The Relevance of Relevance in Children's Cognition.

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Abstract

Current research in cognitive development shows that people's reasoning and decision-making strategies are deeply grounded in contexts of use. They are situated and thus cannot, as many developmentalists have it be gauged according to logical criteria alone. Two broad empirical approaches can be used to study children's embodied thinking. On the one hand, we have ethological studies which preserve the complexity and "naturalness" of the settings in which people dwell, on the other, variations on classical laboratory experiments can be proposed to highlight the discrepancy between logical and pragmatic constraints. Following this second approach, we will consider three aspects of children's growing reasoning capabilities: conditional reasoning, categorization, and the comprehension of negative sentences. In each of these fields, the authors revisit some of the 'mainstream topics' in cognitive development, with the idea in mind that a pragmatically grounded 'rationality of purpose' might be more characteristic of children's thinking than 'rationality of process'. Authors' own research brings strong empirical evidence to the currently held idea that children's thinking is far more flexible and better adapted than would be supposed on the basis of a Piagetian account of the development of operational thinking

Introduction

Most developmental theories describe cognitive growth as a move away from 'intuitive' towards 'rational' thinking, or from everyday cognition towards scientific reasoning. Whether grounded in action as in Piaget's theory, or mediated through language as in Vygotsky's theory, constructivist models of human intelligence are essentially science-centred and logic-oriented. The lengthy path towards higher forms of reasoning or 'formal operational thought' is seen as proceeding from local to general, from context-bound to context-free, from externally-supported (or 'embodied') to internally-driven (or 'mentalised'). Accordingly, children's cognitive achievements are portrayed in terms of an increasing ability to emerge from here-and-now contingencies (characteristic of practical intelligence), an increasing ability to extract knowledge from its substrate (i.e. from contexts of use and personal goals), and an increasing ability to act mentally on virtual worlds, carrying out operations in the head instead of carrying them out externally (Ackermann, 1991).

Piaget and Vygotsky attributed varying roles to direct and mediated experience in the process of moving beyond the concrete. Yet both shared the commonly held view among developmentalists that higher forms of reasoning emerge from people's ability to separate *what is known* from *how it came to be known* and *where it may best serve*. Consistent with this view, research methods themselves have become 'disembodied'. Experiments designed to study people's reasoning or logical capabilities are carefully stripped of the messy dynamics inherent in actual situations of use, and children's achievements are gauged by their conformity to logical norms or logico-mathematical canons at the expense of their pragmatic or functional relevance.

In reclaiming the deeply grounded, experience-based, and adaptive nature of human cognition, the situated approach to human learning challenges such classical views on cognitive development. Children do not think in a vacuum. Instead, they develop ever more sophisticated strategies as a means to handle complex situations. Children, like adults, progressively shape and sharpen their thinking so that it supports their purposes and augments their potentials. Current research on cognitive development addresses this idea by showing that children's reasoning and decision-making strategies are, indeed, deeply grounded in specific contexts of use, and thus cannot be gauged according to logical criteria alone.

Two broad empirical approach can be used to study children's embodied thinking. On the one hand we have ethological studies which preserve the complexity and "naturalness" of the settings which people inhabit, on the other, variations on classical laboratory tasks can be

used to highlight the discrepancy between logical and pragmatic constraints. Following this second approach, three aspects of children's growing reasoning capabilities will be considered in this chapter: conditional reasoning, categorization, and the comprehension of negative sentences. In each of these fields, recent work has pointed to children's thinking being more flexible and better adapted than would be supposed on the basis of a Piagetian account of the development of operational thinking.

Studies on pragmatic development in particular strongly suggest that children's responses to many classical experiments, far from being based upon logic alone, are heavily informed by concerns of appropriateness and efficacy within specific contexts of use (Ninio & Snow, 1996, Siegal, 1991). Our purpose, then, is to revisit some of the 'mainstream topics' of cognitive development, with the idea in mind that a pragmatically grounded 'rationality of purpose' might be more characteristic of children's thinking than 'rationality of process'.

As mentioned earlier, studies on human reasoning have generally been conducted under highly controlled experimental conditions, in an attempt to eliminate the 'messiness' inherent to practical everyday situations. Wason's Selection Task and Sentence Verification Task and Piaget's "épreuves operatoires" (and more specifically his task on class inclusion) are typical examples of such an attempt. In what follows, we discuss the psychological implications of using these paradigmatic tasks as means to study children's conditional reasoning, their understanding of class logic, and their processing of negatives. First we shall briefly introduce the tasks themselves.

Wason's Selection Task: If a conditional rule is expressed conventionally as 'If p then q', evaluation of the truth or falsity of the rule must logically focus upon the conjunction of 'p' and 'not q', since only this conjunction can falsify the rule. The selection task invites participants to specify which of four possible cases (conjunctions of 'p' or 'not p' with 'q' or 'not q') need to be investigated in order to establish the truth or falsity of a conditional rule.

For example, suppose that four cards showing respectively a 9, a 4, a D and an E, are laid upon the table, it being known that each card has a number on one side and a letter on the other. The participant's task is to establish the truth or falsity of a conditional rule stating that 'If a card has an even number on one side then it has a vowel on the other side' by turning over the minimum necessary number of cards. The correct response is to turn over cards corresponding to 'p' (i.e.. the even number, 4) and 'not q' (i.e. the consonant, D), since only with these two cards could the discovery of what is on the reverse side falsify the rule.

Wason (1966) established that this task is surprisingly difficult, even for highly educated adults. However, it soon became apparent that logically irrelevant aspects of task

presentation (namely the concrete contents and context of the rule) had significant effects on the difficulty of the task. For example, Johnson-Laird, Legrenzi and Legrenzi (1972) showed that if the rule was framed as a postal rule saying that if an envelope is sealed it needs a certain value stamp on it, most adults could correctly select which envelopes needed to be checked (for a review of research on 'thematic' versions of the selection task, see Evans, Newstead, & Byrne, 1993). Explanations for such effects range from general inference rules through heuristics and mental models to domain-sensitive rules of various kinds.

Piaget's Class Inclusion Task: According to Piaget (Inhelder & Piaget, 1964), when children are presented with, for example, a bunch of flowers (for instance eight tulips and four daisies) and asked whether there are "more tulips or more flowers", most children below eight years-old mistakenly reply "more tulips". Piaget considered this error as an indication of a lack of mastery of classificatory logic, since the super-ordinate class logically cannot contain fewer exemplars than one of its subordinate classes. Older children's correct responses and justifications were seen as an indicator of mastery of the relevant logical structure, namely, additive class grouping.

Current research challenges Piaget's assumption by showing that success in response to the question of quantification of inclusion is neither a sufficient nor necessary condition to an understanding of at least some aspects of class logic (Markman, 1978; Bideaud & Lautrey, 1983; Houdé, 1990). Moreover, a few studies dealing with conversational aspects of the interview during this task revealed that improving the setting and reducing violations of conversational rules can reveal success at much younger ages than expected by Piaget (Politzer, 1993; Siegal, 1991).

Wason's Sentence Verification Task: Just as in the field of conditional reasoning, Wason (1961) played an important early part in shaping the direction of empirical research on people's processing of negative propositions. He pioneered the use of the Sentence Verification Task, in which subjects are shown a series of images representing familiar scenes. Scenes typically involve an agent (man, woman, child) doing something (like painting, ironing, washing, reading) to some object/s (door, book, window). Each image is accompanied by a sentence which describes elements of the scene, using a negative form (e.g. 'The woman is not painting the door'). Respondents, in this case adults, are required to make a truth value judgement based upon sentence-picture comparisons. Most theoretical debates have focused on the nature of the information processing operations carried out by subjects in solving this task (for a review see Evans, 1982).

Researchers have long ignored the fact that Wason himself had explicitly admitted the low external validity of sentence-verification studies for the study of negation. Here again,

current research, mainly from linguists, has clearly established that a purely syntactic analysis reveals only a small part of what is at stake in people's understanding of negation (Ducrot, 1980; Moeschler, 1990). Many examples show a discrepancy between an interpretation of negatives based on formal logic and one based on a 'logic of use'. A sentence like "Everything that sparkles is not gold", would have to be interpreted by a logician as meaning "nothing that sparkles is gold" whereas people clearly use it to mean: "some things that sparkle are not gold". Moeschler referred to Sperber and Wilson's theory of relevance (1986) to offer a model of uses of negatives considered as specific forms of speech acts (Austin, 1962; Searle, 1969). This work remains undeveloped, however, and very few empirical studies, at least on children, have been reported.

Having introduced these three tasks, we shall now turn to a more detailed analysis of examples of recent psychological research in the three domains for which these tasks have become paradigmatic.

From truth value to relevance judgements:
Deductive reasoning in children

Accounts of the development of deductive reasoning have usually taken their starting points from a Piagetian account of cognitive development (e.g. Ward & Overton, 1990). According to Piaget, reasoning development culminates in the achievement of formal operational thinking only in early adolescence (Inhelder & Piaget, 1958). Thus if selection task performance is analysed in terms of abstract rules corresponding to formal logic we should expect a clear distinction between the performances of children and those of adults.

The main difficulty from a Piagetian point of view, of course, is the poor performance even of adults on abstract versions of the task. Ward and Overton (1990) sought to deal with this difficulty by proposing that contextual factors such as the precise nature of the conditional rule moderate the expression of the underlying competence even after it becomes available. This still suggests that the performance of pre-adolescent or 'pre-formal' children should differ markedly from that of adults. Indeed, Ward and Overton did obtain very poor performance from eleven year olds, even with thematic versions of the selection task on which older participants performed well. However, as Girotto and Light (1992) pointed out, they used a mixture of different rule types on a within-subject basis, which may have led to some complex carry-over effects.

Some of the most reliably easy thematic versions of the selection task in the adult research literature are 'deontic' versions such as the postal rule mentioned above. Here, the

rule has a modal form (stating a conditional permission or obligation, for example). The truth or falsity of the rule is treated as axiomatic and the participant's task is to look for evidence of violation. For example the rule might state that 'if somebody is drinking beer, then they must be over 18'. Cheng and Holyoak (1985) suggested that rules with the general form 'If an action is to be taken then a precondition must be satisfied' are typically solved by the application of a 'pragmatic schema' embodying rules for action or inference which are specific to this type of social regulation. It is these socially grounded rules, rather than the more abstract rules associated with formal deductive logic, that are held to support correct performance on appropriate thematic versions of the selection task.

Pragmatic schemas are envisaged as being fashioned out of children's experience of particular forms of social regulation. There is every reason to suppose that children are exposed to conditional permission and obligation rules from an early age (Dunn, 1988). Moreover, recent work by Harris and Nunez (1996) has shown that children as young as three and a half can accurately identify transgressors of a conditional permission rule. Thus we might expect from this point of view that children, certainly by elementary school age, would show much the same responses to deontic versions of the selection task as adults.

Using a radically simplified ('reduced array') version of the selection task, we have been able to show in our own research that children even as young as six can indeed do well when the rule corresponded to a conditional permission (Light, Blaye, Gilly & Girotto, 1989). Even with the full selection task, we have been able to obtain competent performance from children as young as eight with such rules (Girotto, Light & Colbourn, 1988; Girotto, Gilly, Blaye & Light, 1989; Frydman, Light & Alegria, 1997). Evans, Newstead and Byrne comment on how strikingly these findings testify to the context-dependence of reasoning both in children and in adults, showing as they do that "a task which defeats most university students in its abstract form is comparatively easy for a ten year old in a permission context" (1993, p.128).

Thus for children as well as for adults, correct performance on deontic versions of the selection task appears to depend upon the interpretability of the rules as conditional permissions or obligations. Where such interpretation is available (whether from direct experience, explicit justification or plausible hypothesis) selections typically correspond to those suggested by a formal logical analysis, though of course, according to this account, they do not in fact result from such an analysis.

However, domain specific pragmatic schemas are not the only available option in explaining these findings. A more general interpretation of the pragmatics of selection task performance is that, in all forms of the task, participants may be relying very largely upon unreflective intuitions of relevance (Evans, 1989). Sperber, Cara and Girotto (1995) argue

that the selection task is, as its name suggests, a test of selection - namely selection of potentially relevant evidence. Looked at from this point of view, Ward and Overton's distinction between the 'competence' and 'performance' aspects of the task (i.e. between the intrinsic logical demands of the task on the one hand and the 'moderating' effects of content and context on the other) dissolves. Interpreting the task is part and parcel of performing it. Whether in children or adults, Sperber and colleagues argue, rationality involves the efficient allocation of cognitive resources, and considerations of potential relevance shape this allocation.

The focus of attention thus falls not on particular types of 'pragmatic schema', but on more general pragmatic processes of comprehension which involve determining where relevance lies. Sperber, Cara and Girotto argue that the way to produce 'good' performance on a selection task is to construct the rule in such a way that it is readily interpretable as a denial of the possibility of 'p and not q' cases. It is precisely this implicit denial that makes these cases relevant, and thus supports correct selection. The deontic versions of the task achieve this by having the 'p and not q' case represent a rule violation which the participant is cued to look out for.

From a relevance theory point of view this is only as a particular instance of a more general process. By appropriate 'relevance management', easy versions of the selection task can be produced in any cognitive domain. For example, with a rule such as "If a woman has a child then she has had sex", the 'p and not q' combination (namely *women-who-have-had-children-but-have-not-had-sex*) can be highlighted by making it the object of a journalistic scoop. Here, even without any deontic element to the rule, adult performance is indeed good.

Neither explanation in terms of domain specific pragmatic schemas nor explanation in terms of a more general relevance theory offers any clear developmental story. As far as pragmatic schemas are concerned, the obvious developmental scenario would be that schemas of permission, obligation etc. are gradually abstracted from concrete instances of experienced social regulation. A less obvious and more interesting story might posit a developmental link between the understanding of deontic necessity and the understanding of logical necessity. Harris and Nunez (in press) for example, explore the idea that 'must' in its modal sense may be a developmental antecedent of 'must' in its logical sense, and point to linguistic evidence such terms make their first appearance in deontic contexts.

More tulips or more flowers?
Categories, contexts and conversational conventions.

Categorization is generally considered as a primary way in which people make sense of their world and themselves. Research on the development of categories has long been oriented towards the formation of logical classes defined by necessary and sufficient properties (Inhelder & Piaget, 1964), or scientific concepts (Vygotsky, 1934). Bruner, Goodnow and Austin (1966) likewise characterised categories in terms of a system of hierarchical classification organised in terms of inclusion relationships.

Following Piaget's perspective, the class inclusion task has been considered for decades as the key test of access to the logic of class hierarchies. However, several studies have demonstrated that many children between 8 and 11 who succeed in this task also believe that one could, in principle, get more tulips than flowers (by adding tulips or taking away flowers; Markman, 1978). Bideaud and Houdé (1983) proposed a distinction between empirical inclusion, as assessed by the classical class inclusion task, and logical inclusion which is acquired a few years later and assessed by the revised versions of the task proposed by Markman. Success to the Piagetian task can be achieved by considering the two classes (subordinate and super-ordinate) as disjoint collections, thus leading children to admit that one can change the extension of one of them without modifying the other. While they challenge Piaget's account, none of these studies question that logical reasoning is the endpoint of development.

These studies suggest that Piaget's test can result in false positives. Other researchers, in revisiting the task from a conversational pragmatic point of view, show that a move towards reducing referential ambiguity in the standard task can elicit correct answers in younger subjects than Piaget supposed (Politzer, 1993, Siegal, 1991). In natural language "flowers" can both designate the super-ordinate class and any of the sub-classes. Moreover, when such a word is used in context with the specific name of one of the subclasses, it is taken to refer to the complementary subclass, and not, as in Piaget's situation, to the super-ordinate class.

Politzer's analysis of children's performance in the standard task suggests that it results from the respondent's judgement of 'what understanding the experimenter wants me to demonstrate', in other words, what could be a relevant answer to such a surprising question. Why then do children less than 8 fail to this task while older ones succeed? According to Politzer, for younger subjects, demonstrating their ability to count and then compare the cardinals of the two subsets can seem appropriate. For older subjects, this is far too easy, so they judge that it cannot be the relevant answer. In effect, they are saying: 'You're asking me a trick question, but I shan't fall into the trap!'.

There is, however, more to the construction of categorical knowledge than solving the class inclusion tasks or any of its revised versions. Alternative accounts exist which suggest

that categorical knowledge could be organized on 'non-logical' bases, such as graded categories (Rosch, Mervis, Gray, Johnson, & Boyes-Braem, 1976) or schematic-based categories (Mandler, 1983, Nelson, 1986). Such research seems to demonstrate that even if people sometimes do categorise on a strictly logical basis, this is only a small part of the story. For instance, both children and adults seem to consider that members of a category are not all equivalent to one another, and that some are "better instances" of the category than others (the so called 'gradient of prototypicality').

Research on schematically organized categories, stimulated by Mandler (1983) has been developed in particular by Nelson (1986). In Nelson's model, children's categories are envisaged as emerging from event representations corresponding to routines in their everyday life. Such schematic representations (also called scripts; Schank & Abelson, 1977) specify the range of potential elements in a category. Members of a same category, in such a sense, do not necessarily share perceptual similarity. For example, 'high chair', 'milk' and 'bib' are all linked by a common script, though they do not in any obvious sense 'resemble' one another. Rather they are organized in spatial and/or temporal contiguity relationships.

Later on, Nelson argues, children reason on 'slot-filler' categories, grouping together items which are mutually substitutable in the same slot of a script (e.g. various types of baby food). These categories are seen as still highly contextually bound. Further development leading towards a taxonomic organization of categories results from language development, which makes possible a progressive de-contextualization from specific scripts. Thus, although Nelson admits the possible co-existence of these different modes of grouping, her model remains hierarchical. Early forms of categorization remain described as experience-based and contextually bound, and the endpoint of development coincides with Piagetian logical classification.

While Rosch's and Nelson's perspectives have opened new avenues by highlighting different forms of categorization, we would like to suggest that further steps can be taken, which could offer an image of development in which these different forms co-exist in subjects very early on, and remain co-present through adulthood.

In one of our studies (Blaye & Bernard-Peyron, 1996), 90 children at three age levels (mean ages: 5;8, 6;11 and 9;8) were confronted with a free sorting task involving 18 drawings which could be organized either taxonomically (e.g. 'people', 'animals', 'tools') or schematically (e.g. 'the forest', 'the circus'). Both types of groupings were observed at all age levels with a non-significant *increase* of schematic groupings in the older children. No developmental hierarchy could be evidenced in terms of type of groupings. However, what

appeared to develop was children's ability to switch between different mode of sorting on request.

Other recent studies confirm the idea that the type of grouping which is privileged depends largely upon factors such as instructions (Deak & Bauer, 1996), or the kinds of materials involved (Markman, Cox, & Machida, 1981). In a recent study (Lecacheur, Fraysse, & Blaye, 1996), we investigated the role of this latter factor in tests with 4;9 and 5;8 year-old children. Forty three small plastic toys representing pieces of furniture suitable for a kitchen, an adults' bedroom and a baby's bedroom were introduced to the children. Independently of their suitability for different rooms, these objects had been divided in three subsets painted respectively in red, yellow and blue. Half of the children were asked to distribute the "objects" in the rooms of a cardboard house and the other half in three transparent plastic bags each with a colored sticker (red, yellow and blue). Then all the children were asked to do another sorting on a small piece of cloth (a quarter of A4 size).

All subjects produced schematic grouping in the 'rooms" condition while the majority of subjects in the "bags" condition achieved a sorting by color, with a significant increase in this proportion among older children. Intra-individual shifts between the first and second phase again clearly highlight contextual sensitivity of the sorting mode. Children who used a color grouping in the first phase generally maintained their mode of sorting when confronted with the small piece of cloth, while those who had used the schematic mode produced totally disorganized collections.

The micro-context induced by particular task instructions and spatial constraints thus appears to make one mode of organization more accessible than another. Such results have led us to the view that development of categorization may be less a matter of the acquisition of new sorting modes and more a matter of achieving a progressively higher degree of flexibility to move from one mode to the other as a function of the task context and the experimenter's requirements.

Although not developmental in itself, the study to be presented in the next section concerning children's understanding of negatives will also offer evidence that children's processing of information does not typically conform to logical requirements but does nonetheless reflect a good sense of appropriateness and adjustment to pragmatic aspects of the situation.

'She ain't no trouble': Form and function of negations

From a logical point of view, the function of a negative is to reverse the truth value of a proposition: If 'p' is true then 'not p' is false. As Evans (1982, p. 25) puts it, this property of negation is fundamental to any system of formal logic, and hence of considerable relevance to the study of reasoning. However, what is at stake in any 'real life' situation that involves negations or disclaimers often seems to have little to do with truth value judgements. Double negatives like the one in our section title are unlikely to be taken as positives, though formally they should be.

More generally, if someone claims that "A is not X", a conversational partner will not be likely to respond in terms of any kind of mental truth table. What they are likely to do, instead, is (i) gauge the pertinence of the assertion made ('what is the speaker refuting?'), (ii) consider the beliefs and intentions of the locutor ('why is he refuting X?'), and (iii) agree or disagree with the locutor with regard to a referred-to state of affairs in the world ('what do I see as being the case?').

From a pragmatic viewpoint, it is not relevant for the purpose of communication to make a judgement on the validity of a statement without also signaling agreement or disagreement with the locutor. Agreement with a disclaimer (e.g.. 'X is not blue') could be signaled by a reply such as "Yes [i.e. you are right], it's not [i.e. not blue]". More colloquially, however, one might reply: "No, it's not blue". Similarly, disagreement with the locutor could take the form: "No [you are wrong], it is blue", or, more colloquially "Yes, it is blue".

Research on the understanding of negatives by children have shown that although children as young as three have some understanding, there remain long-standing difficulties due to the interpretation of what is negated, in other words, on the locus of negation (e.g. Jakubovicz, 1971; Rumain, 1988). However, empirical research is sparse on children's development of the concept of negation (Marti, 1991). It is only recently, with the emergence of developmental pragmatics and with a growing interest in children's theories of mind, that authors like Ninio & Snow (1996) and Olson (1994) have started to pave the way for a functional-pragmatic approach to children's production and understanding of negative statements.

We recently undertook a study aimed at pragmatic contextualization of the sentence-verification task, described earlier. Our research was based on a previous study by Bouzigue, Chamorey, & Delcenserie (1994). It used a sentence verification task to test 7 to 8 year olds' understanding of true and false negatives. The focus in this initial study was on the ways in which the object being negated (agent, action or recipient) affects children's understanding of negation. Children were shown a series of pictures with short subtexts, either true or false, commenting on the people, their doings, and things in the picture (e.g.: 'the man is not

painting the door'). The children were asked whether the sentence, always a disclaimer of a given state of affairs, 'fits or does not fit the picture'.

Bouzigue *et al*'s most striking result was that children's logically incorrect answers were generally accompanied by arguments revealing a true understanding of what was negated. This is to say, the children seemed to show an appropriate judgement on a given state of affairs. For instance, confronted with a false statement such as "It is not the lady who brushes her hair" a subject replies: "Yes, it is her - so it fits!".

In order to highlight the pragmatic underpinnings of children's judgements of negative statements, we repeated Bouzigue *et al* 's experiment with two minor changes. Firstly, instead of having children read the sentences written under each picture, we introduced a puppet (of an old woman with thick glasses, manipulated by the experimenter) who spoke out the text. Secondly, instead of having the puppet speak out in a neutral voice, we endowed her with two distinct moods. In a first mood (assertive), the puppet began each sentence with: " I know...." (e.g.. "I know; the man is painting the door"). In the second (indirect interrogative) the old woman began: "I can't see very well....(e.g.. "I can't see very well; the man is painting the door?").

Our purpose in introducing these slight variations is to enhance the pragmatic relevance of the task. The explicit goal given to the children is now "to help the old short-sighted lady see what is really drawn on the pictures". We opted for an indirect mode of questioning as a way of keeping the actual proposition identical in both cases. These two minimal changes in the tones in which statements are produced: (i) from written only to written plus oral and (ii) assertive to interrogative, were designed to shed light upon children's sensitivity to conversational rules or maxims, and their ability to understand disclaimers within this context.

We used a within-subjects design. Three factors were combined leading to 12 types of utterances, each kind being exemplified with three different contents: Type of mood {interrogative, assertive} x truth-value {true; false} x locus of negation {subject; verb; object}. Thirty-four children (mean age 7;8) were then required to make 36 judgements. Our analysis focused on the relation between subjects 'yes/no' answers and their arguments. Here we consider specifically the effects of the type of mood, this being the only specifically 'pragmatic' factor.

The mood- marker "I know..." signals assurance on part of the locutor. It has less a function of communication than a referential function, and hence focuses the interlocutor's attention on its propositional content. The proportion of responses congruent with the logical

norm should then be more numerous in this case than in response to an interrogative mood which suggests the need for additional information or repair, and constitutes more clearly a discursive act. For these reasons, when turning to justifications of responses, we hypothesized that questions would call for correctives whereas assertives would invite the interlocutor to take a stance vis-a-vis the locutor (agreement or disagreement).

The results agree with our hypotheses. Thus, for example, children's typical pattern of response to a true negative changes according to whether the utterance is produced in assertive or interrogative mode. To a (veridical) sentence like "It's not the man who is painting the door," children will say: "yes, it's not the man" in response to the assertive mode, and "no, it's the boy" in response to the interrogative mode. Thus, while from a logical viewpoint a single answer "yes" would be expected, the observed pattern reveals the adaptiveness of children's responses to a factor, namely mood, which is totally irrelevant from a logical viewpoint.

Discussion.

Experimental tasks developed in laboratory settings to assess children's reasoning are typically well-defined problems in which, from the point of view of the experimenter, 'correct' responses equate to logical responses. Tasks used in the three fields discussed in this chapter are no exception. As suggested in our introduction, human rationality has also been long equated with logicality. Logic has not only been considered as the appropriate normative theory, but also as a descriptive theory of reasoning processes in general. The ultimate goal of development has been seen as being a 'rationality of process', namely "reasoning in a way which conforms to a supposedly appropriate system such as formal logic" (Evans, Over, & Manktelow, 1993, p.168).

Situated approaches to cognition have served to highlight the peculiarity of laboratory tasks (in which most characteristics of the children's social and environmental 'niche' are absent), bringing about a new agenda for developmental psychology. What needs to be studied, from this point of view, is not so much the individual child's growing logic, but the growing adaptiveness of the child to his/her social and physical environment. Much work still remains to be done in this direction.

The small steps we have taken in this chapter to move away from classical laboratory situations have allowed us to create what we call a "pragmatic contextualization" of some of the paradigmatic tasks. Keeping in the tradition of these tasks has enabled us, via comparisons of standard versus "contextualized" versions of a task, to highlight the crucial

role of pragmatic constraints in children's reasoning. A new picture of development emerges which is no longer seen simply as an age progression towards logical reasoning. Age related changes may be better understood in terms of 'changes in the pragmatic landscape', (together, perhaps, with increasing flexibility and adaptability) than in terms of an overall shift towards more abstract or logical forms of thought.

Logical reasoning is only one amongst several different modes of adaptive reasoning available in a child's mental toolkit. Based on their everyday experience, well routinized long before formal schooling, children are skilful at using other and often pragmatically better adapted forms of reasoning. These sometimes make them fail in laboratory tasks, but these failures are often more a consequence of the presence of a pragmatically grounded reasoning capability rather than of the absence of a logically grounded form. A critical characteristic of most traditional tasks is that they require not only the activation of logical reasoning but also the inhibition of alternative and highly accessible routines (see for instance Houdé, 1995). Paradoxically, then, an important aspect of the development of reasoning skills may be a development of effective inhibition of pragmatically based routines unadapted to most formal assessment tasks (cf. De Corte, Saljo, this volume).

The picture that emerges from the present chapter is that children, like adults, base their responses to contrived experimental measures (whether of deduction, categorization or negation) on judgement of relevance, made within the setting of conversation and interaction framed by the experimenter. Though the responses they give may differ, it appears that the determinants of young children's responses are not fundamentally different from the determinants of adults' responses. The gradual recognition that infants and preschoolers are far more cognitively competent than psychologists had previously supposed has been accompanied by a recognition that the reasoning of adults is characterized by all manner of previously unappreciated 'biases'.

However, the extent of the mental 'toolkit' available, and the flexibility of selection of appropriate tools for particular purposes may both be subject to developmental change. Children's situations vis-a-vis adults also change with development, and as Politzer suggests, what changes with development more than anything else may be the child's judgement of what is most relevant to the task at hand. To this extent, the course of development would be expected to be linked in part to the child's developing mastery of the pragmatics of language and communication more generally.

The results of studies such as those described in this chapter show there is much more to rationality than logical reasoning. Children do demonstrate, even in their early years, a 'rationality of purpose', which may be defined as "reasoning in a way which helps one to

achieve one's goals" (Evans et al. 1993, p.168). What seems to be critical to children's performance (and indeed that of adults) is their interpretation of situations, and more precisely their analysis of what kind of response might be most *relevant* to the situations they encounter.

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