Children's Conversations

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Researching Children's Understanding: Piagetian Perspectives

In his preface to Jean Piaget's (1926) Language and Thought, Claparède acknowledged Piaget's contribution "to the science of child logic" (p. ix) in offering, at once, "a completely new version of the child's mind" (p. xi) from those that had gone before and a "method (in Piaget's (1926) words, 'the clinical method') ... of great originality" (p. xiii). Claparède described how Piaget had not been content to record a child's answers to questions put to him, but rather preferred to let the child talk of her/his own accord. He quoted Piaget's own description of the method,

If we follow up each of the child's answers, and then, allowing him [sic] to take the lead, induce him to talk more and more freely, we shall gradually establish for every department of intelligence a method of clinical analysis analogous to that which has been adopted by psychiatrists as a means of diagnosis (p. xiv).

Developments of the Piagetian clinical interview have resulted in an expanding literature about children's knowledge and ways of finding out about it. Two such developments which have been particularly significant for science education are known as interviews about instances (Osborne & Gilbert, 1980) and interviews about events (Cosgrove & Osborne, 1981; Osborne & Cosgrove, 1983). Here particular instances have been depicted or events demonstrated as the focus for an interviewer-led discussion with a child. Echoing Piaget's intent, this typically began with a set question which was then "followed by further questions generated by the interviewer's reactions to the young person's first response. The interviewer attempted to find out the young person's own views on these situations" (Cosgrove & Osborne, 1981, p. 2).

Whilst Piaget's work set researchers on a course of seeking better-resolved information about children's thinking, the course was to prove rockier than might at first have been imagined. We now have reason to ask if interviews can tell the researcher all that a child knows. Furthermore, if they can, how could we be sure and if they cannot, why not? In his discussion of a collection of his and others' experimental work, Siegal (1991) advanced the theory that it is a direct result of interviewers' transgression of accepted conversational rules in Piagetian interviews that children respond in ways that lead researchers to underestimate what they know. For example, a child might reasonably conclude that if an interviewer repeated a question, then she/he expected a different answer. By changing seemingly simple details of the experimental situations so that the verbal exchanges conformed to conventional conversational rules, children seemed able to succeed where they had previously failed. Siegal (1991) concluded that children's knowledge can be "obscured by a clash of conversational worlds" (p. 25). For other children such interviews might be said to embody a clash of cultural worlds: it is well-known in some Polynesian societies, for example, that children are rarely called upon to give their views to an adult, who is thought to be of higher status.

Whilst they do not detract from the detail of Piaget's observations, his view of children "as builders of their own intellectual structures" (Papert, 1980, p. 7) or his desire to describe this, these insights have sharpened our focus on researching children's understanding. They have emphasised, in hindsight, the constraints that a research philosophy and methodology can impose on the texture of the information it provides.

These concerns about interviews have been further highlighted by a recent contribution to this refinement of research philosophy, one of significance in our current work. Donaldson (1992) distinguished amongst different kinds of knowledge that which cannot be projected,

Some kinds of knowledge are in the light of full awareness. Others are in the shadows, on the edge of the bright circle. Still others are in the darkness beyond (p. 20). ... our knowledge is not all of a piece. In some cases we can readily say what we know - say it to others or to ourselves. We can discuss our knowledge and reflect on it. ... It is spelled out, available for scrutiny. But what we know is not always ready for inspection. Some of it is kept dark (p. 23).

Having articulated this distinction, Donaldson (1992) immediately raised the possibility that knowledge can be kept dark deliberately. For us, this suggests that researchers have, at best, been dealing with those kinds of knowledge that Donaldson (1992, p. 20) envisaged to be "in the light of full awareness" or "at the edge of the bright circle."

The questions that emerge for us from this characterisation of light and dark knowledge require methodologies that give a view that is better-resolved still: what lies in the darkness beyond and how might we find out? How might we extend the bright circle?

In an episode entitled Knowledge or Uncertainty in his odyssey, The Ascent of Man, Bronowski (1973/1992, p. 223) posed the question, "How fine and how exact is the detail that we can see with the best instruments in the world - even with a perfect instrument, if we can conceive one?" To answer in metaphor he shone, one by one, lights of decreasing wavelengths on the face of his friend. At the longest wavelength, a radar screen merely represented the face as a blur. As the wavelength shortened, more detail was able to be picked out, until in white light, it was possible not only to recognise the person, but to notice such things as the textures of his skin and hair. Once beyond the visible spectrum, X-rays penetrated the skin to reveal new information about bones and teeth and at even shorter wavelengths, radiation allowed skilled observers to pick out chromosomes.

In this episode, Bronowski's (1973/1992) point is made powerfully over this spectrum, through the unity of these scientists' images with an artist's paintings, both of which "[do] not so much fix the face as explore it" (p. 222).

Changing the Wavelength: A methodology which might give us a clearer view

The judicious combination of the role of researcher with that of a distinctive kind of teacher in a special kind of learning context seems to us to provide a way of answering these emerging questions. We set out to create a learning context which would encourage the kind of sustained intellectual searching that Tizard and Hughes (1984) described in young children's talking and thinking at home and which these researchers pointedly contrasted with those same children, subdued and passive at nursery school.

What we envisaged for the children in our study has much in common with Csikszentmihalyi's (1990) idea of flow, "the state in which people are so involved in an activity that nothing else seems to matter; the experience is so enjoyable that people will do it even at great cost, for the sheer sake of doing it" (p. 4). By gathering information about the quality of those experiences people most enjoy, Csikszentmihalyi (1990) identified eight elements, at least one but frequently all of which people mentioned in describing their most positive experiences.

First, the experience usually occurs when we confront tasks we have a chance of completing. Second, we must be able to concentrate on what we are doing. Third and fourth, the concentration is usually possible because the task undertaken has clear goals and provides immediate feedback. Fifth, one acts with a deep but effortless involvement that removes from awareness the worries and frustrations of everyday life. Sixth, enjoyable experiences allow people to exercise a sense of control over their actions. Seventh, concern for the self disappears, yet paradoxically the sense of self emerges stronger after the flow experience is over. Finally, the sense of the duration of time is altered; hours pass by in minutes, and minutes can stretch out to seem like hours (p. 49).

We chose to develop such an optimal context for learning for the Year 4 (nine-year-old) children in our study, based on aspects of control technology. Experiences were drawn from an electricity learning and teaching package (Cosgrove, Osborne & Forret, 1989) which engages children's hands and brains through designing and which has already been extensively trialed and evaluated. The children came from a composite Year 4/Year 6 class, whose Year 4 members were described by their class teacher as being of above-average ability, although it was later revealed to us that the class teacher considered one of the children to have specific intellectual, social and physical difficulties.

The children participated with the two authors in sessions arranged in three parts. In the first part, the children spent five one-hour sessions each day for a week, working in pairs or threes, each with a student teacher. They designed a simple circuit consisting of a cell, a bulb and wires so as to make the light glow, and undertook a range of exploratory activities, including making their light flash using a switch, sending and receiving Morse Code using their lights and cells, investigations to do with the brightness of their lights and role plays to simulate possible theoretical interpretations of their circuits. The second part, beginning three weeks after the first, consisted of four sessions in one week. We provided the children with a computer with Lego-Logo installed as a convenient way to send Morse Code and the children engaged with some technological problems from the electricity learning and teaching package. Whilst all 14 Year 4 children participated in the second part, a smaller group of seven children was selected to continue on to the third part. This third part, three months later, consisted of nine sessions interspersed over a three-week period. In the second and third parts, each session lasted from 40 minutes to 150 minutes depending on the time the class teacher could make available. By the third part, these children were pursuing more ideas of their own, designing different kinds of burglar alarms and fridge door circuits that would activate an alarm when someone opened the fridge. Whenever appropriate, they made use of the Lego-Logo-based package, for example, in designing a musical doorbell, touch-sensitive and light-sensitive burglar alarms and sets of traffic lights.

The development of such a learning context and our researching of children's understanding in that context necessitated genuine, serious and purposeful technological exploration by children and researcher/teachers together over a sustained period of time. In this way, conversations between the children and the researchers could evolve naturally and spontaneously and most often in response to the children's urge to make sense of what they were doing. The children took opportunities to initiate conversations with us and when we judged it appropriate to initiate conversations with them, we always took care to preserve their freedom and dignity and their control and ownership of their investigations. The interchanges in our study therefore differed markedly from the teacher-dominated pattern of classroom discourse (teacher initiation, student response, teacher evaluation) Cazden (1988) most commonly noted in classrooms and which Tizard and Hughes (1984) criticised. Our contributions to

conversations with the children were deliberately intended to assist them to pursue their own investigations, to help them circumvent an obstacle to their thinking or to develop together a fruitful and related avenue of investigation or issue for discussion if we could see one, with the benefit of our experience.

We can identify several kinds of conversations which occurred over the course of this study. Of the four we distinguish here, the first three we consider to provide fertile models of discourse for learning and teaching. Though we will describe these three kinds of conversation briefly, it is the fourth kind, with its implications for better-resolved research information about children's knowledge, that we wish to highlight in this paper.

Four Kinds of Conversations

Coffee-table conversations

We coined this term to describe those conversations which frequently occurred once a child or group of children had designed a prototype and could demonstrate it to us or to other children. Its name signifies for us the essence of the exchange: having been created, the prototype can now be put “out on the table” for the community of learners to consider, in much the same way as an architect, having completed a draft design, might put it out for colleagues, as clients, to view and appraise. One such conversation occurred when Monica demonstrated to Lyn the Lego-Logo burglar alarm she had designed. Monica first explained what she had tried to do. She then pointed out each of the different components of her alarm and how they related to the code she had written to program the alarm, and Lyn followed, making sense of each piece by commenting or questioning when necessary. Monica's dramatic demonstration of her alarm betrayed her delight in the invention.

In coffee-table conversations, the teacher is typically invited to participate as an equal, a partner, but also one with considerable world experience who can ask hard-nosed questions or propose tough evaluations. Once the design is “out on the table," the exchange of views can take place at some more comfortable distance from the designer. There are obvious advantages of such “disembodied” criticism of that thing out there, rather than of that elusive and highly personal something, still existing in the designer's head. In the case of Monica's alarm, it was a group of children who asked the difficult question. Having made a burglar alarm out of cells, wires, a switch and a buzzer which they could easily disarm, they wanted to know how Monica would make sure her burglar alarm did not go off when the owner of the house came home.

For us, these coffee table conversations occupy an important place in this learning and teaching context. They accord both the recognition and the serious consideration that are all technologists' due if invention and improvement are to flourish.

Feynman Discussions

Feynman (1988) wrote affectionately of how his father had nurtured in him an enduring interest in all the sciences, through what he called "lovely, interesting discussions" (p. 16). One such discussion, on a walk through the woods, concerned a bird they noticed. Feynman recalled how his father "named" the bird in several languages, before cautioning him that knowing the different names for something amounts only to knowing something about the humans who call it those names. To know about the bird, you had to look at the bird and see what it was doing.

He said, "For example, look: the bird pecks at its feathers all the time. See it walking around, pecking at its feathers?"

"Yeah."

He says, "Why do you think birds peck at their feathers?"

I said, "Well, maybe they mess up their feathers when they fly, so they're pecking them in order to straighten them out."

"All right," he says. "If that were the case, then they would peck a lot just after they've been flying. Then, after they've been on the ground a while, they wouldn't peck so much any more - you know what I mean?"

"Yeah."

He says, "Let's look and see if they peck more just after they land." (p. 14)

Several of the conversations which took place during the present study had the flavour of Feynman discussions. In these, we chose to focus the children's attention in a direction which we anticipated to be fertile and, by nurturing the children's curiosity, they and we gradually opened out the topic into a full-blown, fruitful and enjoyable investigation. On one such occasion, Mark initiated a conversation with the children about flashing lights. They talked about all the flashing lights with which they were familiar - on cars and aeroplanes, on microwave ovens, in traffic lights and lighthouses. In the course of the conversation, one child asked why aeroplane lights aren't "stiff" (as opposed to flashing) and one child immediately suggested that flashing lights were more effective in attracting attention, whilst another contended that flashing lights might be more economical of energy than steady lights. Once the children had made lights flash using a switch, Mark prompted the children to consider how they might make lights flash automatically. One child suggested a mechanism by which rotating weights on strings could turn a light through 360˚ behind a set of blinds, making it appear to flash as it went. This ingenious suggestion invited Mark's description of lighthouses and he gave the children information about the distinctive codes of lighthouses. He then showed the children a way to make lights flash using a computer with Lego-Logo installed and from this modest beginning and on their own initiative, they soon devised a way to send Morse Code successfully and easily by computer. We believe Feynman discussions provide a gentle and effective means of inducting children into the pleasures of techno-scientific investigation.

Critical or Galilean Conversations

In writing about different kinds of science experiments, Medawar (1987, p. 95) distinguished what he called “critical or Galilean experiments.” These he described as “actions carried out to test a hypothesis or preconceived opinion by examining the logical consequences of holding it. These experiments discriminate between possibilities.”

In the present study, we noted many instances of what we call critical or Galilean conversations, borrowing Medawar’s term. Here, the children proposed several possible theories and pursued their logical consequences in an attempt to discriminate between them. One such conversation occurred when the children were examining a circuit designed by Monica, Lorrie and Sophie, and airing their views as to what was happening in the wires. John and Lorrie put the view that some of the electricity was being “used up” by the light bulbs; however, Monica proposed a carrier model of electricity, saying that the volts were given to the light bulbs but the amps came back, and dismissing John and Lorrie’s view with the analogy of twins having a birthday party: “you wouldn’t just give them one present and just take the other one back.” After Dominic’s formulation of the group’s question (“I’d just like to know how much of [the electricity] comes back”) and John’s desire to look inside the wires, the children were introduced to the use of an ammeter. That the ammeter readings on both sides of the light bulbs were identical was a finding that several of the children found very confusing; as Dominic said, “Then how do batteries get flat if all of it comes back?” Cosgrove (1994, in press) gives a detailed account of a sustained series of critical or Galilean conversations amongst children attempting to resolve this discord by generating and developing their own analogies for electricity. Often animated and even passionate, Galilean conversations reveal that children enjoy and excel in the scrutiny involved in discriminating between ideas.

Philosophical Conversations

Now and then, mostly after many weeks or even months of work, we noticed that what might have begun as a coffee-table conversation, a Feynman discussion or a Galilean conversation becomes a rarer, sharper, finer kind of conversation, a conversation which illuminates young children’s urgent need to know about the nature of things, a feature of children’s conversations that Carr and Kirkwood (1990) and Matthews (1980) also noticed. Such philosophical conversation gives researchers insight into children's patent lack of satisfaction with superficial explanation, their digging below the surface for how people might find out. We describe two instances of such conversations which occurred in the present study.

At the very end of the second part of our study, Dominic and Jay had made a fan out of Lego, mounted on a stand. When they turned it on, to their great delight, the fan skittered shakily across the table. The lesson ended but Dominic stayed behind to talk about the fan. In the one breath, he told us that it moved because of the "vibrations" in the table and that it was "like earthquakes." Mark had not expected that Sydney children would know much about earthquakes at all and he was interested to hear what Dominic had to say. "So you know about earthquakes? Tell us some more about that."

And Dominic's story unfolded, prompted here and there by a comment or a casual, conversational question from Mark. The child's little hands became curved pieces of "orange-peel" crust (his metaphor), enclosing the orange which was his earth. Maintaining their curved shape, he moved his hands slowly and unpredictably, at times overlapping each other, as he described how he envisaged the movement of "plates". He told us that the plates moved against each other, their edges sometimes overlapping. He explained that at the edges of the plates were areas of weakness, cracks, prone to earthquakes. Very hot, molten lava shot up through those cracks between the plates. Here, needing to show it, Dominic's right hand temporarily left the orange-peel crust vividly in our imaginations to become a fleeting shower of molten lava, arching explosively from the edge of the remaining plate-hand. But here the fluid explanation stopped and both hands again became the orange-peel crust.

"But I don't know how scientists know the plates are moving 'cause if you put a stick in one, you wouldn't be able to measure how much the plate moved 'cause the stick would move, too."

Dominic's lively right hand had by now become the "stick." We saw it move with the plate but now it also shook with the child's laughter. Hardly had he put the run-away train of his logic into words, than he was proposing a way out of his own dilemma. Perhaps they sent a satellite into space so they could see the movement from up there, he was suggesting. Perhaps that was how they knew.

Here, in Dominic's philosophical inquiry, we believe we had been privy not only to the detail of his extensive knowledge of earthquakes, but also to his spontaneous, moment-by-moment piecing together of how that knowledge might have become known.

Again, in the very last session of the third part of our study, Dominic articulated a struggle with deep questions about knowing. Mark was spread-eagled on the floor talking with him and John. The two children had each made circuits with batteries and a light and they had told Mark that they each had different theories about what was happening in the wires. Then he asked them, “What comes out of the battery?” The conversation then chased, cat-and-mouse, question-and-answer, through a series of the children’s ideas - acid in the batteries, electricity poles and electricity stations - before languishing for a little while

in Dominic’s description of how turbines make electricity,
Well, what happens is you have this big dam and you have this little tube going to the electricity station and all the water pools across the turbine which, they go round and round and round making the turbines go, so it makes the turbines and that somehow makes electricity, I wouldn’t know how.
Taking the conversation up again in the context of the children’s circuits, Mark said, “So anyway we’ve got this stuff in the battery.” Dominic supplied him with the word and he continued, “Will ‘electricity’ do? And what does it do to the light bulb?” Again, in like pattern, Dominic answered the question, “Makes it go on, I think,” but there was a distractedness in his tone which did not seem to match the superficiality of what he was saying. And for good reason: mid-answer, he began a deep, philosophical inquiry, to which John also contributed, into the nature of electricity.
D: But I actually want to know, “What is electricity?” ‘Cause that’s a very hard question, ‘cause they talk about electricity makes all this power, but what is it in itself?
MC: What is it in itself?
D: Yeah, what is it, ‘cause we just say it’s the power that runs nearly everyone’s home.
J: It’s the power, most people say, if you ask a third, um, normal fourth grader you ask, “What is electricity?” they’d probably say, “A thing that runs light bulbs.”
D: Yeah, but what is that? You’re just saying, “Oh, something that runs everybody’s home nearly,” but what is it in itself?
The next part of the conversation was taken up with John’s difficulties with Dominic’s phrasing of the question. For Dominic, the words “in itself” were essential to the question for reasons he was later to illuminate, but John did not yet appreciate their significance.
D: You’ve got to say the question a bit better you’ve got to say, “What is electricity in itself?” You can’t just say, “What is electricity?”
J: But how would they know what it means, like, “What is electricity in itself?”
Urged by an overwhelming desire to find out, Dominic said, “I wish you could get a big bucket and hold it up in a storm and catch the lightning ‘cause then you’d get electricity but I want to find out what it is.” The conversation continued,
MC: Well, ... one of the very first people who studied this was a

man called Benjamin Franklin and he did just that, didn't he?
D: Yeah, he put a key on a kite and the lightning came down and hit the key.
MC: Put a key on a kite, well, well, well. What happened to the key?
D: The key got charged with electricity because of the lightning.
MC: "Charged," that's an interesting word. What does "charged" mean?
D: Well, the lightning's got a lot of volts so when something gets - I don't really understand what it means.
Having veered to the very edge of Dominic's understanding a second time, Mark steered the conversation back to John's question of a "normal fourth grader" and this reopened the issue of Dominic's phrasing of his question about electricity. Dominic now had to find another way of making his point about electricity clear to John and he did.
D: Well, what is [electricity] not what it does ... not what it does, but what it is (his emphasis). Like you could say, "Oh, a lion is a thing that goes around the jungle eating a lot of things." That's not going to answer your question, is it?
MC: It wouldn't tell you how to look, how to see one when you saw it, would you, unless it was eating something.
D: And then you might think it is a jaguar, a leopard, anything that eats.

Dominic had made his point powerfully, legitimating the phrasing of his question. The conversation eddied for a few minutes around "dumb questions" and "dumb answers" before Mark refocused it by asking, "OK, how are kids going to find out answers if they want them, when they want them?" John suggested looking in books in the library, but Dominic was more circumspect. "Yeah, but I don't think most authors would know what electricity is 'cause you've got to really have a look, 'cause most people find it hard 'cause you can't see it."
This prompted John to think about lightning and he was reminded of a scene from a film he had seen which he then described. Dominic listened and took up the conversation again.
You can see lightning but then you can't see normal electricity. You can often see the reaction from metals, so why couldn't lightning be a reaction to something 'cause, like, you watch metals on a grill when the electricity goes through it, when it heats up it goes red ...
Mark summarised what Dominic had said. "Maybe there are some things that you can't see but you can only see ... how they react."
Immediately Dominic countered, "But then how are you supposed to know, 'What is electricity in itself?'"
The ending of this segment of the conversation was even more salutary.

MC: Do you think we've found any answers in our work with you since the [student teachers] came?
D: Not really.
MC: Not really?
D: Not really, but we've found a lot about what electricity does but not a lot about what it is in itself.

For us, his words rang with the sharp critique of a philosopher, weighing up the adequacy of scientists' ways of knowing - and finding them wanting.

Discussion

The first three of these four kinds of conversation appear to us to provide significant opportunities for teaching and learning, whilst we believe that the fourth kind can give us well-resolved research information about what children know. Coffee-table conversations give children the chance to lead a discussion of their ideas; they can indicate what they set out to do and the compromises they made. Adult interrogation and judgement are avoided and adult and child can participate in serious critique in a style of discourse which more clearly reflects the techno-scientific enterprise. In Feynman discussions, the children's consciousness is raised by the adult's open-ended and stimulating question or suggestion, prompting children to initiate exploration in a particular direction. In Galilean conversations, children are able to bring their own ideas to bear to discriminate between possibilities, often invoking analogies to lend weight to their argument. Philosophical conversations not only reveal the breadth and the depth of children's knowledge; for us they also highlight the critical issue of children's familiarity with and trust in researchers, for only in these circumstances do children have enough confidence to risk articulating shaky, new or partly-formed ideas.

Emerging from a context where the children and researcher/teachers were absorbed, together, in purposeful, real-life explorations, these conversations provided the children with comfortable opportunities to talk about techno-science. It is clear to us in all four kinds of conversation that, given such opportunities to talk freely about what they know, these young children demonstrate wide-ranging, profound and subtle insights. We can perceive a comfortable fit between Donaldson's (1992) different kinds of knowledge and our four conversations: in coffee-table conversations, the children report confidently and eagerly, as Monica did, on what they know and often how they came to know it, too; in Feynman discussions and in Galilean conversations, we can speculate that we may be accessing children's knowledge from further towards the edge of Donaldson's (1992) "bright circle;" in philosophical conversations, we have reason to believe that children may be articulating knowledge that has hitherto been kept dark to researchers. If access is being gained here to children's dark knowledge, then we contend that features of our conversations and the contexts in which they have taken place have been successful in negotiating with the children for this access. The approach we have taken yields a view of children's knowledge as being intricate and elusive; whilst some "brighter" facets may be elicited by sustained kinds of research interviews, we now contend that children choose to reveal (or not to reveal) what they know and that they will make opportunities for disclosure, given favourable circumstances and trusted and patient researchers. We believe that through our approach we are sharpening the focus on children's bright knowledge and extending the size of the bright circle.

Providing opportunities for these kinds of conversations early in children's lives raises implications not only for researchers but also for parents and teachers. We think this approach addresses concerns about plasticity, in that such conversations and the rich learning and teaching context of which they are a part may allow children's ideas to remain fluid rather than closing off too soon, to become hard-wired intuitions resistant to explanations which may run counter to common sense. McCrone (1993) has already attested to the significance of young children's conversations in the still-raging battle between nature and nurture as the primary determinant of intelligence, citing Fowler's evidence of early and stimulating parental influence on the lives of Gauss, Picasso and Einstein, and Csikszentmihalyi's studies of fruitful styles of conversation (most notably stimulating and supportive) with young children in their homes. Such findings hold potent implications for teachers conversing with children in classrooms.

Conclusion

We began this paper by tracing a path through research in children's understanding, noting that a research philosophy and methodology - in Bronowski's (1973/1992) metaphor, radiation of a particular wavelength - can place constraints on the information it provides. From these considerations it emerged that if we were to gain a better-resolved view of what children know, an alternative research methodology was indicated; our solution in the present study was to combine the role of researcher with that of a special kind of teacher in a distinctive learning and teaching context. We have described four kinds of conversations drawn from this research; in the first three, we can discern implications for learning and teaching whilst the fourth provides clearer, sharper research information about what children know. We are now in a position to draw some conclusions.

Just as for Bronowski (1973/1992) different kinds of radiation were more or less valuable in illuminating different aspects of his friend's face, we can recognise a range of benefits from shining different theoretical lights on what we found. In particular, we have identified a fit between our four kinds of conversations and Donaldson's (1992) different kinds of knowledge; however, to return to Bronowski's (1973/1992) metaphor, we are also aware that in looking with the benefit of one kind of theoretical light, we are necessarily blind to other information. This paper represents a beginning exploration and, though we anticipate doing so in the future, we have not pursued the implications of our analysis of these conversations for theories of reasoning and logics, cognitive stage theories or ideas about children's emotional life. It is a characteristic of this kind of study that we do not know in advance what light to choose. It is not self-evident, either, that we ought to be

aiming to seek sharper and sharper resolution in the first place, but merely to find some good lights. Vygotsky (1962) gave the example of the separate study of phonetics and semantics as too sharp a method of analysis and Goldman-Segall (1990) has been concerned to preserve the unity of the smallest meaningful piece of video footage in her multimedia classroom investigations. Not only is there the danger of gaining too little information with a sharper resolution, but there is also the danger of gathering too much: we can watch a ball rolling across the floor and gather a great deal of information or we can take snapshots of its position over time and benefit from selecting information about its journey.

Bronowski's (1973/1992) original question was answered for him in the achievement of twentieth century physics. Whilst aiming to give an exact picture of the physical world, physicists have shown instead that this is not possible (p. 222).

re more delicate, more fugitive, more startling than we catch in the butterfly net of our senses (pp. 229-230).

We remain convinced that, carefully nurtured, conversations with children can provide us with a powerful way of researching what children know; however, Bronowski (1973/1992) reminds us of the need for humility in interpreting the information gained. In a curious and potent circularity, it is precisely this need for interpretation in the face of perceptual uncertainty that validates our initiation of young children into what Hutchins (1952) has called “The Great Conversation.”

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