watering the flowers'
Natural Object part
Mountain protuberance: 'for to climb' (√)
Cloud trail: 'to fly', 'for rain'
Natural Object whole
Mountain: 'to climb' (√), 'for people', 'to drive around'
Cloud: 'for rain' (√), 'to make it storm or not', 'for the sun to go on'

than the familiar artifacts (75%) and their parts (86%). 'Don't know' responses were below 26% for all other items, except the woman (31%). In relation to other 'non-functional' categories of response; the overall tendency for children to offer 'silly' responses was low with the greatest number occurring when preschoolers were asked about the tree (19%), binturong tail (19%), ring stone (19%) and tryogaster part (19%). Analyses were performed to see whether the five children who offered 'silly' responses on one or more occasion, gave a more adult-like pattern of response to the whole biological entities and the natural objects and their parts. It was found that these children did not differ from adults in their tendency to assign functions to the biological wholes (34% vs. 34%) and natural object wholes (57% vs. 38%) but had a greater tendency than adults to attribute functions to the natural object parts (36% vs. 13%) although this effect was marginal ($t(19) = 1.81$, $P < 0.08$).

Finally, children's tendency to attribute functions to the biological wholes and the natural object parts and wholes was also examined at the individual level. Children were classified into four different response groups depending upon their answers to the eighteen items representing these categories; They were classified as 'functional', 'don't know' or 'silly' responders if more than 72% of their responses across the items were 'functional', 'don't know', or 'silly' respectively. In each case the likelihood of such a pattern occurring due to chance was 3% ($P < 0.03$). They were categorized as 'unclassifiable' responders if their responses demonstrated no consistent pattern or several of their answers were uncodable. It was found that the greatest proportion of the children – ten of the sixteen preschoolers (63%) – corresponded to the class of 'functional' responders. Two children (13%) were 'silly' responders, two preschoolers (13%) were 'don't know' responders and two children (13%) were 'unclassifiable' responders.

2.3. Discussion

Consistent with both PT and ST, Study 1 found that adults were selective in their attributions of function. They viewed clocks, pockets and beaks as 'for' something but – in accordance with current scientific thinking – denied purpose to lions, mountains and their parts. Nevertheless, while adults' overall tendency was to constrain their functional responses, their degree of functional attribution to the biological wholes varied depending on the particular nature of the living thing being probed. They tended to have a teleological construal of domestic and baby animals and showed a marked bias to view plants in ecological-functional terms.

Turning to the children, consistent with the predictions of PT, Study 1 found that in contrast to adults, preschool children broadly assigned functions to all kinds of entities: to animals and their body parts, to clocks and their components and to non-living natural objects and their parts. In general, they appeared to view all kinds of objects as 'for' something. However, while children tended to assign functions broadly, they did make discriminations between entity types that are consistent with ST. Specifically, preschoolers distinguished biological parts as more 'functional' than whole living things. They were, therefore, more likely to ascribe a function to a tiger tooth than to the whole tiger.

It should be noted, however, that while children ascribed functions quite generally, many of the answers children gave for the living and non-living natural entities are curious from an adult's perspective as Table 2 indicates. What does it mean when a child says that a 'tiger is for biting' and 'being in a zoo' or that a 'man is for walking around'? It is difficult to interpret whether preschoolers were really stating these as teleological functions that explain why a tiger or man is here – what these entities are *made for* in a teleological sense – or whether they were merely describing activities that these entities can 'do' or be 'used to do' with no explanatory implications whatsoever. The nature of children's responses raises several possibilities. One possibility is that children truly intended these responses as teleological. Children may really think that clouds *exist* to rain in the same way as clocks *exist* to tell time. A second possibility is that children may simply have felt a pressure to respond with *some* kind of answer to the question 'what's the X for?' and did so despite being encouraged to say 'I don't know' or 'silly' and despite selective teleological intuitions. Third, the nature of the responses could indicate that children did not really understand the question they were being asked and were just randomly generating activities associated with the items.

Several aspects of children's pattern of response suggest that neither the second or third interpretation can fully account for the results of the study. With respect to the second possibility – the idea that children felt a pressure to respond – while the number of children who ever used 'silly' as an answer during the main study was, as PT predicted, quite low (only 31%), the results found that preschoolers were certainly able to withhold functional responses if they chose to. 'Don't know' responses were offered by 63% of the children on at least one occasion and only three of the children used neither 'I don't know' or 'silly' during any of the trials. In light of this, children's bias to provide functional responses rather than withhold them, both at the overall and individual level, remains marked. In relation to the third possibility, children's tendency to appropriately offer 'I don't know' responses with unfamiliar items implies that they had both a command of the pragmatics of the task and an understanding of the question that they were being asked. However, the question of whether children truly intended their responses to be teleological is pivotal for claims that children are endowed with a functional tendency and needed to be examined more closely. A close-ended question task was therefore designed to examine this question directly and to further explore the scope of children's functional intuitions.

3. Study 2

Study 2 was developed to find out if children really believe that entities are 'made for' something or whether they just think that they can 'do' or be 'used for' certain activities. In contrast to Study 1, this study focused on whole objects rather than parts because children's statements about whole entities, such as tigers and mountains, had been a major source of difference between children and adults. Also unlike Study 1, Study 2 used a forced-choice paradigm

so that the processing requirements of the task were low: children simply had to listen to two characters discuss whether a particular entity was 'made for something' or 'not made for anything' and then point to the person that they agreed with.

The predictions for the whole objects in Study 2 were the same as in Study 1. Both ST and PT predict that adults will view living things such as lions and non-biological natural kinds such as clouds as able to 'do' many things, (e.g. move around) and be 'used' in certain ways (e.g. clouds being used to predict the weather) but that they will not see them as 'made for' these activities. The only entities that adults are likely to view as 'made for something' are artifacts, because they are created by people to perform functions. ST argues that children should share adults' limited teleological view. In contrast, PT predicts that rather than having adults' restricted teleological intuitions, children should view all entity types – living things, natural objects, and artifacts as 'made for something'.

Although the focus of this study was whole objects, a small selection of entity parts was also included. These were one natural object part (mountain protuberance), an artifact part (a clock hand), and two biological parts (an earlobe and a lion's leg). The predictions for the parts were the same as for Study 1. While ST predicts children and adults will view only artifact and biological parts as made for a purpose, PT predicts that children will be functional about all kinds of entity parts.

3.1. Method

3.1.1. Subjects

The participants were 24, 4- and 5-year old children attending several daycare centers representing a broad range of SES (nine girls and 15 boys; mean age = 5 years, 0 months, age range = 4 years, 3 months to 5 years, 11 months, SD = 6 months) and 24 university undergraduates. None of the subjects had participated in Study 1.

3.1.2. Materials

Subjects each saw 16 magazine photographs of familiar and unfamiliar objects: nine whole biological kinds, four artifacts and three natural objects. Fourteen of the items were taken from Study 1 and two new pictures were added (an earlobe and iceberg). A pencil and pencil sharpener were used in the pre-trial training session. There were also two photographs: a man ('Ben') and a woman ('Jane') used in the forced-choice task. The list of items appears in Table 3.

3.1.3. Procedure

Subjects were individually tested over two sessions (eight trials per session) of approximately 25 min. Subjects were asked if they would like to play a game looking at some pictures with the experimenter and two of her 'friends': 'Ben' and 'Jane'. They then participated in a training session. All sessions were audio tape-recorded.

Table 3
Items and categories for study 2

Living things	*Artifacts*	*Natural objects*
Woman	Jeans	Cloud
Man	Ring	Iceberg
Baby	Tryogaster	
Tiger		
Cat		
Binturong		
Tree		
Biological parts	*Artifact part*	*Natural object part*
Lion leg	Clock hand	Mountain protuberance
Human earlobe		

3.1.4. Pre-trial training session

Before each testing session, subjects were trained on the distinction between objects that are 'made for something' and those that are 'not made for anything but can maybe be used for something' using a pencil and pencil shavings. First, the experimenter sharpened the pencil, leaving a pile of pencil shavings on the table and then pointed to the pencil tip stating: 'This is the tip of a pencil. The pencil tip is made for writing with – that is what it is made for'. She then pointed to the pencil shavings, explaining 'But some things aren't made for made for anything. See this pile of stuff? It isn't made for anything, it's just something that is there. Maybe somebody could use it for something but it isn't made for anything'. After this distinction was summarized again, subjects were probed for their understanding of the explanation and asked in turn whether they thought the pile of stuff and pencil tip were 'made for something' or 'not made for anything'. Discussion and repetition of the explanation was given as needed.

Following this, subjects were familiarized with the procedure of the experimental trials and introduced to the two characters in the photographs: the experimenter's friends 'Ben' and 'Jane' who 'love to talk about different things but never ever agree with each other'. The subjects were asked to listen hard to what each of them said and point to the one they thought was right. They then received two practice trials in which Ben and Jane discussed the pencil tip and the pile of stuff in turn, and debated whether these objects were 'made for something' or 'not made for anything'. The procedure and counter-balancing measures for these trials were the same as in the main study (described below) the only difference was that in the practice trials, subjects received feedback on their responses.

3.1.5. Main study

Subjects were shown the pictures in random order. In each trial, the item was placed between Ben and Jane (who remained in fixed positions throughout the study). The experimenter then pointed to each character as she reported what each of them thought about the entity and whether it existed to perform a function. In each case, one character would state that the entity was 'made for something' and

suggest what it was made for. The other character would then disagree and argue that while it might be able to 'do' certain things or be 'used' in various ways, it was 'not made for anything'. During every third trial, there was an explicit reference back to the pile of stuff and the pencil tip to remind subjects of the distinction between entities that are 'made for something' and those that are 'not made for anything'. At the end of each trial, subjects were asked to point to the character who was right; the one believing the entity was 'made for something' or the one arguing that it 'isn't made for anything'.

The functions used were those generated by children in Study 1. For example, the preschoolers in Study 1 had variously stated that a man was for 'walking', 'eating' and 'looking'; Study 2 therefore asked whether a man is made for these activities or whether those are just things he 'does'. Since the children's predominant response to the unfamiliar artifact (tryogaster) in Study 1 had been 'I don't know', no function was stated for this item. Instead Ben and Jane asserted that while they had never seen one before, they could 'guess' that it was 'made for something' or 'not made for anything'. The two new items were assigned novel functions. For example, subjects were asked whether an earlobe was made for 'wearing an earring' or not. For all items, however, the wording made clear that the activities mentioned were only suggestions as to the entity's function rather than definitive statements. This was done to ensure that adults felt free to generate credible functions of their own rather than being restricted to those proposed by 4- and 5-year-olds. An example of a trial is shown in Table 4.

Subjects were randomly assigned to one of two counterbalancing groups. In one group, the assertion that the entity was 'made for something' was followed by the counter-argument that it was 'not made for anything'. In the other group the order of these arguments was reversed. In both groups, Ben proposed the 'made for something' point-of-view in half the trials and Jane proposed it in the other half of the trials. Three children were replaced for demonstrating a consistent bias to pick either Ben or Jane irrespective of the viewpoint espoused by the character.

3.2. Results

The central question to be addressed in these analyses was whether children

Table 4
Example of a Study 2 trial

See this. This is a tiger.
Ben says a tiger is made for something. It could be that it's made for eating and walking and being seen at the zoo or it could be that it's made for other things. But Ben is sure that a tiger is made for something and that's why it's here.
Jane says that this is silly. A tiger isn't made for anything. Even though it can eat and walk and be seen at the zoo, that's not what it's made for, they're just things it can do or people can do with it. Jane is sure that a tiger can do many things but they aren't what it's made for and they aren't why it's here.
Point to who you think is right. Ben who thinks a tiger is made for something or Jane who thinks that's silly because a tiger isn't made for anything.

showed a broader tendency to be teleological than adults. In order to compare children's and adults' responses to each of the whole entity types (entity parts were analyzed separately due to the small number of items), a 2×3 repeated measures ANOVA was conducted. The dependent variable was the number of times subjects had agreed that the entity was 'made for something', with age (children vs. adults) as the between subjects factor and whole entity type (artifacts vs. biological objects vs. natural objects) as the within subjects variable. Preliminary statistics indicated no effect of counterbalancing group and so this variable was dropped from the analyses. Fig. 3 shows the mean percentage of 'made for something' responses by children and adults with each entity type. Significant age differences are indicated by the arrows. All post-hoc tests were conducted with Scheffe's *F*-test.

The analysis found a significant main effect of entity type ($F(2,46) = 22.01$, $P < 0.01$) and an age by entity type interaction ($F(2,46) = 11.39$, $P < 0.01$). Post-hoc analyses indicated that the effect of entity type occurred because there was an overall tendency for subjects to endorse teleological responses more with artifacts (90%) than whole living things (73%) and more with both of these entity types than with whole natural objects (53%) (all Scheffe *F*-tests $P < 0.05$). However, analyses of the interaction indicated that this effect was probably a consequence of variations in adults' rather than children's responding.

To explore the interaction, analyses were first conducted to compare children's and adults' responses with each of the whole entity types. These found that children and adults differed significantly from each other when considering non-biological natural objects. Children were more than twice as likely as adults to view icebergs and clouds as 'made for something' (73% vs. 33%). In interesting contrast

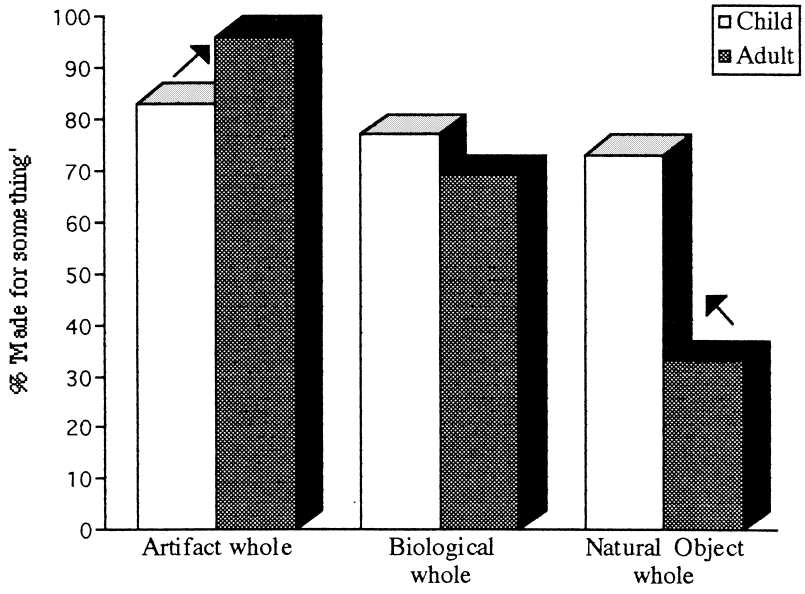

Fig. 3. Mean percentage of functional responses to the whole entities in Study 2.

to Study 1 however, there was no difference between children and adults when considering living things. Adults were highly teleological and selected the 'made for something' argument as frequently as children, therefore accepting, in principle, the notion that binturongs are 'made for something' (children: 77% vs. adults: 69%). Finally the analysis of the whole artifacts found a difference between children and adults. While both children and adults had a strong tendency to view the jeans, ring and tryogaster as 'made for something' (children: 83% vs. adults: 96%), adults were almost at ceiling in offering teleological responses (all Scheffe *F*-tests, $P < 0.05$).

Further analyses of the interaction focused on responses across entity types within each age group. A repeated measures ANOVA on children's responses to the natural objects, biological wholes, and artifacts found no effect of entity type. Contrary to Study 1 where children's responses had varied, children were as teleological about natural objects (73%) and biological organisms (77%) as they were about artifacts (83%) ($F(2,23) = 1.58$, $P > 0.05$). In contrast, adults' tendency to be teleological varied between object kinds ($F(2,23) = 22.85$, $P < 0.01$). Adults had a greater tendency to be teleological about artifacts (96%) than living things (69%) and were more functional about living things than natural objects (33%) (all Scheffe *F*-tests, $P < 0.05$). These analyses therefore suggest that the main effect of entity type found in the main ANOVA was due to variations in adults' rather than children's responses to different entity types.

The consistency of each child's tendency to endorse the view that the biological and natural objects (ST 'low function' entities) were 'made for something' was also examined. Children were classified into three different response groups depending upon their answers to the nine items representing these categories: an individual was classified as a 'made for something' responder if more than 89% of their responses to items were teleological. They were categorized as a 'used for something' responder if they endorsed a non-teleological perspective 89% of the time. In each case the likelihood of such a consistent pattern occurring due to chance was 2% ($P < 0.02$). A child was categorized as a 'mixed' responder if their tendency to endorse either viewpoint was non-significant. The analysis found that the largest proportion of the children, 16 of the 24 (67%), consistently endorsed the view that entities such as icebergs and lions, are 'made for something'. One child was classified as a 'used for something' responder (4%) and seven children gave 'mixed' responses (29%).

Turning to the analyses of the object parts, a series of chi-square statistics was carried out to compare the way children and adults responded to the four entity parts. The mean percentage of teleological responses to the object parts are shown in Fig. 4. Significant differences are indicated by an arrow.

As Fig. 4 shows, children and adults were equivalently teleological about the both the biological part (children: 71% vs. adults: 92%: $\chi^2(1, n = 48) = 2.20$, $P > 0.05$) and the artifact part (children: 79% vs. adults: 96%: $\chi^2(1, n = 48) = 1.08$, $P > 0.05$). However, preschoolers endorsed the 'made for something' argument significantly more than adults when considering the natural object part (children: 83% vs. adults: 12%, $\chi^2(1, n = 48) = 19.04$, $P < 0.01$).

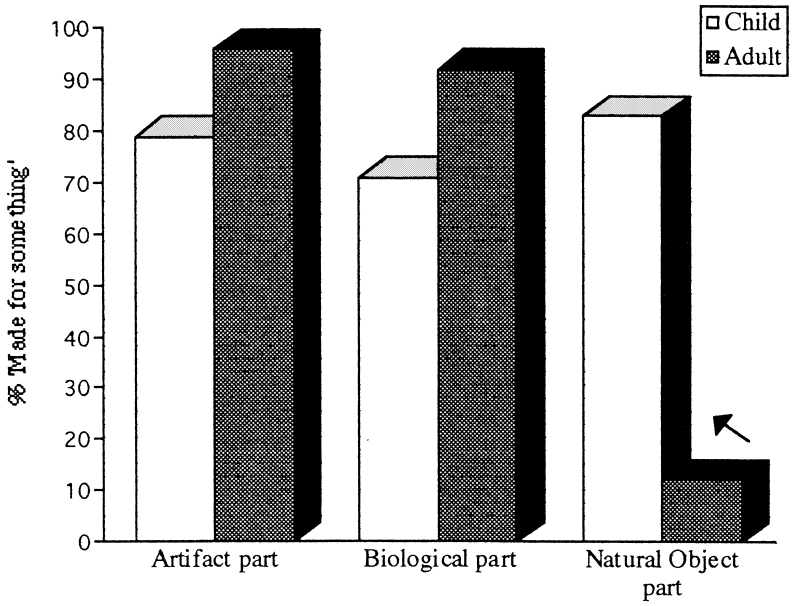

Fig. 4. Mean percentage of functional responses to the part entities in Study 2.

3.3. Discussion

Study 2 was developed as a forced-choice task to examine whether preschoolers' statements in Study 1 reflected what they thought the entities were 'made for' or just what they 'do' or are 'used for'. The results indicated that, as in Study 1, adults were selective in their functional intuitions. They did not generally endorse the view that whole natural objects such as icebergs are 'made for something' and also denied purpose to a natural object part. However, in contrast to Study 1, they were as teleological as children about whole living things. One tentative explanation for this finding is that it was a consequence of the method. Unlike the method of Study 1, Study 2 confronted adults with a choice. They could either actively deny purpose to living things, which some adults may have construed as akin to questioning the value of life in general, or they could endorse the more life-affirming statement that living things have a reason to exist. Given the forced choice, adults' tendency to accept biological kinds as 'made for something' may have occurred because they found the implications of this latter option less aversive. In addition, informal questioning of several adult subjects subsequent to the task suggested that the Study 2 method may have tapped into religious convictions in ways that the open-ended questioning in Study 1 had not.

Replicating the results of Study 1, Study 2 found that preschoolers' tendency to view entities in teleological terms was more promiscuous than adults' tendency. They endorsed the 'made for something' viewpoint for all varieties of whole entity, artifacts, biological kinds, and natural objects, as well as all kinds of object parts. In addition, children did not discriminate between classes of entities in a manner that

would be consistent with ST. Artifacts such as jeans were viewed in highly teleological terms but so were whole biological entities such as tigers and whole natural objects such as icebergs.

In general then, children responses in Study 2 parallel those of Study 1 even though different experimental methods were used. While these results provide tentative support for the PT proposal that young children have a generalized teleological bias to view all kinds of entities as existing for a purpose, alternative explanations for these results nevertheless needed consideration. One possible explanation for children's broad assignment of function is that it has something to do with their default causal beliefs about various entity kinds. But another explanation is that children ascribed function very generally in Study 1 and 2 because preschoolers have a different concept of function than adults. Study 3 was designed to explore this possibility.

4. Study 3

An adults' concept of artifact function is largely based in original intent. Even if a thesaurus is only ever used to wedge the window open, that is not what it is for. It was created as a dictionary of synonyms and although it may never have a single word looked up in it, that is why it is here (see Bloom, 1996 for further discussion). Some adults reason in a similar way about biological functions: ears are for hearing, because God made them that way. But for other adults who no longer share this intuition there is a biological equivalent to intentional causation; evolution. Hands are for holding things, not clapping along to music, because that is what they evolved to do. In short, whether it occurs through natural or intentional forces, adults' concept of function is based in notions of original design. How then, do children understand function?

One possibility is that preschoolers' notion of function is exactly the same as that of adults. In other words, both age groups believe that when an object has been designed or has evolved to perform a certain activity, then that is what is 'for'. If this is the case, preschoolers broad attribution of function in Study 1 and Study 2 is consistent with the PT hypothesis that children have different beliefs than Western adults about the causes of natural phenomena.

A second possibility is that 4- and 5-year-olds have no teleological concept of function at all, or at least none that has been mapped onto their knowledge of the English expression 'for'. As Matan (1995) has proposed, they may simply believe, that what something characteristically 'does' is what it is 'for'. The findings of Study 2 run somewhat counter to this hypothesis. The *only* difference between Ben's and Jane's viewpoints in Study 2 was that one character claimed that an activity explained the existence of an object while the other denied this. Both characters always agreed, however, that the activities were those that the objects typically did. Any failure in preschoolers' ability to distinguish what an object 'does' from what it is 'for' should, therefore have led to equal endorsement of the 'made for X' or 'used for X' perspective since both would have equally well described what the entity was

'for'. Instead children consistently preferred the 'made for something' response. Nevertheless, the proposal that children do not understand the difference between what an object 'does' and what it is 'for' requires examination since, if it is correct, preschoolers clearly have nothing like a teleological stance.

A third possibility is that children have a different notion of function than adults. They may construe any sort of intentionality, not just the creator's, as a source of function. As a result, an object may be viewed as 'for' a particular activity simply because an agent intends to use it that way. If this hypothesis is correct and children's notion of function is broader than that of adults, it suggests yet another way of interpreting the results from the previous studies. In Studies 1 and 2, children may have been viewing entities as 'for' something, not because of any beliefs about the creational origins of the entities, but because of what they thought people or animals could intentionally do with the objects. As a result, in Study 1, children may have stated that clocks and clock hands are 'for telling time' and mountains 'for climbing' because they are intentionally used that way. They may have said that tails are 'for wagging' because that is how binturongs deliberately use them, and that lions are 'for walking' because that is something they intentionally do.

Study 3 evaluated these three hypotheses by manipulating the degree of intent involved when an object (body part or artifact) which had been intentionally or naturally designed to perform one activity (Original Function) was used to do something else (Alternative Use). Subjects had to decide which of these activities was what the object was 'for'. The study had four conditions. In one condition, the Alternative Use was an accidental occurrence that only ever happened once ('One-Time Accident'), while in another condition, it was also accidental but occurred repeatedly ('Frequent Accident'). In the two remaining conditions, the Alternative Uses were intentional activities. In one condition, it was an activity that was done purposefully on only one occasion ('One-Time Intentional') while in the other it was an everyday occurrence ('Frequent Intentional').

The three hypotheses presented earlier suggest three distinct patterns of response. It was predicted that if children and adults have the same concept of function, then like adults, children should disregard the Alternative Use in all of the conditions and view an artifact or body part as 'for' its Original Function.

If, as the second hypothesis suggests, children have no concept of function and do not discriminate what an entity 'does' from what it is 'for', they should be willing to accept the Alternative Use as an object's function in all of the conditions regardless of whether this use is accidental or intentional and whether it occurs once or repeatedly.

Finally, if children's notion of function is more 'intentionalized' than that of adults, they should not accept what an object accidentally does as the object's function, however frequently it occurs, because it is unintentional. But, if the Alternative Use is intentional and occurs either once or repeatedly, then children should be drawn towards thinking that this use is what the entity is 'for', particularly when the use is deliberately repeated since the concerted nature of the act suggests a higher degree of intentionality on the part of an agent.

The study used artifacts and biological parts because both children and adults

have the strong intuition that these entities have functions. However, none of the hypotheses predicted any differences between artifact and body part trials.

4.1. Method

4.1.1. Subjects

The subjects were 32, 4- and 5-year-olds (mean age; 4 years, 9 months; range; 4 years, 1 month to 5 years, 10 months; SD; 6 months) and 32 university undergraduates. None of the subjects had participated in any of the prior studies. The children were from several preschools representing a broad range of SES.

4.1.2. Materials

There were 13 sets of hand-drawn pictures; six depicted novel animals with strange body parts and seven showed novel artifacts. The sets consisted of three cards; a standard picture of the novel entity and two test cards showing the artifact or body part performing two different activities. Examples of picture sets are shown in Figs. 5 and 6.

4.1.3. Procedure

The study took approximately 15 min to complete. Subjects were randomly assigned to one of four experimental conditions and asked to look at the picture sets and listen carefully to some stories. In each condition, subjects received 12 trials: eight 'conflict' trials (four artifacts and four body parts) and four control trials (two artifacts and two body parts). Prior to the main body of the study, subjects also received an extra artifact 'conflict' trial as a practice trial to familiarize them with the procedure. They received no feedback on their response to the practice trial and

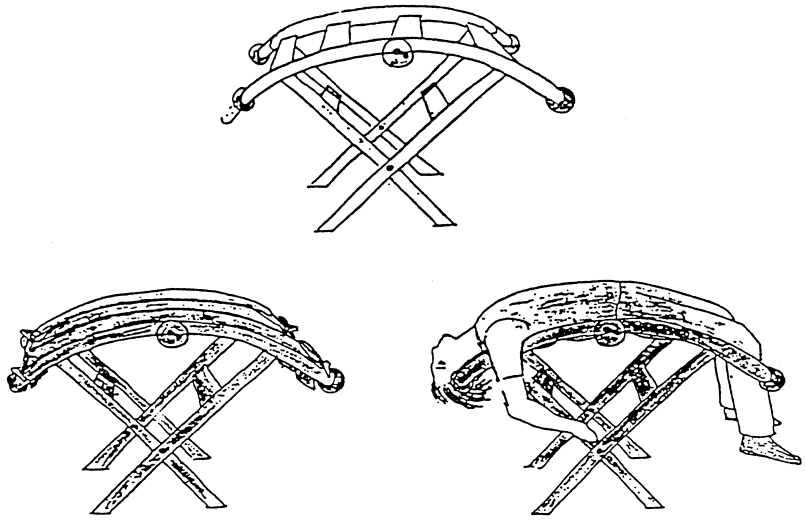

Fig. 5. Example of a Study 3 artifact picture set (see Appendix A for story).

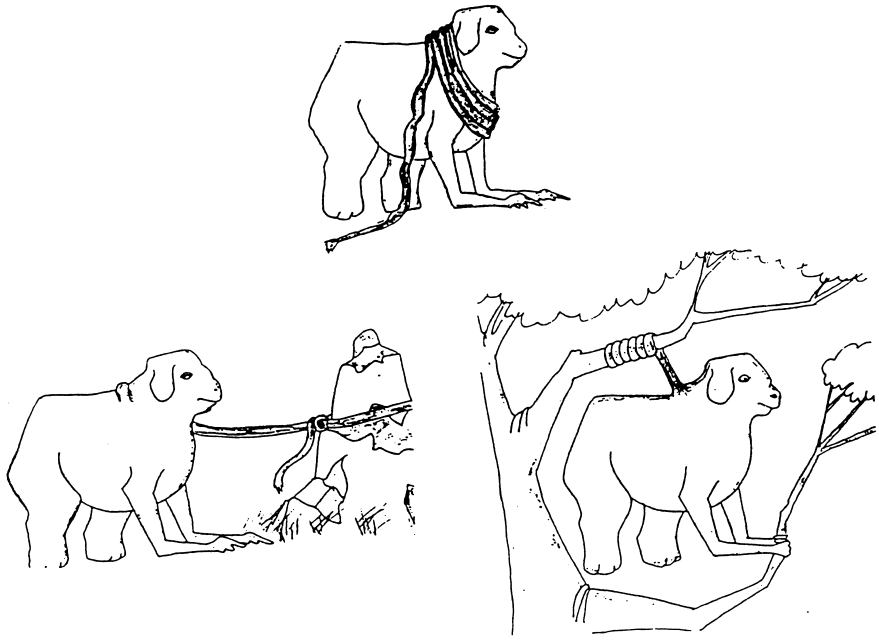

Fig. 6. Example of a Study 3 body part picture set (see Appendix A for story).

their response data was discarded. The procedure for the 'conflict' trials will be described first.

In the 'conflict' trials, subjects were first shown the standard card followed by the two test cards. As the experimenter presented each of the test cards, she described one test card activity in a way that conveyed an Original Function and the other in a way that described an Alternative Use (it was the clash between these activities that led these trials to be dubbed 'conflict' trials). Subjects were then asked to decide what the entity in the standard card was 'for'. The 'conflict' trials for the four conditions were as follows.

One-Time Accident Condition: For the artifacts, the Original Function picture was described as the activity the object was designed to perform (e.g. Ben made it to stretch out his clothes) while the Alternative Use picture showed what was accidentally done with it on one occasion (e.g. Jane fell on it and it helped exercise her bad back. Although it worked out well, it never happened again). For the body parts, the Original Function picture was described as what these kinds of animal generally do with their body part (e.g. Proles tie themselves to rocks) while the Alternative Use picture was what one animal accidentally did with it on one occasion (e.g. she got to hang from a tree and see far away. Although it worked out well, it never happened again).

Frequent Accident Condition: This condition was the same as above except for the description of the Alternative Use. In the artifact trials, the Alternative Use was described as an activity that accidentally occurs with the object frequently (e.g. Jane

falls on it and it helps exercise her bad back. When it happens, it works out well and it'll probably happen again). In the body parts trials the Alternative Use was what one animal accidentally does with the body part frequently (e.g. She gets to hang from a tree and see far away. When it happens, it works out well and it'll probably happen again).

One-Time Intentional Condition: This condition was the same as above except for the Alternative Use. In the artifact trials, the Alternative Use picture depicted what one individual intentionally did with the artifact on one occasion (e.g. Jane decided to exercise her bad back on it one day. Although it worked out well it never happened again). In the body part trials, the Alternative Use was what one animal intentionally did with the part on only one occasion (e.g. the Prole decided to hang from a tree so she could see far away. Although it worked out well it never happened again).

Frequent Intentional Condition: This condition was the same as above except that with the artifact trials, the Alternative Use described what one individual intentionally does with the artifact everyday (e.g. Jane decides to exercise her bad back everyday. Since it works out well, it happens again the next day). In the body part trials, the Alternative Use described what one animal intentionally does with the body part everyday (e.g. She decides to hang from a tree so she can see far away. Because it works out well, it happens again the next day).

The four control trials did not differ across conditions and used the same procedure as the 'conflict' trials except that in these trials, the test card contrast was between the Apparent Function and the Alternative Use. For example,

Control trials: In both the artifact and body part trials, the Apparent Function picture was an activity that an object looked like it was made to do but has never done (e.g. 'This thing looks like it was made to scrape the mud off shoes' or 'to shoo away bugs') and the Alternative Use picture was described as what one individual always does with the object (e.g. 'Mary always uses it draw designs in cement' or 'The Dorbit always uses it to sweep his nest').

There was therefore no clash between the Original Function and Alternative Use in the control trials and obtaining a 'correct' answer to 'what do you think this thing is for?' involved selecting the Alternative Use. These trials were included to ensure that children understood the methodology and also to check if subjects ever adopted a blanket strategy of *never* picking the Alternative Use, perhaps because of expectancy effects.

In all trials, as the experimenter told the story, she pointed to the test card picture being described to help subjects follow along. However, in order to make sure that subjects remained focused, when one test picture was being described, the other was turned face down. Once both test pictures had been described, they were both turned face up. The experimenter then gave a quick reminder statement summarizing the difference between the two test card activities once again. Finally, subjects were asked to consider the artifact or body part in the standard card, and then point to the test picture showing what the entity was 'for'. For example, in one artifact 'conflict' trial, the question was: 'What do you think this thing is for? Is it for exercising a bad back or is it for stretching clothes?'. Examples of body part and artifact 'conflict' trials are given in Appendix A.

Several counterbalancing measures were taken in this study. Two versions of all of the stories were created. Activities that were described in one version as Alternative Uses were described in the other version as Original/Apparent Functions. Half the subjects received Version 1 and the other half received Version 2. Within each set of 12 trials, six stories described the Original/Apparent Function first and the Alternative Use second, and six stories reversed this order. Finally, while the reminder statements always restated the test card activities in the order of the story, in half the trials the forced-choice question reversed this order. Subjects received the trials in semi-randomized order so that they never received a control trial in the first trial or more than three trials of any particular type in a row.

4.2. Results

To explore their relationship to each other, the 'conflict' and control trials in each of the four conditions were compared in a $2 \times 4 \times 4$ ANOVA. The dependent measure was the number of times subjects selected the Alternative Use in response to the question 'What do you think this thing is for?' The two between subjects factors were age (child vs. adult) and condition (One-Time Accident vs. Frequent Accident vs. One-Time Intentional vs. Frequent Intentional). The within subjects factor was trial type (body part 'conflict' trials vs. artifact 'conflict' trials vs. body part control trials vs. artifact control trials). All post-hoc comparisons were conducted using Scheffe *F*-tests unless otherwise stated.

Fig. 7 shows the mean frequency of Alternative Use choices in the 'conflict' trials of each condition and an overall mean for all of the control trials. Preliminary

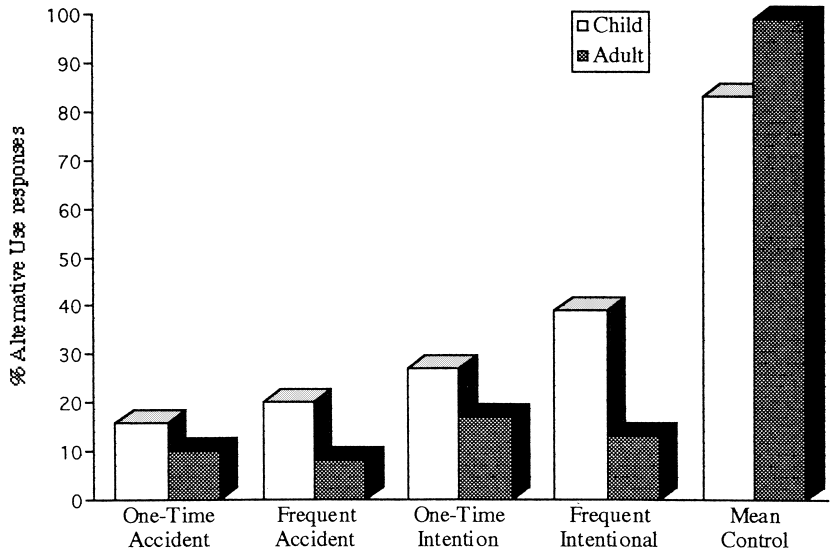

Fig. 7. Mean percentage of 'Alternative Use' responses in Study 3.

analyses indicated no effect of counterbalancing and this variable was therefore dropped from further analysis.

The analysis found no main effect of age ($F(1,56) = 0.15$, $P > 0.05$), no main effect of condition ($F(3,56) = 1.73$, $P > 0.05$), and, importantly, neither an age by condition interaction ($F(3,56) = 0.923$, $P > 0.05$) nor an age by condition by trial type interaction ($F(9,56) = 1.73$, $P > 0.05$. In other words, regardless of condition, children and adults were equally likely to select the Alternative Use. This was the case whether the Alternative Use was an Accident (16% vs. 10%), a Frequent Accident (20% vs. 8%), a One-Time Intentional event (27% vs. 17%), or a Frequent Intentional event (39% vs. 13%). One-group *t*-tests indicated that, in all conditions, children and adults had a significant tendency to view artifacts and body parts as existing for their Original Function (all *t*-tests, $P < 0.01$). This was true, even in the Frequent Intentional condition, where preschoolers selected the Alternative Use 39% of the time, but still reliably preferred the Original Function ($t(7) = 2.5$, $P < 0.04$).

The ANOVA did, however, find a main effect of trial type ($F(3,56) = 166.46$, $P < 0.05$) and an age by trial type interaction ($F(3,56) = 6.82$, $P < 0.05$). Post-hoc analyses indicated that the main effect of trial type occurred because, as expected, subjects endorsed the Alternative Use more frequently in the control trials (body parts: 92%, artifacts: 84%) than in the 'conflict' trials (body parts: 19%, artifacts: 18%). Children and adults therefore clearly understood what they were being asked in the study and had no global bias against selecting an Alternative Use. The interaction occurred because, while both children and adults had a strongly significant tendency to endorse Alternative Use responses in the control trials, adults were at, or near, ceiling in doing so (body parts: 100%, artifacts: 96%). In comparison to this, children displayed a greater tendency to select the Original Function in the control trials and this resulted in a significant difference between children and adults (Alternative Use: body parts: 84%, artifacts: 81%). Similarly, while both children and adults had a strong bias to select the Original Function in the 'conflict' trials, adults rarely selected the Alternative Use in these trials (body parts: 12%, artifacts: 12%). By comparison, preschoolers response tendencies were more variable and it was therefore found that children were significantly more likely to select the Alternative Use in the 'conflict' trials than adults (body parts: 26%, artifacts: 24%).

4.3. Discussion

At the beginning of this section, three hypotheses were presented regarding possible relationships between children's and adults' concept of function. One hypothesis suggested that children do not conceptualize any distinction between what an entity 'does' and what it is 'for' (see, for example, Matan, 1995). Perhaps the clearest finding from the present study is that this is not the case. In the 'conflict' trials of all conditions, children were the same as adults in that they rejected the notion that an object's Alternative Use is what it is 'for'. They did this, regardless of whether the Alternative Use occurred accidentally or intentionally, or on one or

many occasions. In consequence, contrary to this hypothesis, children and adults do not understand function, or the question 'what is the X for?', in fundamentally different ways.

A second hypothesis proposed that, while children might conceptualize a distinction between what objects 'do' and what they are 'for', they might nevertheless have a slightly different concept of function than adults: children might be so sensitive to an agent's intentions that they will accept any goal-directed use of an entity as its function. Again, the results of the present study suggest that this is not the case. Manipulating the degree of intentionality involved in the Alternative Use did not result in any effects of experimental condition in this study. While, unsurprisingly, preschooler's responses were more variable than those of adults across the conflict and control trials of all conditions, children, like adults, had a significant tendency to select the Original Function, regardless of how deliberate the Alternative Use was. This held true even in the Frequent Intentional condition were subjects were presented with an Alternative Use that was not only deliberate, but also highly typical, by virtue of its repeated occurrence.

In summary, children and adults, in all conditions of this study, predominantly shared the intuition that body parts and artifacts are 'for' the activity that they were originally designed to perform. This tendency to favor the Original Function can not be attributed to any misunderstanding of the task or blanket response bias because subjects selected the Alternative Use in the control trials of all conditions. Study 3 reliably finds then, that children's and adults' notion of function is largely the same. Artifacts and body parts are 'for X' because they are 'designed to do X'. Whether children view the causal force that creates functioning body parts to be literally 'intentional' is something that the present study could not assess. But what the evidence suggests is that 4- and 5-year-olds, and adults, have some kind of belief that biases them to think that the function of a body part is the way that a kind of animal generally uses it, and the function of an artifact is the purpose that it was designed to fulfill.

5. General Discussion

To summarize, using very different methods, Studies 1 and 2 investigated the scope of children's attribution of function. Consistent with PT, both studies found that preschoolers differ from adults in broadly attributing functions to entities of all kinds, although consistent with ST, Study 1 also found that the parts of living things were assigned more functions than whole living things. Study 3 then examined whether the results from Studies 1 and 2 might be explained by differences in children's understanding of function. The study found that preschoolers and adults both have a strong tendency to view a body part or artifact as 'for' the activity they were originally designed to perform. Given these results, what could explain the developmental differences found in Study 1 and 2?

One explanation concerns children's beliefs about the casual history of different entities. As suggested earlier, children may be promiscuously teleological because

their notions about the origins of natural objects differ from those of contemporary adults. They may construe natural phenomena in much the same way as they think about artifacts and view them as though they have been intentionally caused for a purpose, perhaps by some under-specified non-human agent. Evidence from other research suggests that such a proposal could be true. As mentioned earlier, recent findings indicate that preschoolers from religious and non-religious backgrounds endorse the idea that God causes natural phenomena to exist (see also Gelman and Kremer, 1991; Petrovich, 1993; Evans, 1994; Evans et al., 1995). Furthermore, in the absence of other explanations, adults tend to naively reason about entities and events in this manner (Campbell, 1987; Livingstone, 1993; Lewis, 1995). While Study 1 also found some support for ST – children assigned more functions to biological parts than to whole living things – this result is not necessarily in conflict with the explanation given above. It could be the case that young children do have intention-based beliefs about origins, but that during preschool some children are beginning to display the kinds of teleological intuitions that strong versions of ST propose they have from the outset.

Another explanation is that children's promiscuous teleological ascription in Studies 1 and 2 is simply a language effect. In other words, children's generalized teleological responding in these studies has nothing to do with any default ways of reasoning about the structure of the natural world, it simply results from probing preschoolers about what objects are 'for'. In relation to this interpretation, it should be noted that the developmental differences found in Studies 1 and 2 are robust and can be replicated using methods that do not rely on asking children what objects are 'for'. Specifically, in a recent study (Kelemen, submitted), the explanatory preferences of adults and elementary-school children were probed by asking them to choose between physical and teleological explanations for the properties of unfamiliar animals and non-biological natural objects. In one trial, for example, subjects were shown a picture of a kind of pointy rock and asked whether they thought the rocks were pointy 'because little bits of stuff piled over a long time' (physical) or 'so that animals won't sit on them and smash them' (teleological). The study found that while adults selectively endorsed teleological explanations for biological parts (e.g. an animal's long neck), they eschewed any kind of teleological explanation for non-biological natural kinds (e.g. a pointy rock). In contrast, first and second graders consistently, promiscuously, preferred teleological explanations over physical explanations for both biological and non-biological natural kinds. This was in spite of the fact that they had engaged in a short pre-trial session which explained, in simple, non-teleological terms, the physical-mechanical process by which natural objects, such as clouds, form. It was only by fourth grade – after some exposure to a science curriculum – that children behaved more like adults in their pattern of endorsing teleological explanations.

To conclude, the present studies provide empirical support for the idea that young children have a broad bias to view entities and events in terms of a purpose. Furthermore they suggest that, in Western culture, the scope of this tendency undergoes a developmental shift to become more selective by adulthood. To better understand the cause and nature of early teleological intuitions requires further research,

both on young children's beliefs about the origins of entities and events, and on the kinds of explanatory input that adults and peers provide to children during the course of development. The present findings also raise a number of important questions regarding the way promiscuous teleological intuitions might influence children's everyday interactions with objects in their environment. Projects focusing on issues such as these are currently in progress. Indeed, the possibilities for future research on this topic are manifold since one of the most striking aspects of teleological thought is that people not only find it convenient to reason in terms of purpose, they also seem *compelled* to do so. Acquiring a deeper understanding about the development of our beliefs about purpose will therefore shed light, not only on the specifics of children's early theory-formation, but also on substantial questions about the underlying nature of mind.

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Appendix A. Examples of 'Accidental' and 'Intentional' Trials

(a) One-Time Accident Condition: Artifact Trial

Ben wanted to make a thing to stretch out his clothes after they got shrunk by his washer. When Ben finished it, he was really happy with it. As soon as it was finished he gave it to Jane. One day Jane tripped and fell backwards onto this thing. By complete accident it ended up helping to exercise her bad back. She was very, very surprised by this because she didn't mean that to happen. Although it worked out well, this didn't happen ever again.

(b) One-Time Intentional Condition: Artifact Trial

Ben wanted to make a thing to stretch out his clothes after they got shrunk by his washer. When Ben finished it, he was really happy with it. As soon as it was finished he gave it to Jane. One day, Jane climbed on to this thing and lay down backwards on it. She decided to use it to help exercise her bad back. She was very, very sure when she did this with it because that's what she wanted to happen. Although it worked out well, this didn't happen ever again.

(a) One-Time Accident Condition: Body Part Trial

This animal is a Prole and this is a part of her body. All the Proles everywhere have always used this part of their body to tie themselves to rocks to stop the wind from blowing them away. When they do that, it works really well. One day, this Prole was crawling around in a tree. By complete accident this got all twisted and

wrapped around the top of the tree and she ended up hanging there and seeing far away. She was very, very surprised by this because she didn't mean that to happen. Although it worked out well, this didn't happen ever again.

(b) One-Time Intentional Condition: Body Part Trial

This animal is a Prole and this is a part of her body. All the Proles everywhere have always used this part of their body to tie themselves to rocks to stop the wind from blowing them away. When they do that, it works really well. One day, this Prole was climbing around in a tree. She decided to use this to wrap and twist around the top of the tree so she could hang there and see far away. She was very sure when she did this with it because that's what she wanted to happen. Although it worked out well, this didn't happen ever again.

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