

## CHAPTER FOUR

# THE CHILDISH NATURE OF SCIENCE: EXPLORING THE CHILD/SCIENCE RELATIONSHIP IN POPULAR NON-FICTION

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This essay is an exercise in considering representations of children's relationships with science. Although references will be made to a range of children's science media, I focus on a single case study: Scholastic's *Horrible Science*. This is a non-fiction series for eight to eleven year-olds, explicitly aimed at a popular market (rather than being marketed as textbooks). As a literary case study, the relationships between children and science discussed here are largely symbolic. They are the kinds of relationships presented in children's media: those assumed and imagined by adult writers, teachers, publishers, documentary makers, politicians and curriculum developers. This essay outlines a typology of such child/scientist relationships. To list these upfront, they imagine the child as: distinct from the scientist; similar to the scientist; as a scientist in waiting; or as a "critical friend" (in waiting). I should provide the standard social science caveat that these categories are not exclusive, neither are they exhaustive. I hope, however, that they have some heuristic use in considering (a) the diversity of ways that the many agendas around science and children intersect; (b) how science is planned into children's lives; and (c) the role of images of childhood in the cultural construction of science. This is largely a UK-rooted study, but much of what it speaks to and from can be traced across the English-speaking world (and aspects of European cultures), partly as a consequence of the increasingly globalised nature of science education and children's media.

I start with a brief overview of studies into children and science, and a sketch of my four forms of child/science relationships. Then, after a brief introduction to *Horrible Science*, I use examples from these texts to explore each relationship in more detail. I will conclude by arguing that

although *Horrible Science* suggests a range of ways in which children might relate to science, the idea that children are chiefly an audience for science is dominant. Following some of the earliest critics of “the deficit model” (e.g. Hilgartner 1990), this audience role not only places the child as distinct from science but implies a hierarchy, with the child/scientist boundary utilised to increase science’s symbolic social, cultural and epistemic “capital” (Bourdieu 1997 [1986]). Developing and adapting traditional critiques of the deficit model, I argue that children are invited to join in the building of such capital with promises that by celebrating the superiority of science they too may be allowed the (reflected) glory of social distinction. *Horrible Science* does not imagine its child readers to be a passive audience, although arguably they are a highly controlled one.

A methodological note before I continue. I largely bypass questions of whether young people are strongly influenced by their media, but am not unsympathetic to such issues. This research is built on a study of writers’ ideas, as expressed in texts and in interview, and aims to look at how images of science, and children’s interactions with it, are presented in children’s literature. I assume that such symbolic relationships both reflect thoughts and behaviours of social actors and act as images on offer to young people. The extent to which young people actually internalise these ideas is a matter for another research project.

## **The child and science**

Children’s media products can provide science communication research with a range of rich and plentiful case studies. Children are not only a key audience for much science communication work, but additionally have an odd, ambivalent and variable social status—providing fascinating topics for social research. The child is in some ways familiar, yet also strange; a marginalised social group, but one we have all been part of. Looking at the times, places and spaces where children and scientists meet allows us to track similarities and differences between the two groups and, in the process, learn much about what is meant by the cultural identifiers “science” and “scientist” (or “child” and “childhood”). There are also particular temporal issues when it comes to the child. As Vivian Sobschack (1991) argues, children are both futuristic and nostalgic, and thinking about childhood involves both hope and memory in equal measure. Thus cultural products invoking images of children provide studies of both the promises of scientific and technological progress and a (Romantic) reaction against it. Most importantly, I believe, much of the work available to science communication graduates aims to engage

children; we should provide developed research on the issue, if only to meet the needs of such students.

For the most part there is little reflection, critical or otherwise, on the peculiarities of the child as a social, cultural or psychological actor. It is as if children are “seen and not heard” by science communication researchers. There are, however, some exceptions to this rule. There has been a reasonable amount of research into creationism in schools (e.g. Nelkin 1982; Locke 1999). Further critical work has emerged from the history of science and medicine as this field increasingly finds rich case studies in popularisation and pedagogy (e.g. Keene 2007; Toon 2004). Sara Delamont has worked to synthesise sociologies of science and education (e.g. 1989), and Alan Prout has done similar work with sociologies of childhood and medicine (e.g. 2002). Robin Millar and his associates have, in recent years, worked hard to integrate ideas from science communication studies with science education research (e.g. Millar 1996; Osborne *et al.* 2002). Yet such work tends to occur in teacher training institutions and to focus on classroom concerns and policy agendas. It rarely questions the worth of school-science; though it does contest what school-science might be, and how exactly it might be of use. Useful such science education research might be, but there remains a place for more reflective and less school-centric work. Science communication studies, however, seems to fall back on assumptions similar to those made by educationalists, as if their usual call against the deficit model cannot be made in the context of a “public” that is under-18 (see, for example, Weigold & Treise 2004). It may be true, as Millar argues, that deficit model bashing is merely a fashion, out of place in the education context (Millar 1996, 12), but there is much more to children’s interactions with science than simply the schoolroom, and fashions in science communication research should not be dismissed out of hand.

Perhaps children are so often ignored by science communication research because they are seen as being so very distant from the workings of scientific life. But following those who have found it fruitful to look at clashes of cultures between science and other social groups, I would argue this is a reason *to* study the issue, not dismiss it. Sharon Dunwoody (1992) talks about this in the context of science and news media, and science’s interaction with non- or “pseudo-” science is well established as a rich area of study within science studies (e.g. Collins and Pinch 1982; Gieryn, 1999). If, following Gieryn, Dunwoody or Collins and Pinch, we are to use child/science interactions to explore what we mean by “science”, it is important to remember that the same can be done for “children”. Sociologist of childhood Chris Jenks (2005) neatly describes the diversity

of cultural uses for “child” and its cognates. It is worth quoting him at length to consider the range of meanings at play here:

Whether to regard children as pure, bestial, innocent, corrupt, charged with potential, tabula rasa, or even as we view our adult selves; whether they think and reason as we do, are immersed in a receding tide of inadequacy, or are possessors of a clarity of vision which we have through experience lost; whether their forms of language, games and conventions are alternative to our own, imitations or crude precursors of our own now outgrown, or simply transitory impenetrable trivia which are amusing to witness and recollect; whether they are constrained and we have achieved freedom, or we have assumed constraint and they are truly free—all these considerations, and more, continue to exercise our theorising about the child in social life. (Jenks 2005, 2)

It is important to note that when he talks about “theorising” about the child, he does not only mean academic work but refers also to the quite prosaic theorising we all do as part of everyday social life. Jenks’s notes on adult ideas about the child also point us to another key reason why children’s media can be so useful in science communication research. Because adults generally control children’s media, these texts provide as much insight into the ideals, hopes and histories of dominant (adult) society as they do any juvenile subcultures. This might be considered contradictory to the idea of studying a clash of cultures, but I believe we can take the two as complementary. As Jenks puts it, children are both alien and similar: a child “inhabits our world and yet seems to answer to another” (Jenks 2005, 3). The study of children’s media requires a constant awareness of dealing with the movement between social worlds.

In the context of such a diversity of definitions, relationships between science and the child are as complex as those between science and any of its other “publics”. I posit four ways of considering the child/science interaction below; before moving on to the case study, I will provide a brief sketch of each of these. The reduction to four exists for potential heuristic value, not because I believe child/science relationships to be actually that simple. Wary of falling into the simplistic dualism of deficit vs. interactive, I would like to emphasise that these four categories are *overlapping*.

*Children as distinct from the scientist.* This is an oppositional category that, like scientist/public or any number of other cultural dualities, draws a boundary and defines one member in comparison to another. In such a system we might imagine the child as naïve, lacking a scientist’s “mature” knowledge, and therefore work the boundary and its associated definitions of child and scientist around notions of intellectual capacity and/or

learning. We might, however, equally see the child as good and science as corrupt. The cultural image of the child comes with many optimistic and positive connotations, and we should not assume that children are always placed at the bottom of the comparison.

*Children as similar to the scientist.* In some respects, this is the opposite of the first category in that it finds points of similarity between children and scientists. We see this both in educational theory with ideas of the child as acting “like a scientist”, and in the construction of images of the scientist where a sense of the childlike can be worked to endow science with the positive connotations of the child. For example: the idea of having “the future in their bones”; the curiosity of a child; an intuitive link to nature; or a sense of innocence which fits neatly with the scientific aim to attain the simplicity of Occam’s Razor.

*Children as scientists in waiting.* This is often articulated in policies stressing the need for more trained scientists to maintain the national economy. I have argued elsewhere (Bell 2007b) that this is largely to think of the children in question not as children, but as the adults they will be in the future. Thus studies of the child and science also show us something of the (youthful) construction of the scientist, as well as ways in which science interacts with a (youthful) public. This category could be subsumed within child-as-scientist; it tends, however, to maintain a sense that children will remain distinct from science at least until they have reached a certain age. Therefore it could also be seen as a mix of the first two categories.

*Children as “critical friends” (in waiting).* This has a very different political history from the other three categories. Rooted in “post-PUS” calls for engagement or dialogue with science, it suggests a collaborative relationship between science and the child, in which they can work in dialogue to work out issues of science policy. I place the “in waiting” in brackets, rather than defining a separate category, because such dialogic work tends to be considered only in terms of adult relationships with science. This is not simply a science-specific issue. Opinions on current affairs and matters of public policy may be encouraged as part of personal development, but tend to be ignored substantively until individuals reach voting age. When the education community has taken on such ideas, it tends to be seen as preparation for a later, adult role.<sup>1</sup>

## **Introducing the case study**

The *Horrible Science* series started in 1996 and now consists of almost thirty books aimed at eight to 11 year olds. Based in the UK, the series

sells internationally and has been translated into several languages. It covers a range of scientific topics, including sound, insects, the body and electricity. In some respects they are similar to *The Magic School Bus*, a US-based series also from Scholastic. *Horrible Science*, however, places less emphasis on story and more on an anarchic form of humour which has a much less reverent attitude to the education system. The series itself is a spin-off of the larger *Horrible Histories* series and its publisher, Scholastic, also produces Geography, Maths and Biography sub-brands and a range of “spin-off” products: stickers, jigsaw-books, kits of hands-on activities and magazines (see Bell 2007a for further description of this).

*Horrible Science* has an individual style and its own writing team, distinct from the other *Horrible* titles. Virtually all of the *Horrible Science* books are written by Nick Arnold (an early one on evolution was authored by Phil Gates). A historian by training, Arnold started writing about science while working as a journalist, and describes himself as a keen observer and communicator of science, rather than someone situated firmly within the scientific community (Arnold 2006). Tony De Saulles has illustrated all the *Horrible Science* books so far, although other illustrators are starting to be brought in for special editions and non-book products. De Saulles was a book designer before working as an illustrator, and writes his own books in addition to his work on *Horrible Science*. He has no special training in scientific illustration, but, like Arnold, sees this outsider role in many ways as an advantage in communicating science to young people (De Saulles 2006).

Each title is the size and shape of a short children’s novel (around 160 pages long) with heavily illustrated, colourful covers. The books are highly intertextual, parodying images and styles of popular and consumer culture as well as borrowing approaches common to popular science, textbooks and other educational media. Words and pictures work together in these books; few jokes or passages of explanation work by image or text alone. Features are repeated within each title as well as across the series—*Test Your Teacher*, *Science Fact Files*, *Dare You Discover*—providing a sense of coherence across the brand. These features include a diverse fusion of quizzes, comic-style graphics and explanation, creating a fast moving “magazine” style.<sup>2</sup> Katherine Gillieson (2006) discusses such comparisons under the title “Glossy Science”, comparing the typography of Dorling Kindersley’s (DK) *Eyewitness* to travel or fashion magazines. She argues that such typographical styling signals to the readers that they can “dip into” the books, rather than reading linearly.

The books are composed with a distinctly “personal approach” in terms of narrative style. The writer and illustrator are clearly named, and there is

a cartoon caricature and child-friendly biography of each at the start of each book welcoming readers in. This is in stark comparison to many of the DK books, which downplay author names in preference to links with museums, celebrities or large computer brands. *Horrible Science*, in contrast, tends to focus on the people involved in the construction of science, discussing characters (and caricatures) from the history of science as much as it does more abstract scientific entities (which themselves are often anthropomorphised). Such people are dirty and messy, physically and psychologically; fitting a general aesthetic which eschews conventional beauty. Historical figures are less than heroic and more likely portrayed as self-absorbed, mistaken, spotty and smelly. Readers are sometimes depicted as silly, but so are scientists, teachers and other characters. There are jokes, with a focus on the child's life experience: humour and explanatory examples are often based around the school or domestic settings. It is also worth noting that the books are significantly cheaper than most of the DK offerings; these are titles children can purchase themselves with pocket money rather than solely being given them as a gift by well-meaning relatives. If *Eyewitness* is the *Vogue* of children's non-fiction publishing (a comparison Gillieson draws), the *Horribles* are the *Beano*.<sup>3</sup>

### **Children as distinct from the scientist**

Moving on to a detailed treatment of the categories of child/science relationships I posited earlier, I should first note that in the following sections I am not just describing the categories, but using them to reflect on the use of these relationships in *Horrible Science*, including the ways in which they have been modified or altered by the books. Because these relationships overlap, at times sections run into each other slightly. I start with the idea of children as in some way different to or distinct from science.

In *Horrible Science* we often see child/science distinctions executed by humour. We should not, however dismiss these as simply made "in jest": jokes are a key way of implying, and sometimes quite directly stating, positions in culture and around social issues. Sociologist of humour Christie Davies (1998) has written extensively on jokes told at the expense of so-called "stupid people"—a topic especially applicable to topics in science communication. Stupid people jokes, Davies argues, are particularly noticeable in a post-industrial society. As notions of rationality become more highly prized, we increasingly tell jokes which distinguish ourselves from apparently less rational others. To take an example from

the pages of *Horrible Science*: a child is shown in a cartoon box talking to a white-coated scientist. A speech bubble from the child shows him mistaking the word “turbine” for “turnip” and complaining that he does not like them in soup (*Fearsome Fight for Flight*, 128). The box below provides a commentary from the author correcting the mistakes, with exclamation marks and scolding upper-case type. Thus the child character becomes the centre of the joke of this page, mocked for his lack of scientific vocabulary and held up as a warning for readers.

Although this is a recurring feature in the book on flight, such jokes at the expense of child characters are relatively rare in *Horrible Science*—stupid people jokes are much more likely to be made at the expense of teachers. Jokes are also made at the expense of scientists, as part of the irreverent tone of the books. We should not, however, assume that such joking about scientists is necessarily dismissive. Davies (1998) also talks about jokes made about the “canny” (the workaholic, the over-efficient, the over-rational), which he suggests display a critique of modernism and the Protestant work ethic. Although we see quite a few jokes made at the expense of scientists as too “canny”, I would argue that in this case, they tend to continue to be distanced and viewed with some reverence. Jokes at the expense of particular scientists (or in some cases professional groups) tend to be ultimately framed within a celebration of their work. A sense that the achievers of science and technology are special is maintained as we laugh at these odd people doing things we never would (but also because these odd people were successful). They are not normal, which makes them funny, but it also gives them power.

It is perhaps tempting for science communication scholars to assume that child/science boundaries will be framed in terms of the “deficit model”, and enacted to privilege the scientist. Arguably there is a degree of this, as discussed above, but it is not the only way of imagining the boundary. Indeed, children’s literature research tends to assume almost the opposite. Jacqueline Rose (1994) and Noga Applebaum (2006) both note strong child/science boundaries in the (fictional) texts they consider, but argue that writers tend to paint child characters and characteristics in a very positive light and use them to critique science. Both Rose and Applebaum work their analysis through the Romantic image of the child, which they argue is the dominant one in children’s literature. Such Romantic ideas see nature and science as distinct, and place children firmly (iconically, even) on the side of the natural. As Rose puts it, the child is “constantly set up as the site of a lost truth” (Rose 1994, 43). Although Rose and Applebaum both suggest that this Romantic form of the child/scientist boundary is prevalent in children’s media, we do not see

it expressed to any great degree in *Horrible Science*. Arguably, this is largely because such a Romantic view critiques science, and *Horrible Science* tends to fit the “science PR” model of popularised science. We should be careful of following Rose and Applebaum’s argument that a childlike link to nature is necessarily anti-science. Indeed, the idea of the childlike scientist (or vice versa) is a common trope throughout discourses of science education (see, for example, Sleight 2007, 106-117). It does not, however, feature enough in *Horrible Science* for me to discuss it in detail here. We see a different image of youth enacted to critique school-science in the books, via a (rebellious) treatment of the teachers. Interestingly, this enforces less of a child/science boundary, more a child/school one, and it does so to facilitate a connection between their child readers and science. As this sits more neatly in the next category, that of children as scientists, it will be discussed in the following section.

### **The child as scientist (or scientist as a child)**

As briefly referred to above, *Horrible Science* works a critique of school science to make the idea of their particular brand of “horrible” science more readily connected with the social identity of the child. Science branded as “horrible” is a sort of “Bash Street Kids”<sup>4</sup> science, and the appeal against the school is largely exhibited by signalling the character of the teacher. In the illustrations, teachers are dressed quite differently from members of the scientific community. Scientists tend to be in simple white coats, science teachers wear heavily patterned jackets and ties, or other “bad” fashion choices (women teachers often wear too much make up and large jewellery). Moreover, teachers are much more frequently directly ridiculed than scientists, with laughable images of teachers often being presented on the introductory page of a book. Teachers tend not to narrate the scientific information, unless it is to underline a technical point that is also described as a bit dull. There is, underneath this, a sense that science itself could exist in some pure state as inherently fun, but that this is hidden from the child by the evils of school: “that’s what this book is about. Not the bits you learn in school—but the funny bits and the fascinating bits, the bits you really want to find out about” (*Chemical Chaos*, 6). Educational researchers Jane Kenway and Elizabeth Bullen (2001) suggest that appeals to “school is rubbish” are a key trope of children’s commercial culture. They complain that too often children’s television, toys and film set up an implied “child-only space” in opposition to adults. Further, they suggest this is (a) largely a tactic for undermining parents so that advertisers can target a child market directly;

and (b) socially divisive, exacerbating the generation gap and discouraging children from participating in education. They also specifically discuss the use of grotesque humour and scatological references as ways of articulating this child-only space (Kenway and Bullen 2001, 63-89), something *Horrible Science* is heavily reliant upon. Yet the Horrible books present a challenge to Kenway and Bullen's analysis. As both commercial media and non-fiction books, they appeal to the child-only space, for which the anti-school image has become a rehearsed shorthand, but at the same time sell themselves on the pleasure of knowledge. *Horrible Science* deals with this problem by offering the possibility of an alternative type of scientific culture. They do this by defining the extra character of the science teacher as a means of demarcating the child from a form of science, while also articulating a way of making child/science connections more palatable.

This use of the teacher character is only one way that the idea of children-as-scientists is worked in the *Horrible Science* books. It is most often expressed at points where the child is invited to do some interactive work with science. Arguably, this is largely rhetorical. That is, *Horrible Science* references the idea of the child-as-scientist in its allusions to interactivity, but does not really provide scope for substantive expression of it. There are lots of instructions for what are called "experiments", and several books and toy-kits are devoted to this. This interactive work is, however, ultimately limited—the experiments tend to be more demonstrations of scientific principles, and share only the hands-on aspect of strictly experimental work. As educationalists have pointed out (most notably Rosalind Driver 1989), the child-as-scientist approach only holds as far as we agree that scientific research comes from such uncomplicated interactions with physical entities. Moreover, ethnographic work (e.g. French 1989) of such "discovery learning" lessons showed students being coerced and led to particular conclusions by their teachers, with any anomalous results explained away rather than being held up as new discoveries. The idea of the child as a scientist in this context is largely illusory, and to apply Bernstein's (1975) idea of "invisible pedagogies", it gains much power through such illusion.

Indicative of the lack of substantive interaction in *Horrible Science* is that the books provide little or no space for the child to make a mark on them (even to the extent of lacking a "this book belongs to" frontispiece). For example, there is a "Top Secret Lab Book" included in the *Explosive Experiments* kit. This is a large boxed kit, a sort of play on the idea of a chemistry set, which includes equipment to make a model volcano, "snot" (a polymer-based stretchy substance), and a small rocket. When first

investigating this kit, I assumed the Lab Book would be a place for users to keep a note of their observations, a way of training children in scientific styles of “writing up results”. However, it is purely a step-by-step guide to using the activities. The only place a reader is asked to write anything is a space to make a note of the phone number for the local poisons unit. Similarly, readers may move shapes around in the sticker or jigsaw books in the series, but these are largely puzzles with specific places to put the pieces. Answers are provided at the back of books, or upside down at the bottom of pages. There is a right and a wrong way of doing science in *Horrible Science*—rather than opening science up to the child, the books perpetuate this.

Although, as argued in the previous section, a childish link to nature is not employed to critique science in these books, we can see some of the Romantic imagery of the child appropriated by images of scientists. Scientists are playful, obsessed with the natural world, and inherently curious. One of the most interesting examples in *Horrible Science* comes at the end of the book *The Terrible Truth About Time*. Here the book quotes from Einstein:

We are in the position of a little child entering a huge library whose walls are covered to the ceiling with books in many tongues... The child does not understand the languages... He notes a definite plan in the arrangement of the books, a mysterious order which he ... only dimly suspects. (*Terrible Truth About Time*, 144; ellipses in the original.)

Arguably, this humbles science by way of connection with the image of the child’s ignorance. This is underlined by the striking caricature of Einstein that is used to illustrate this quote. Generally *Horrible Science* depicts Einstein with a reasonably straight caricature of the iconic photographs: large hair, friendly smile (e.g. *The Stunning Science of Everything*, 9). Here he is blubbery and greasy. Indeed, it is hard to tell from the visual signals alone that it is Einstein at all. Before assuming that this is a way in which *Horrible Science* employs an image of the child to be critical of science, we should note that childlike ignorance is rather more socially acceptable than that of adults, and that arguably this quote allows an image of the scientist to be imbued with a childlike (as opposed to Faustian) curiosity.

### **Child as scientist in waiting**

*Horrible Science* often makes references to scientific careers, and many books include several pages outlining the different jobs scientists in

a particular field might do. However, the idea that only the best will be able to become scientists is a dominant theme. Being a scientist is described as something very difficult to achieve, and is suggested as a challenge via quizzes and language such as the “Dare you Discover”. As such we could argue that it acts once again to emphasise difference between science and the child; it will be a long, arduous journey before readers can call themselves scientists. The quizzes with which the books are suffused perhaps provide the most interesting example of this. One of the most noticeable things about the quiz questions is that they tend to be used as a delivery medium for trivia. The answers are not points readers are likely to know. Watching a quiz performed at a *Horrible Science* promotional event (Kew Gardens, September 2 2006), the children were asked multiple choice questions, and told to put up their hands to declare which they thought were correct. Those who got it right were cheered, and everyone was encouraged to laugh at those who got it wrong. This is despite the fact the questions were based on extremely obscure knowledge that was occasionally, but not always, counter-intuitive. Although an events-based form of *Horrible Science* content, this is indicative of the use of quizzes throughout the brand. These not only celebrate knowing decontextualised “facts”, but also knowing them arbitrarily.<sup>5</sup> I would argue that this, in effect, emphasises the rather mystical way scientists might appear to know things. Moreover, in the absence of any clear way of telling how one person knows something over another, the ability to know appears innate and the state of being a scientist is naturalised, becoming a role you are born to (Bernstein 1975).

One of the most interesting aspects of *Horrible Science* is the way in which scientific uncertainty is mobilised to make a place for the child audience within the future of science. Harry Collins (2000) argues that there is a paradox in STS-inspired science education: while it is useful to teach the general public that science is uncertain, such messages would be harmful to any future scientists also in the classroom. To Collins, such science-specialists are to be the Kuhnian “normal scientists” of the future, and should not be taught to critique the dominant paradigm. *Horrible Science*, however, does not seem to be caught in this paradox. It manages to present science as authoritative and wrong at the same time. For example, *Suffering Scientists* largely takes the irreverent tone of focussing on how great people got things wrong. Yet, because it also uses progressive notions of the history of science, this tends to act to celebrate modern science. For example a document presenting “Physics by Aristotle” is preceded by a “Horrible Health Warning”:

Every “fact” you are about to read is WRONG. Not just mildly incorrect or even half-true. We’re talking utter rubbish, drivel, clap-trap, humbug and poppycock. [...] We’ve asked a boring scientist to add a few corrections. (*Suffering Scientists*, 32)

The book then ends on a celebratory note, not only of current science, but of the past and (crucially) the future. For all that Aristotle and Newton are laughed at, as I have previously argued, this is done with a reasonable amount of reverence (the scientist pointing out the inaccuracies above is “boring” for spoiling the fun). At the same time, the idea that current science is contingent is also hinted at. The idea that science progresses by disproving old ideas, with a future that no one knows (be this a Kuhnian or Popperian future) is central to the books’ telling of the history of science. For example, from the end of *The Terrible Truth About Time*:

But one thing’s for sure. Slowly, scientists are unravelling time’s riddle. And the answer is out there. Somewhere in the universe, somewhere in the cold and dark amongst the fluttering stars is the key to the mystery. And one day we’ll find it... OH YES, IT’S ONLY A MATTER OF TIME! (*The Terrible Truth About Time*, 143-4)

*Horrible Science* puts the reader in a story with an end, but the book stops its narration somewhere in the middle. If the books were to wrap everything up with a sense of certainty, we might imagine that the child reader is left outside. Thus *Horrible Science* employs a sense of uncertainty as impetus for future study. We should remember, however, that by focusing on the child’s interaction with science *in the future*, this discourse relies once again on a distinction between science and the child (as a child rather than as a future adult).

### **Child as critical friend (in waiting)**

Noticeably, *Horrible Science* contains very little reference to science policy issues. Further, as previously discussed, there is no child-led content in *Horrible Science*—asking readers questions is a matter of testing and so-called “experiments” are largely closed demonstrations. In some respects, however, the books do function with a form of post-PUS science education discourse, by showing the people behind the science, spots and all. In some respects they are similar to Joan Solomon’s approach to STS-science education (e.g. 2002). The *Horribles* laugh at overly heroic and unquestioned belief in science. Moreover, the books often promise to explain the odd language scientists use and to stop you

feeling confused, blinded by jargon. The very first *Horrible Science* book starts from the point of view that it is important to know some science because science tells us about ourselves: “[science] belongs to everybody, because everybody’s got a body—and you’ve got every right to know what’s going on in yours” (*Blood, Bones and Body Bits*, 5). Most of the other books start similarly, or sometimes with explicit promises to “translate” what is depicted as the unfairly technical language of scientists. Although many popular science books draw on the appeal of the authority of their readers, *Horrible Science* sells itself on speaking science to non-scientists, at its own level. In this, it is not anti-academic (quite the reverse), but it revels in its non-science identity and argues for a reasonably inclusive approach to science from the seemingly more trustworthy position of the outsider.

But despite such explicitly democratic appeals which make fun of those who use science to obfuscate, *Horrible Science* is just as likely to suggest that once you have learned the languages of science you can use these illusory powers to impress and confuse your friends. You are not learning science’s tricks in order to outwit science, but only to replicate it. Thus, the boundary between science and society is actually celebrated and maintained. One of the recurring features of the *Horrible Science* books is that they tend to start and end with some explicit statements on why reading the book might be/has been a worthwhile experience. Although the social and/or environmental benefits of such science will be referenced, they tend to stress more “individualistic” rewards. They celebrate the personal success and rewards available in learning science, in terms of academic success and impressing your friends as well as being able to understand what scientists are saying. Two examples:

Scientists have their very own language which only they understand. Now’s your chance to learn a few key words. And afterwards you can sound off and amaze your friends and silence your teacher with your word-power. (*Sounds Dreadful*, 8-9)

Your new-found knowledge of light science is sure to put your teacher in the shade. And afterwards, who knows? You might even become a leading light in science—then you’ll really enjoy the limelight! So now there’s only one question... Are you bright enough to read on? (*Frightening Light*, 7)

The first quote above is notable for the way it starts by referencing ideas of understanding of science as a way of gaining social (or democratic) power, but ends with scientific knowledge being seen more as a means to impress

people with less scientific knowledge than yourself. The latter transports the reader from the more local, social “impress your friends” approach and takes it on to notions of future careers. This has consequences for what we imagine the use of science is to both young people and non-experts. To some extent the extracts above suggest it is a matter of performing superiority, and in many respects reflect Bourdieu’s (1997 [1986]) ideas of the “symbolic capital” of education. Thus we can see an apparently anti-authoritarian discourse being utilised expressly as a way of opening up science, making it better than boring school science, but implicitly revelling in the status quo and arguably applying involvement in science communication simply as a way of social distinction.

## Conclusion

This essay started by positing four different child/scientist relationships, then described how they are reflected in *Horrible Science*. That they all appear in the series may appear inconsistent, even logically impossible. But such “pick and mix” cultural categories are arguably an accurate depiction of the multitude of ways in which young people encounter science (for all that Collins (2000) may talk of “paradoxes”). It may also be a consequence of *Horrible Science*’s broad subject matter. Arnold and De Saulles deal with cultures of biology, engineering, theoretical physics, medicine and more, rather than—or as well as—an apparently coherent culture of science. Arguably, these cultures will include discourses which argue many different approaches and philosophies of science. In producing a far-reaching brand, *Horrible Science* reflects the inconsistencies and complexity of the “brand” of science.<sup>6</sup>

The consistency of science aside, the most noticeable aspect of *Horrible Science*’s depiction of children and science is the relatively low agency allowed to the child. Several child/science connections may be articulated and referred to by the books, but the notion that the child is the *recipient* of scientific knowledge remains, I believe, the dominant one. *Horrible Science* may present itself as opening up possibilities for the child to construct (or at least debate) science, but it is (implicitly) just as likely to close it down. Most work critical of science is achieved by the voice of the (adult) *Horrible Science* narrator, not child characters. The “experiments” demonstrate the big ideas, the quizzes deliver trivia—the books provide not so much interaction as pre-scripted “audience participation”. To be fair on the *Horrible Science* team, this is arguably largely a consequence of the rather didactic medium of the book. It is also a consequence of the political roles generally imposed upon both science

and the child. Although this case study looks at the *Horrible Science* books in particular, it points us towards broader social trends. (Personally, I prefer *Horrible Science* to most of their competitors; sales suggest that many readers agree.)

Despite a rhetoric of connecting the child and science, we continually see young people marginalised, limited in their ability to articulate scientific ideas, reprimanded for being wrong, outshone by the (adult) narrator's jokes or simply "put on hold" until they have jumped through the necessary educational hoops to become grown-up white-coated scientists themselves. Where the child is provided opportunity for empowerment, it is largely in terms of using the knowledge in the books against people around you. Science is thus depicted as a way of getting "one up" on your peers, teachers or family. Join in at laughing at the stupid people because this performs your own status as not-stupid. Play the game of losing the quiz or being led through an experiment, because then you can replicate the project to bamboozle others, and (ironically) delight in the same science/society boundary the book has taken aim at.

Science communication research tends to assume the hierarchies of science communication are something done to "the public". However, in *Horrible Science* children appear not only in the rather passive role of an audience member, but via devices of "audience participation" are asked to become willing accomplices to processes defining such hierarchically figured boundaries of science. Whether this is a new and innovative way of empowering a marginalised group to use the system against itself, or simply a rather underhand way of perpetuating epistemic inequality, is not a question I can readily answer. Readers will have to make up their own minds.

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## Notes

1. Rare examples of children being asked their opinion as children on science issues can be seen in a student review of the English school-science curriculum (Cerini *et al.* 2003) and in public participation work on children and the environment (Blanchet-Cohen and Rainbow 2006).
2. This is “magazine” in the more general sense of a periodical containing miscellaneous features, rather than necessarily being a paperback publication, although in this case it is that too.
3. The *Beano*: a weekly comic aimed at a similar age group to the *Horrible Science* books, published in the UK by Dundee-based publishers, DC Thomson & Co., since the late 1930s. It is perhaps best known for its cover-star, Dennis the Menace (different from the US Dennis). The very British example of the *Beano* is deliberate; for all that *Horrible Science* has international sales, its humour and cultural references remain quite local.
4. *The Bash Street Kids*, a recurring strip in the *Beano* since the 1950s, features a class of rebellious students who terrorise their mortar-board wearing teacher.
5. For those familiar with trivia on British television, it is the question delivery of *QI*, with the reward system of *University Challenge*.
6. As Celia Lury (2004) argues, brands are largely a rhetorical guarantee of a consistency. See Bell (2007a) for more on this as applied to children’s books, especially non-fiction.

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Chapter four the childish nature of science: exploring the child/science relationship in popular non-fiction. Article. Alice R Bell. This essay is an exercise in considering representations of children's relationships with science. They are the kinds of relationships presented in children's media: those assumed and imagined by adult writers, teachers, publishers, documentary makers, politicians and curriculum developers. This essay outlines a typology of such child/scientist relationships. To list these upfront, they imagine the child as: distinct from the scientist; similar to the scientist; as a scientist in waiting; or as a "critical friend" (in waiting). Visual narratives, such as comics and animations, are becoming increasingly popular as a tool for science education and communication. Combining the benefits of visualization with powerful metaphors and character-driven narratives, comics have the potential to make scientific subjects more accessible and engaging for a wider audience. While many authors have experimented with. How can we use these tools more effectively in the field of science communication? In this regard, it would be interesting to explore the application of comics patterns to data visualizations and other types of scientific visualization [Bach et al., 2016; Bach et al., 2017].

Proposals for Core Nature of Science Content in Popular Books on the History and Philosophy of Science: Lessons for Science Education. In Lee, Y. J. & Tan, A. L. (Eds.) Science education at the nexus of theory and practice. Rotterdam: Sense Publishers.

Sinatra, G. M., Southerland, S. A., McConaughy, F., and Demastes, J. W. (2003). Jim Strickland I suspect that the root cause of this kind of insanity is a lack of innocence. Q's obsession with child abusers is likely due to psychological

The Prophecies of Q Sunday, May 17, 2020. S Herb The question seems to be whether Qanon is a conspiracy.