CHAPTER 4
THE WRITING COMMUNITY

> I think of historians as lonely people who aren't necessarily surrounded by as many people and the opportunities that I have to work out their ideas as they're going on.
>
> — Gao, Chapter 4

> Science is, of all the creative areas, the most social. You take a writer—they're a very solitary person. A composer, an artist is solitary too. But as a scientist, it is very hard to be solitary. . . . It is very social.
>
> — Richard, Chapter 2

One of the most significant issues that emerged through these interviews was that, although writing in the sciences is largely a collaborative process, it can be, at the same time, an isolated and often *isolating* experience. From the graduate students who often struggle alone with the writing process, to the senior scientists who make a switch to cross-disciplinary or public-focused writing mid-career, writing can be a lonely activity which is rarely explicitly discussed with colleagues.

Some graduate students are lucky. Those who fare best tend to belong to a large research group, working on a project that is funded as part of a larger project, led by a senior scientist who has the language and the motivation to talk about writing. But most of the doctoral scientists I interviewed—and this was confirmed by most of the interviews from senior and emerging scientists speaking of their own experience of developing as writers—perceived writing as not explicitly discussed with seniors or colleagues. And this lack of discussion was ongoing, into the collaborative work of senior scientists:

> . . . we didn't talk about writing, we talked about the math. Not the writing process, ever that I can think of. I mean we didn't have typesetting to even waste time talking about that which is now what we talk about when we're not talking about math. (Senior Scientist, Interdisciplinary Mathematics)

For some emerging scientists, as we have seen in Chapter 3, this lack of intentional, articulated support is traumatic. Those who struggled most were the doctoral students whose project was self-standing; it seemed that, in this situation, advisors and peers showed even less capacity or motivation to discuss writing.

This lack of discussion was puzzling on a number of levels. Most participants in this study saw writing as, in some way, critical to the work of science. Everyone agreed that writing was a way of communicating findings, but for many it was far more than that: it was *part of the work of science.* It was the way a scientist tested their ideas, interpretations or intuitions. It was the way new ideas—either about the current research or new research—emerged.

The literature on effective research communities seems also to suggest that issues critical to the aims of science, such as writing, should be discussed within that community. Bereiter and Scardamalia (1993), for example (see Chapter 1), consider scientific research communities as the archetypal learning community. The notion that these research communities are not engaging with writing *in the same way* as they engage with their science is therefore intriguing.

The answers given by participants when this issue was questioned became reasonably predictable: while agreeing that writing at advanced levels should be taught within disciplinary communities, most scientists felt they were ill equipped to teach these skills. They used these skills themselves, but because they had learnt by reading and imitation, by gleaning meaning from their advisors' or co-authors' revisions, rather than through conversation, they felt they did not have a language with which to discuss writing.

Another way of addressing this question is to hypothesise that, since science and writing are not separate processes, scientists are, in discussing the science, implicitly discussing the writing (Graves, 2005; Yore et al., 2002, 2003). The second narrative in this chapter supports and demonstrates this idea: in discussing his ideas in multiple venues with a range of audiences, Gao is experimenting, not with the data itself, but with how best to construct the story that will convince an audience. His process calls into question Yore et al.'s (2002, p.689) finding:

> [Scientists] appeared to disconnect the verbal interactions about their writing and the embedded ideas as being part of the writing process. . . . It is hard to believe that a team meeting to consider draft reports or to address reviewers' comments about style and content did not focus their discussions and clarify their thinking about their understanding.

However, the point remains that most scientists in this study perceived conversations about, and collegial support for, writing to be in short supply—*and this was felt as a lack*. A worrying number of scientists, both emerging and senior, did not feel explicitly or sufficiently supported, engaged, or trained as writers of science within their research communities.

In the course of my research, I encountered one group that I felt approached writing as a learning community. The two leaders worked within the same institute and were friends, and the group consisted of faculty and graduate students. There were two catalysts for this group. First, the leaders were already concerned for their own productivity and for the writing of their graduates. Second, these instigators attended a writing seminar where they acquired a language with which to talk about writing. Already motivated to write, but struggling to find a way to write within their busy schedules, this seminar gave them practical strategies which they found convincing. It is significant—and an important point for writing teachers working in the sciences—that their professional scepticism meant that they needed evidence that this would work, and they also needed to test empirically their own experience and the experience of others within the writing group.

This chapter opens with two narratives which highlight how an individual is supported in their writing and their science by engagement with others. Mostly they write alone, but their community is critical to that process. The first story is that of a doctoral scientist, Eugene, who focuses on the diverse nature of the community with, and in which, he works. Gao, like Eugene, is active in seeking out support—though his support network is perhaps more traditional in the way it comprises peers and academic mentors. The chapter concludes with a narrative from one of the instigators of the writing group and a conversation between the two of them. For these scientists, developing a writing community has been a solution to particular problems but also a cause of concern: how can they maintain the momentum?

EUGENE

Eugene has a gift. Within a few moments of listening to him, I'm so interested in his extraordinary migrating birds that I struggle to stay focused on writing. I've since watched him weave the same magic in public seminars and listened to him convert a sceptical radio interviewer into an instant conservationist. What he conveys is that his research aims to explain a genuine mystery. He has travelled around the world to research his birds, and for five years now, he has bunkered down on the beach that 'his' birds fly from to watch them leave on their long trip. He appears to know each of these hundreds of birds personally. His views on writing are perhaps unusually sophisticated for a doctoral student, and are informed by his first career, as a graphic artist, as well as some superb training in scientific writing experienced earlier in his career. But the most distinctive aspects of his writing are its relational quality, and the diversity of the community that supports his work.

I Don't Just Have My Advisor—I Have All these People

When I was going through my master's degree, I noticed that I could split the master's researchers into two groups: people who were really serious about research and people who weren't; people who were getting a master's degree just to get one and people who were really interested in doing research. And the people in the category who weren't that serious tended to be people who were afraid of writing and not confident about writing and didn't want to do it. The people who were really into research were much more likely to be good at writing and confident about writing and just be able to write. It is just an observation—I don't know what that means exactly, whether writers are predisposed in some way.

I find people to be atrocious writers in general. Most people are not into it or are afraid of it or something. Even in classes during my master's degree, when we were doing scientific writing, I was amazed at the low level of writing, the lack of ability to put coherent sentences together. Maybe it's more about thinking than it is writing as far as putting coherent thoughts together. And yet, in scientific writing, it's so logical, it's just like A B C, compared with creative writing.

Scientific writing is very cold and impersonal, and I do a lot of it. But the writing I enjoy a lot more is much more informal. During my research in March, I'm super-busy; I'm doing field work every single day, and I get extremely isolated from people. I could go the entire month without talking to anybody because I'm in the field almost all day, come back, collate the data and write notes. So I found a way to handle this almost in a social way. The project I am working on is on migratory birds, and there's a really hard-core group of people spread all over the world who are interested in this topic very intensely, and we collaborate and communicate. It's a very tight group of people, a lot of whom have never met each other, and my results are pretty interesting. I thought one way to communicate with people and get my thoughts together and have other people respond to what I am thinking would be to publish something like a blog of what I am doing in my fieldwork. So what I do during March—I've done it the last two years—is basically rattle off a three-or four-page report of what I have done that day and what I have found and what it means in my study, and I send it to people all over the world. It's a list of like 20–25 people who are really intensely interested in the subject and I treat it very informally. Sometimes it diverges from science quite a bit. I mean the science is in there and that's the basis for it, but I seek to entertain myself and other people by just going off on surreal tangents and saying things that are blatantly false, just to stimulate discussion.

Since I've become a researcher, this has been the only creative writing outlet that I've had. But I've enjoyed it because it's a sharp break from the scientific

writing where you don't get to interject your personality much at all. I needed something that was my personality coming out. So it was a lot of fun and people seem to enjoy it. It's like keeping a research journal but with an audience.

This social aspect also turns out to be important for the scientific writing, too. Let me give you an example from today as I was trying to write—I haven't written a single paragraph today, by the way. There's a lot of research being done on migratory birds by non-professionals, volunteers, and a lot of this stuff is sitting around in very capable hands and not being published. And so today there were some questions I had about the Australian population of the bird I study, and there's a lot of data on comparing the Australian and New Zealand birds, and I know there are people out there that know the answer to the question that I'm wondering about. So I'd simply send an email out to five people and say "here's my question—I'm doing this with the data and these are the things I'm finding interesting. What's your information on that?" It usually ends up with a two-week email conversation, and people start adding people from Europe because they say—"oh, that guy knows something about that—here's his email." And so it becomes this ever-widening group of people discussing the question I have for one paragraph in my dissertation. So it's actually really interesting because I don't just have my advisor—I have all these people.

Bird-watching is huge and there's no clear division between bird-watchers and scientists. A lot of the best science is being done by people who are doing it in their spare time because they love it. I don't think there's much financial backing of some of these things here, and so it falls into the hands of people who just have a love for the subject. They're retired people and people who have jobs and are just doing it in their spare time. I'm absolutely amazed at the number of people who are in this group—like, "I'm a house builder, 60 years old, and just decided to start cannon-netting birds and recording data for 25 years in my spare time!" I mean, I've been researching this bird for four years but this guy's been researching the bird for 25 years and he's never been paid, he's got no degree and he's not going to publish his stuff because he's not a writer, he's not a scientist, but he's got all this stuff and he's this incredible resource for academics. And my advisor, he's also part of this whole thing, and both of us benefit continuously by contacting these people and building relationships with them. And they're all great people because they love what they do and they're really excited to share it. Academics in a similar position might be more guarded about their results and their thoughts, but these guys don't even care about publishing or being a co-author—they just want their work to become common knowledge. It's a great position to be in; I have more than 20 years of experience at my fingertips even though I've only been on the scene for four years.

I finished all my fieldwork in April when the last bird left on migration, so since then I've just been writing and analysing data. I did three field seasons and during the last one I was actually already starting to write, which is a little hectic, but I'd gotten two manuscripts submitted already before my field season ended. So my Ph.D. is going to be basically six published papers with a general intro and a discussion added onto them.

Each one of these chapters has to be a completely coherent paper that a journal is interested in, so there's a bit of repetition going on there, but still I think that's a better way to go than to write a thesis and think that you're going to go back and rewrite it for journals, and then never do it, which you see time and time again. I've finished writing a short methods paper which I thought would be very interesting to people in the field, so I got that out really quickly and that's already in print. Then I had a second paper which we also rushed out early because we thought we had a very sexy, interesting result that would get in a very high-level journal. We wanted to get that out quickly, not only so other people didn't scoop us, but also because if we got it in a high-profile journal we would be able to use it as ammunition to get post-doc funding. So while I was doing field work, I got this thing together, a short paper that we submitted to *Nature*. It was rejected without being reviewed, and then by *Science,* and then two weeks later *Nature* invited us to submit it to their online journal—it's called *Nature Communications*—and it's been accepted and I just put in the last changes.

And so I've gone through multiple rounds of revisions. During that time between March and now, I've been working on the third paper and collating and analysing data for the other papers as well. So I will have six papers and I'm in the final throes of this third one. In the next 3 or 4 months I need to write three or four papers. A lot of the data is sitting there waiting to be written up—I have tons and tons of data and to figure out which goes into which paper is a tortuous process. But even though this one paper's taken me way too long, the path seems very clear to the other ones. So they should come out very quickly. It's not like a retooling for every single paper. They're very interconnected—sometimes I'll write a manuscript and say "oh, that part belongs in that other paper" or the editor will tell you that. But right now, I've got all these pieces and it's a matter of putting them in the right spots. So that should get much quicker.

The first thing my advisor and I had to do, before I even came here, was collaborate to write the proposal for the Ph.D. grant, and we did this by email without ever talking to each other; that just went back and forth and we sort of wrote it half and half. So when I got here I had an advantage over many Ph.D. students, in that I already knew exactly what I was going to do, rather than spending months developing my project. And in fact I started collecting data as soon as I could buy a car (to get out into the field). We basically knew what

needed to happen and so some of what I did was backwards compared to other Ph.D. students, because my official Ph.D. research plan was presented to the university after I already had a field season of data. Which in fact is the same thing I did with my master's degree.

I would say, in my experience, that the idea that there's an *a priori* hypothesis, that you collect the data specifically for it, and then report your results, almost never happens in wildlife ecology. People don't know what they're going to find, and they don't know how good they're going to be at finding it, and they're scrambling for sample sizes no matter what. So usually it's a matter of "that's really interesting—let's go find everything we can about it" and then later on you think "well, I *could* have had that hypothesis—it certainly sounds believable. But that was one of the ten hypotheses I had and it's the only one that works so we'll write about it!" It's not strictly hypothesis-testing but sometimes it's dressed up as that.

In terms of working with my advisors and getting feedback, my second advisor was brought in as a mentor of the whole process and it's turned out very good that way. I mostly work independently and then just give drafts to them and they're both really good about turning things around. A lot of times I have given them pieces that are just fragments of stuff—like, "here's a write-up of the results" and then just a schematic of the intro and the discussion including what points I might hit. We meet very regularly—every week or two—and go through ideas. So, the thought process has always been peer-reviewed and I never go off for three months and then come back and say "look at this" and they go "*what?*" We are really collaborating on what the thought process is at every moment. It's a good process. Both my advisors are really energetic people and they are both extremely interested in my project. It's been a great collaborative experience.

The relationship has not been such that I give them a draft and they hand back the entire draft with all their comments written up on it. We have been working in the form of having a meeting where they print out a document I've sent them and scribble stuff on it but they usually don't just hand that over for me to interpret on my own. Usually we go through the manuscript together and they say "this is unclear" and I'll go "OK—I'll make a note of it and fix it." Because we've already taken a couple of things all the way to publication, there have been times when they have taken a word file and tracked changes and actually rewritten sentences saying "I think this would be better," but that's not usually the case.

I had lead-authored four papers before I got here and so I think, to a certain extent, my process is more refined than a lot of Ph.D. students. I don't think I'm being taught anything specifically about writing—I mean, of course I'm getting better at it through practice and because my project is much more complicated

than when I was doing my master's degree. But I'm not sure that I've learned anything specific during my Ph.D. that I can put my finger on about "this is how you approach writing." There are stylistic things that I used to do that I don't think are the right idea to do anymore. For instance, there are different ways to write papers and one of them is to write it linearly, but I'm finding a better way to work is to write it backwards.

Actually, I was having this discussion a couple of weeks ago, with someone who's just starting to write. What I think young writers do is they write their intro first and it becomes this big blathering of everything they've learned on the topic and that's not what a journal wants to hear and it's not what a reader wants to hear. And someone taught me this way back, that you should write your results first, and then write the methods that explain your results. You don't write everything you did—you write only the methods that explain what you want to talk about. Then you write your discussion, which doesn't talk about anything except the results that you presented, and then you go back and write the intro that would lead you into that. That's very different from writing the intro by talking about the subject, especially when you're given the task of "do a literature review on everything that has to do with your topic." You have all that at your fingertips; you have all this literature that you've been thinking about and so you start to write an introduction and you could just go on forever because your general topic is huge. No matter what specific thing you're studying, the topic is bigger than that, and so you end up with big, bloated rambling introductions that actually don't set up your paper very well.

Right now I'm writing a very complicated paper that has data taken from all over the place and different sources, and it's been a nightmare. The methods are long because it's a bunch of different types of data, and the results are longer than you'd expect. I wrote a three-paragraph intro for it and I'm totally happy with it. Because I realised that that's all it needed; all they need to be told is why I'm doing it and why it's relevant—anything else can be left for the discussion if you still think it's important. I think that's the biggest transition I've made, almost out of necessity to be more efficient, to write backwards.

What happened in my master's degree and my first paper—and I think I see this a lot with people writing their first paper—is people want to say *everything* because they're proud of what they've done. They've done a lot of things and it's all cool and they want to get it all in there. And with my very first paper I did that. I ended up writing three more papers on a related subject and by the time I got to the fourth one I looked back at that first one and thought "what was I doing?" But that first one got published in a nice journal anyway.

Drafting that paper for *Nature*, there was something about it that I really loved and when I finished the thing I thought "that felt great." And the reason

it felt great is because it didn't get into all the grey areas that bog down ecologists. The word limit was ridiculous—it had to be really short; we knew that it couldn't ramble on. So I would write one or two sentences on a subject that I knew I could write an entire paper on. You know, I could write 4,000 words on that topic and I even had data that would confirm what I said, but I knew that *Nature* wouldn't put up with it, so I was just writing "dah dah dah—this could mean this—*end*," and then moving on. It was really liberating to write a paper that way because ecology is so complicated that if you're really thinking about what you're doing you'll never be able to write a sentence. It's so muddled with "maybe" and "these guys found something else" and "I don't know what that means" and "it could mean these twelve things"—but when you're writing a paper that short, it was so nice to just put that all aside and just say "what do you know?" and just write it and stop. It was criminally short, but it felt so liberating because there was no way I could get bogged down in the things that normally bog me down.

But while it was liberating, it was also unsatisfying because I kept having to put aside things that I knew or just say "this might mean this" when I knew there was a lot more to say about that, which was also kind of painful—it actually felt a little dishonest. But when the reviewers' comments came back with "what about this?," "what about that?," I was right there with "well I have all the data on that—it just wasn't in the paper." And so I found the best way to respond to the reviewers, because I didn't have the word limit any more (*Nature Communications* doesn't have the strict word limit that *Nature* does), was to actually make the paper about 35 or 40% longer. And at the end of that process I think it became a much better paper—at least for the purposes of my dissertation because now it stands better as a chapter than it did in that ridiculously abbreviated form. It feels like a more honest paper—I feel like I'm not hiding as much stuff; I had the length to actually deal with some stuff.

It's unusual for a master's student to have four papers published. This is what happened: I attended one of the best wildlife programmes in the US, and one thing that they really did was make scientific writing a focal point of basic wildlife classes that were being given to bachelor students. So, my very first course, my first semester, included an in-class research project and they had a policy that across all their courses any of these research projects were written up in journal format in the style of a given journal. This was a brilliant move. I think this is probably the single best thing that has happened to me as a writer. So in the first class (this is also being taken by second-semester bachelor students), we were given a file which contained the publishing guidelines for a particular journal. And so we had to write abstracts and everything; we were writing in essentially the same format I am using today. I used it right from

the beginning, so in two years of course work I'd written probably six or seven reports in journal format.

The faculty were always publishing stuff with their grad students, and so you were getting exposed to real scientific writing and peer-review in your first semester; it was absolutely brilliant! Many of the issues around writing things in a scientific manner were just dealt with right off the bat and were already second nature by the time I was writing up my master's dissertation. And I can't thank them enough. We would do class peer-reviews where we would break off in teams of three or four, go out and do field research and we would be writing collaboratively with two or three other students on a report that was in journal format, and then we would bring it into class. Everyone would peer-review two other people's manuscripts. All this stuff about the economy of scientific writing—it was painful. The only previous writing I had done was creative writing, and the extremely terse and to-the-point writing that is required in ecology was beaten into us immediately. We would turn in these bloated manuscripts and the teacher would say: "All this is unnecessary. These five sentences could be said in five words." And just right from the get-go you were starting to think how to be super clear. And that is so much more important than anything I've learned here.

I think that's the way scientific writing should be taught. We didn't have any classes that were about scientific writing. We didn't have any classes that were about writing at all. But every single class had writing in it.

Do I think about my audience when I'm writing? That's a good question. Maybe not as much as I should, because I personally don't have really strong relationships with particular journals, and so I often don't even know who is the typical person that's going to read that journal. I guess to a certain extent I don't know who my audience is in a lot of these cases. In some cases I do, like the methods paper I wrote where I knew specifically who was going to read that and what they were going to be interested in. So that was very specifically written for specific people, and it went to a journal that I knew would reach them.

I think anyone writing their first scientific paper is probably uncomfortable with their audience, and so when I started out writing papers I didn't know exactly how what I was writing was going to be viewed. "Am I a total poser? Am I just going to be outed as someone who doesn't know what they're talking about with what I've just written?"

Science is supposed to be all unbiased and matter-of-fact, but we know that's not exactly true. So in a sense, I guess I am trying to be persuasive because of course *I'm* convinced of things; hopefully I'm not convinced of them before I take the data, but that's not always the case. But after I've taken the data, I'm probably convinced of something and then the whole process of writing gets mired in the statistics which I'm very cynical about. I mean in some cases I don't

know, and so I will write a few paragraphs basically saying "I don't know and neither do you—you know, these are the messy facts and this is just the way it is." And other times I'm pretty convinced of something and then find the best way to make sure that comes across. It's always a tricky line to draw between whether you're just trumpeting your pet theories or whether you actually have facts behind you, and so that's something that has to be constantly thought about and hopefully your peers call you on it. I try to be as objective as possible but I don't think it always happens.

I'm not sure whether I just have a contradictory personality or whether this is just the nature of scientific writing, but I've found that my papers tend to say "this is what people have believed, and they don't have the evidence to believe it. Here's some evidence; what I've shown contradicts what everyone thinks." And maybe that's the only way you're going to get published, because if you just write "I took this data and it agrees with 100 papers before me," no one's going to care. But I wonder if I actually exaggerate the combative nature of it just to make it more interesting to read. Because I do think that, to a certain extent, scientists (and this is my big pet peeve with them) often don't know how to write to an audience that isn't the five people that they collaborate with, that already know their subject really well.

I think scientists should spend more time figuring out, not necessarily how to be persuasive, but how to be interesting. I think a lot of scientists are oblivious to how to keep someone's interest in a narrative fashion. And even though it's scientific writing, there needs to be, not necessarily drama, but pay-off.

OK, here's something I have learned that I forgot to mention. I had this revelation a couple of months ago: I write in a dramatic style and it's contrary to what people might be looking for in a scientific article. What I mean by that is I tend to build up the tension in a question, which means that an introduction of mine will start vague and unfocused and the last sentence will be "ba *bam*!" This is not necessarily the way to write a scientific paper. I'm remembering back to a humanities writing course where you have topic sentences in each paragraph. We were taught you should be able to go down a paper and read all the first sentences and that should give you the story. And then you read the rest of the paragraph if you are interested in more detail about any one of those. What I tend to do is the opposite: I end the paragraph with the topic. I keep on getting more and more focused, and at the end you figure out what I meant.

But I'm finding that that's killing me. I had this discussion with my advisor on a specific paper because we were finding that the best ideas were always buried. As opposed to the best ideas leading off something—leading off a section, leading off a paragraph—they were always buried where someone might not find them if they were just skimming through a paper. I think it's not helping

the scientific style of my papers in that I know scientists want to quickly scan a paper and find out what the points are. The first sentence should just be a bold declarative: "we're going to do *this*" instead of having that be at the end where you've had to wade through everything that I've said. I think my personality's more comfortable with the persuasive approach. Coming from copywriting and creative writing, I have a great love of fiction, and I just love writing that is alive and that has flow to it and thrust and dramatic tension and even, you know, gags. Maybe there's no place for that in scientific writing—well, there's less of a place.

GAO BOLE

Walking into Gao's office, I'm assailed by colour and texture and light, and the almost life-size figures in the corner seem to be taking notes. Meanwhile, Gao is full of welcoming energy. He's made an international career out of his remarkable track-record as an award-winning teacher (his fields are chemistry and education)—he is always in demand and travels extensively (which, he explains, is how he's acquired most of the treasures that fill his office). I have chosen to place his narrative in a chapter on the writing community because of his unique take on writing as an oral endeavour, undertaken within a wider community, and the impact on his writing of a group of "trusted people."

The Idea that Somebody Is Taking Seriously the Job of Reading Something that You've Written . . . Is Just Invaluable to Me

Back in the days when there were actually bookstores one could go to, one could go to a science section of bookstores and find lots of books on mathematics and theoretical physics and so forth for the public. And chemistry has always been really under-represented in that area. There was a handful of people, Oliver Sacks I think has done well. There's a chemist at Cornell who's tried, who thinks about these things pretty broadly, and a couple of other people who do write with that intent in mind. But it never took up more than an 8- or a 10-inch area of the bookstores. Why hasn't chemistry ever generated its Carl Sagan? I don't know the answer to that question, really. You've got terrific people who can talk about black holes for God's sake—you'd think somebody could talk about drugs and write this kind of business.

I think what science writing does for the public is to give people a deeper understanding of something they thought they already knew about, but didn't know deeply enough, but really didn't even understand they could understand it. And then all of a sudden you feel like you're just tapping into that whole "Secrets of the Universe" thing. As a student that was one of the things that appealed to

me about chemistry; it wasn't the classes, it wasn't the experiments—it was that at the end of the year I really felt like I was learning something, and I was learning something that really matched up with things in the world that I knew about.

It really comes down to one question—can you tell a story? I think writing or telling anything is about a story. A good story just means that after the first sentence you haven't tuned out; you're actually interested in hearing what comes next. And it's up to the writer or speaker: that's all under your control. What do you say in order to try to whet the interest and desire of the person who's reading or listening at the time? I think you have to do that in class, every day, every moment.

I have been on the side of justice and good taste when it comes to this question of online learning. Which means that I think they're all bullshit. I really do know in my heart of hearts that you and I sitting here face to face having made a social commitment at this moment to be thinking about this is simply different than us doing this by Skype, by phone, by non-synchronous methods. And I think whether it's me and 10 students in class or me and 400, the commitment that people make at that moment has a special character to it. There's a different kind of social commitment that just is not matched in any other way. So the process of formulating and narrowing down those ideas I really do see as a rehearsing of material. I do see the analogies to comedians and actors very much so, but especially I think comedians' material, as I want to hear how my idea plays for the public.

So the normal part of an academic's life is to be out on the circuit giving plenaries, giving keynotes, and I always feel like I'm testing out the material to see how it sounds. And sometimes it starts as a footnote, and sometimes it starts as a comment, and sometimes it starts as an answer to a question. But I always see myself as playing with the ideas. At some point along the way you feel like you've now got a coherent story that you not only think is defendable but one that you *have* defended, one that has had people jabbering back and forth about it and one that has changed substantially through that process.

If you were writing science, this would apply—absolutely. The story you tell absolutely depends on how it's perceived and reacted to by the people you're trying it out with. And it doesn't mean that the scientific facts change, right. Evidence is evidence. But claims come from a warrant that the evidence provides. And I can take evidence and tell all kinds of stories about it, and I think we do that in science quite explicitly, all the time. In my role as a journal editor or reviewer—I'll make up a number—I think that at least 75% of the time the criticism that I make that recurs and recurs and recurs is people who have over-interpreted their data because they wanted a certain story to be true and they haven't been critical about what the data tells.

I think that's true in all of the things that you write and think. It's an enormous benefit to this profession that so much of what we do has an oral component to it; that there's a venue that allows us multiple times to be trying out our arguments whether it's with our research groups, whether it's in the hallway with your friends. One of my colleagues will be the first to tell you the reason we still interact is that when he's writing something weird that he thinks nobody else will look at, he will send it to me because he'll know I'll read it and give him the feedback.

There's a benefit that doesn't necessarily appear in all parts of the academy. I think of historians as lonely people who aren't necessarily surrounded by as many people and the opportunities that I have to work out their ideas as they're going on. Recently, the editor for a journal I write for saw me at a meeting and he said I'm inviting people to be guest editors; do you have something you want to talk about? And all the thinking I've been doing about a particular issue crystalized in the form of that editorial. But that editorial has its antecedents in talks that were being given two years earlier. You could find the ideas in the drafts of either my PowerPoints or talks, and I still keep notes on my computer. You could see all the little pieces that ultimately came together in a story that looks pretty good now, that people like, was hardly identifiable as a single story two years earlier.

I think you're always being persuasive. I think you have a point of view and you're trying to get people to understand what your point of view is—no matter what—even if it's self-evident. I think it's always true.

I find easiest the writing that has followed the greatest degree of planning and practice. I don't think it's of a particular kind but if you really have jelled the story, then I just think it comes rolling out of your mouth or your fingers. And I think the times that it doesn't are when it still needs to bake a little bit. Now sometimes that process does take place through the writing, obviously. It's just as useful to put it down and think about ordering it as it is to go out and practice with people. So that definitely happens too.

I definitely make discoveries, new ideas while I'm writing. I think at that moment you're just holding all those pieces in a different way than you might have held them, they're touching each other in different ways that they weren't touching before. And if you're at least dedicated to making your story coherent you'll find connections that you didn't find before. I think that's true for everything but I do think that the process itself is a part of science.

In this interdisciplinary space where science hits education there just are not that many people who live there and write there, and so the word that's probably used thoughtfully about things that I've done is *translator*. I'm translating the science into the non-science area or translating the work in education into the science area so that these people can make sense of it.

And the short answer to your question about why I ended up doing this is that I learned in my graduate programme that you're supposed to identify hard problems to work on, and you're supposed to take your creativity and solve hard problems that other people aren't working on. It was clear as a bell to me that working at the interface of chemistry and education was a really hard problem. And I thought I was well suited to work on it.

I think chemistry's notorious for being very conservative; after writing in the passive voice for 30 years, people begin to just think and speak that way. I attribute it to this narrow, narrow genre with fixed rules. All you have to do is copy. And during the most formative time while you're a grad student your writing is going through a very strong editorial process with your advisor and certainly the classical written thesis is totally dominated by this model that just gets propagated like crazy. I bet if you did a writing analysis across every single one of those journals it's a tightly conserved kind of thing. One of the articles that I pick up and throw out to people all the time is Swan and Gopen.[8] I adore Swan and Gopen. I really love what that article does. And I really feel that the most important thing about that article is how accessible it is to the audience and what it models. So the notion of writing a review and making sure you show examples and take people through the alternatives and all that kind of stuff, God I've pulled that out to show to people so many times when the thing that they were trying to do lacked those features.

I loved writing as a child. I loved writing; I was just no good at it. In college, I am sure we wrote lab reports which were just formulaic. I learnt to write science the only way possible: working with great people. So I learned the conventions. I certainly learned the conventions of the writing of laboratory science the way everybody else does. But I think that writing's horrible. I don't even consider that good writing. It's not a kind of writing I would ever do outside of that context, but I understand in that context you have to write that way. I could probably find in that closet right now the very first time I ever tried to write something that was about this business—pages and pages of yellow paper with horrible sentences and no coherence whatsoever. It was a stream of consciousness. And one of my colleagues here in the department was an awesome writer; a really great writer from a technical standpoint. I would not have considered her a poet by any stretch of the imagination, but that woman knew sentence structure and she had a sense of notions of coherence and how to order stuff. And fortunately she was a dear friend and very open in her mentorship which is to bleed red on anything that I gave her.

And I have a wonderful peer group. You know, you either come to value editors or you don't. But the idea that somebody is taking seriously the job of reading something that you've written and trying to tell you if you're saying

something is just invaluable to me. So anybody who will read what I've written and give me feedback is just wonderful, I think.

So while I may not have emerged out of a context where writing and issues were talked about, I'm certainly in one now. Absolutely. Whether it's the broader national community of those people I connect with—but certainly in the day to day works as in my department—absolutely. I like to think I've contributed to that because I have these other great people I've worked with and so the younger people I've worked with have just been naturally drawn into that. And they don't come easily the first couple of times, but boy by the second or third time they absolutely see the value. So, the people who have influenced me? You know that, that subset of trusted people. That really, really sincere group of people that was interested in my career, in my development, that took the time to just read this horrible stuff and respond to it.

THE WRITING GROUP

Elizabeth and Sally are friends who work in related fields and who, inspired by a writing seminar, set out to make a difference to their own writing and the writing of others. They're both mid-career scientists—Elizabeth is more senior than Sally—and they're under pressure to get publications out. The writing group doesn't turn out how they expected, as "why aren't we writing?" dominates successive sessions. But this writing group certainly meets Bereiter and Scardamalia's definition of a learning community, as the facilitators lead out of their own lack of knowledge, and the team develop their understanding together.

Elizabeth: I'm writing more. Writing a hell of a lot more. We both went to a writing seminar last year. And we both came away going "Wow! That was so cool. That was so good." Because we were both struggling with getting our writing done; there just wasn't enough time in the day. She was so inspirational. And Sally said "we should start a writing group."

Sally: And I think the thing she also did was she blew away all of the excuses we have always used. I wanted her to help but I was also thinking, "oh I can't do this because of this, this, and this" and she confronted all of those things and by the end of it, I was like, "oh, okay then—I have no choice!"

First, for scientists it's important that she gave some evidence that the approach she was suggesting actually resulted in changes. Measurable, quantifiable changes. And that for us is important 'cause we're not the kind of people who will take things just on face value. And then the other one was about the "dispositional fallacy" which is basically "I'm not the kind of person that does things every day." And I've been using that one for ages: "Oh I need to set aside a whole day, a day or two days, because I'm just not the kind of person

that does that." She's like: "Rubbish, everybody is the kind of person that can do that."

So with our writing group, we invited students and faculty to come but there was also an element of "it will be really good for us." I needed some extra motivation and some—what's the word?—accountability.

Elizabeth: The seminar leader said "Start a writing group. Start or join a writing group. Regular meetings with a group of colleagues can provide you with motivation, feedback, and camaraderie." At that time my students were just getting to the point where they were about to start writing, and so I hadn't really encountered this as much of an issue whereas Sally already had. She was seeing it for herself and also the people she was advising. And so that's what we canvassed around just within our biological sciences group. Because I suppose we have how many—eight, ten, twelve postgraduate students, something like that? We said, "who wants to come along to an inaugural writing group to see if this might be something that's helpful" and we had the first meeting.

Sally: We had the first meeting in December because we didn't want to wait until after Christmas to get the motivation going. I think we started off by explaining to them why we were trying to do this and what some of the objectives were and how we foresaw the meetings working. But we also made it really obvious to them that it wasn't us leading the group and we weren't going to be giving them answers or telling them how to do things; it's going to be as a group of people trying to figure it out together.

Elizabeth: We've facilitated the group. It has fluctuated, you know sometimes they just come in and they just sit and look at you. And I think that we've usually discussed an agenda before the meeting about what we want to cover. I would say this has been a very organic process. One of the things we kept ending up coming back to (which would keep deferring the planned agenda) was that people were still not writing. And it's this problem of not writing which has been the major one—we spent parts of the first six meetings trying to get over this. And I think because we were struggling it might have been actually quite helpful to the students to see that, oh, we are all in this together.

And in the very first meeting we sat down with the people and said, "well, why aren't you writing, what are the problems you find with respect to writing, why don't you get started?" and there were a number of main points which were brought up. The first one was that they were overwhelmed and they had no idea where to start. So these are students who are largely doing theses, and if you're not experienced with writing a paper you don't know where to start. It's this huge big unopened box and to even peek under the lid was quite a challenge.

The second thing was they didn't know what they should be writing about, so they didn't know what they should be addressing, they didn't understand the

question they should be writing about. So "here you are, postgraduate student, here's a thesis, write a thesis." The third problem they said was they didn't know how to express the material.

So the first thing that we really got into was goal-setting. We keep going back to the comment: write every day, write every day, write every day. And to set the goal of a) doing something every day, and b) having a specific goal that you're heading for in that writing period. And we discussed a number of different goals. We probably discussed writing a paragraph or writing two hundred words. And I think one of the best things that worked for me was when one of the postgraduate students said "Why don't we make a goal based on time rather than on work." And that's been really helpful to me because some days I can get through a lot of work, some days I get through a very small amount. And one of the things I realised part way through is that I set myself goals that are too big and I become despondent about it.

So the setting of a realistic goal is a major component to getting people to start writing. I know I can do an hour a day, or an hour and a half a day, rather than I want to get section four finished by the end of the week. Because section four might actually take me two weeks.

In the first meeting we were going to talk about why people couldn't do it and then we were setting little exercises to say "well here's a little section, have a look at this and see what you think about the quality of the writing." It was a completely inappropriate exercise for the time.

I think at the second meeting we used one of the exercises that the workshop leader used in the seminar. To overcome the belief that you don't think you can write, she gave us ten minutes of free-writing time. She said "for the next ten minutes, you just write. And I don't care what you write about." And we did use that as a technique and I don't know how effective that was but everyone covered quite a lot of writing.

That was up until Christmas. We set goals. We started off with a writing log fairly early because one of the things we talked about was having accountability, having a writing buddy. So Sally might email me at the beginning of the week and say "I'm going to write—this is my goal for the week." And I would email Sally and say "these are my goals for this week." So what we thought was that for all of the people that were coming along, we'd have what their goals were, and then at the next meeting they would check what they had done and then set new goals. And I think it was quite interesting—the complete failure of a number of people to achieve anything. So motivation was a problem and I think it still is.

We set goals for the Christmas period. After Christmas, how many people had done writing? Well there were heaps of excuses. Lots and lots of excuses for why people hadn't achieved what they were meant to be doing.

Sally: The seminar leader's suggestion was that your writing time should be just for writing, but we all struggled so much with that. We just don't have any other time to put aside apart from that two hours we've set aside . . .

Elizabeth: So we had to adapt her method to one that was more suitable to science things. So at the end of January, we're still talking about why people aren't writing. How we need to get people going. Then we actually got started on the second point. The first point was that they were overwhelmed, the second point was they didn't understand what the question is. And we realised that very few of them were undertaking research with a clearly defined hypothesis. They didn't know what a hypothesis was, and that's where Sally's experience came in.

Sally: The advisor wouldn't recognise that there was a problem until they got to the writing stage. So with the kind of work we do—we sit down, we brainstorm and we have a loose idea of the question we are trying to answer, but very few advisors, I think, sit down at that stage and say "right, write down your hypothesis." And maybe we should. Some of my co-advisors are reluctant to get students to do that because they don't want to constrain their thinking at that stage, they want them to keep their mind open. And then so they do the experiment, then they analyse the data, and then they get to the writing stage. By that point any action is remedial.

Elizabeth: I'm not sure that I completely agree with that. I think that you have a major hypothesis, then you set up one group of experiments, and there's nothing wrong with defining a sub-hypothesis at that point. And your hypothesis will change as you get into your research and you get this answer here which will alter this hypothesis over here and that will ultimately feed back to the primary hypothesis at the beginning. But I think I was quite surprised at the ignorance level—including me—and I was quite surprised when we actually sat down and looked at the nitty gritty of what should be driving the research.

So at about the beginning of February the size of our writing group had decreased down to about five or six regular attendees. What we did at the beginning of February (because we wanted to be able to look at this process), we got the people who attended to write, and put into a sealed envelope, their feelings about writing *before* they started the group. Because then at the end of it we can open this again, and they can have a look at what they felt before they started the writing group and how they feel now, so we can see if we've made an objective difference.

Sally: One thing we need to decide for the next iteration is whether we going to open this up to students again or is it going to be offered to faculty? The issues are different and when we first started we hadn't intended to do all this didactic stuff. We had really intended to spend a bit of time to confront the "why aren't you writing" and then get into a stable state where we met regularly and work-

shopped people's material and supported each other in an ongoing way. And it's not that it hasn't been extremely valuable, but it hasn't been what I first envisaged that it would be. So we haven't really come to any decisions about what the next iteration would look like.

Elizabeth: It's giving them the tools. It's giving them the motivation. And tools and motivation is about understanding. And not being afraid to lift the lid of the box because "oh, yep, it's a bit of a jumble, but I have the tools to sort it out. I have the tools to organise it."

So we never got on to what we planned for it to be, right at the very first instance, which was people bringing their work and getting constructive feedback on it. We're getting to that now in terms of structure—will we ever get to it in terms of writing style? I don't know. I don't know whether that's so important. Because I think if you've got good structure a lot of the basics in writing style will follow. If you've got good structure you don't repeat yourself, you don't tangle yourself up in knots. It's all laid out there and you can sit down and, instead of faffing for half an hour and thinking "what the hell am I meant to be writing?" you think "oh that's where I left off yesterday, bang."

ELIZABETH

Elizabeth's office is chaotic. There are books and papers all over the floor, and throughout the interview people are putting their heads round the door asking for advice on a variety of topics. Elizabeth speaks to me, as she speaks to these intruders, with focused, impatient energy. She barely pauses for breath between ideas. I'm struck by her generosity in sharing ideas and time—with me and with her writing group; she's thought a lot about writing, perhaps because she writes to such a wide range of audiences in such varying genres. As well as writing science (books, journals, teaching materials), she writes fiction for young adults, and newspaper articles for young children. She describes her teaching and research as closely interconnected, each feeding the other.

The Only Other Thing I Would Say Is I Am Passionate about Writing

The mechanics of how I write has changed a lot since that first writing seminar. I used to try and do it sometime during the day, which doesn't work. But after we were talking about putting a dedicated time aside, I started trying it at seven in the morning. So the mechanics of it are that I'm in here usually by seven, or seven-thirty on the darker mornings. But I will get two hours in at the beginning of the day when it's quiet, and because I'm doing it every day I know exactly

where it is I've left off the day before and I don't have to think "where the hell was I?" I come in, I make a cup of tea. I usually have my breakfast next to me and I beaver away. It depends what stage I'm at.

So the book concept that these notes will contribute to started about four or five years ago with a colleague, before I left Scotland. We've really only been working on it probably in the last 18 months and F was the one who identified there was a need for this book. One of the problems with the topic is it scares a lot of people off because it's got a lot of terminology, so all the books that are out there at the moment are not user friendly for somebody who just wants to get some basic information. So we're going to do a Noddy's guide. We've come up with some new concepts about how we're going to present the information. So that was done—brainstorming it really—initially just with R because he is here, and then a telephone conversation with F who's in Scotland. And then I've been the one who has largely taken it forward because I've had to write these notes for another course (in Europe) anyway.

We had drafted out a pretty good outline for the book proposal that we had worked up together and we had worked out who would write out each section and roughly how many pages and how many words were going to be involved in each section, and this was also required by the publisher for the contract. But what I found was as I was writing up the notes for the European course then I actually ended up covering the majority of all of the sections. So the first draft of the book is largely going to be all my writing, and my colleagues will come in and add in little bits, and F will end up probably being the major editor of the book.

I've been teaching in my field for about 25 years, but particularly in the last four years my approach has changed, and in particular it's changed in the last 18 months when we came up with this new concept which is part of the book design. I've been changing the way I've been delivering the information to both the veterinary students and the science students that I teach, so there's a lot of interplay between having got this outline and the new concept, me thinking about it, me putting it into practice by delivering it to the students, getting their feedback, and then realising where the difficulties in their comprehension might be, because as you know the more you deliver information the more you understand it. If you have been delivering the same or similar information for a number of years, you'll gradually distill more and more the essence of what you're teaching, so you get better at wording it and the concept is more readily picked up by other students. So those notes, plus the delivery to the students, reshaped a lot of the information in my brain which led to the notes for the European course, which were also written in a format so that they could form a large body of work for the book.

So I had the foundations, I had a reasonable understanding of the structural arrangement. Initially I picked up those notes and I put them down as my format and then rewrote from there. As I repackaged it I realised I needed to understand a lot more and that involved going out into a number of other texts. I sat at my desk and some days I'd have half of that bookshelf on this table, drawing from that and that and that, and checking and cross-checking. I'm looking at it from a new perspective, having to say to myself "if I look at it from that perspective I wonder what such-and-such and such-and-such say about it?" You know how you read a passage with one bias, or you're seeking one bit of information. Then if you change the way you're viewing the information and what you want to get out of the passage, you can read the passage and get quite a different perspective.

I do creative writing, that's my weekends. For the book I'm writing now I have a rough outline so it's plotted out from go to whoa, and when I sit down I've got an overview in my head of where the story is going. But then I've got it down in sections as well. I'll know the section and what's going to happen in it. I begin by reviewing the last section that I wrote, read over it, edit a little bit, then I'll write my new section. So I know what happened before and I know what's coming up next. When I write it pretty well comes out—not fully formed, it needs editing, but I'll write it out in full prose.

To go back to science, I started writing a new manuscript earlier this semester and it was in an area that I really didn't know. So having done the database search and having pulled out all the papers I thought were relevant, I just started working though those papers. And as I read through a paper highlighting the bits that were going to be relevant to the paper—I had a rough idea of the outline of the paper and so could say "that bit goes in this section, that bit goes in that section" so by the end of reading the references the sections would be populated with information from ten references which were all linked but needed then to be turned into a synthesised whole. So they were bullet points, and then I might find that Joe Bloggs and whosey-whatsit had written a similar sort of thing, so then I could take those two bits of information and compile them into one sentence. That's a slow and relatively painful process. I don't know another way to speed that up.

Much of the writing of the materials and methods of a paper will come from previous papers. The writing of the results can be somewhat slow because you've got to go back to your data and have another look at that. And then the synthesis, the discussion, when you're looking at your results compared to what else is out there, much of that information has come out of that first draft of the references. Because this was such a new paper and a new area, I didn't have a really good outline for the manuscript because I didn't know what I was going to come across until I started reading.

I don't start writing with the material and methods. I start with reading the literature. I mean, in an ideal world (and this is something I've really only appreciated in the last couple of years) writing a paper should be done at the same time as you're doing the experiments. So, you can't write the results, obviously, but if you are going through the literature at the same time as you're doing your experiments, then the literature will provide you with the information you need to complete the tests as you planned, but also provide you with thoughts on what else you might need to plan experimentally to go into that paper. And if you are attaining that knowledge through the reading at the same time as you are running your experiments, it means you don't get to the end and start writing up your experiments and think, "oh, blow, I should've also done this and this, because now I could be challenged on that by the reviewers," or "my data's incomplete," or "I made a mistake." So I'd probably start with the literature. And when I get bored with doing that then I'll do the easiest section like the materials and methods, the mindless stuff.

I think one of the most interesting things about the writing group that we've started is that we've realised (not realised but clarified) that the whole structure of the paper is constructed around the hypothesis and the aims. So for example, let us say you have the hypothesis "if x then y." In writing the introduction, you have to introduce x, you have to introduce y, and you have to introduce the relationship between the two. Your hypothesis "if x then y" also determines your aims. The aims then automatically determine your materials and methods. And the aims then also automatically determine the laying out of the results. And the relationship between x and y automatically determines the structure of the discussion. And that has just been a fascinating realisation. It's so cool. We were working through that about the same time I was starting to write this paper. And I think the next time I write a paper I will be starting to write it as soon as the hypothesis is clear.

I think I have a much clearer idea now about writing papers. My old mentor in the UK would always write his papers as he was doing the research. And he would say that to me and I never really got my head round that—I was always too busy at the bench. But I really see the wisdom of that now.

You might change your aims as you go along, depending on your results. And that is why you should be reading as you go. Because then you are going to be much more aware of that potential. Yes, we do throw up surprising results, and that's fabulous. But that doesn't change the structure of the paper. You've got to be prepared for yes or no or maybe, depending on the situation, or for "bugger me, I haven't accounted for that variable." That might also lead you to the end of that paper and saying, at the end of that paper "our hypothesis was if x then y, however we have found blah, blah, blah, this leads us to our new research

which leads us to our new paper." So it's not black and white. It is an organic process. But I think it's going to be a far clearer process of development if you're writing as you go along, because that gets you thinking and distilling. You distill the hypotheses or you refute it, or you change it.

That's my opinion, my thoughts. And they have changed hugely in the past six months because of the writing group. Sally and I were laughing about this—who are we to run a writing group? Okay we've got some experience but, by golly, my ability to write papers—I love writing but I hate writing papers. Why? Because nobody ever taught me how to write papers. My old mentor probably did try, but I was probably, fingers in ears, "I don't want to learn that you've got to write them as you go along." So for Sally and I to say "we're going to set up a writing group" which conveys the thought that these people must know what they're talking about, well, actually we don't. But that's what's been so wonderful—we've all worked together, and together we've come up with this concept that if you've got your hypothesis clearly defined, it's actually pretty easy to understand what you put in the introduction and how you approach the discussion.

I've learnt so much from that writing seminar because she hit the nail on the head about why the writing ain't happening. Our careers depend on us writing. And you know what? The writing of the research papers is, unfortunately, the thing that is constantly put on the backburner. And why? Because teaching has absolute deadlines. Nobody's really standing over you to get that paper out. Your career depends on it, but no one's really standing over you to do that.

I think if you're not aware of your audience, you're barking up the wrong tree. Absolutely. End point. Begin with your end in mind. The sort of work I do is going to have a much wider audience because it pertains to cell culture, it pertains to neuroscience, it pertains to specific neurological diseases, so you can take your pick out of those. That could be thousands of people. I write from school kids to scientists. So a fairly wide range, and in-between that's undergraduate and postgraduate and professors and post-docs. And so of course my style changes depending on who I'm speaking to. But one constant feature I aim for is clarity.

And the second thing which is a common thread from an 8-year-old to an 80-year-old professor is to try and think, what is their experience and perspective? And what you're trying to do when you're writing a paper is to find the best way to pass on the information—it's another form of teaching. I'm a teacher. That's my number one, I think. To help people assimilate information, you've got to think, well what hanging hook for this new knowledge have they already got in their brain? Most hanging hooks are shaped by experience and knowledge at that time. So for an 8-year-old—I was just writing a piece for them last

night—their world is small. An 8-year-old is: "this is me, and here's my mum and dad, and there's my dog, and there's my school, and this is my experience, and my experience is very much about me." So what I was writing on last night was a reply to a student who had asked why birds take dust baths. And I was going to go on about how dust baths are useful for removing parasites, but I needed to introduce the concept of why they got parasites in their nice, warm, dark feathery places. And so, what's a parasite? I said "imagine what it must be like to have creepy-crawlies crawling around in your hair." So I'm trying to link in to their level of experience. I'm not saying I'm doing a good job of it, but I'm trying to think how an eight-year-old would think.

Whereas when I'm writing for a scientific audience—and undergraduates are different from postgraduates, who are different from a research colleague—I'm going to assume a level of knowledge, and that they're busy people, and I'm going to assume that they will want clarity, and they will want to be able to skim it. So I will tend to use a top-crust style of writing, which is: I'm going to tell you in my first sentence or my first couple of words what this paragraph is going to be about. If I'm writing for somewhere in between, like an undergraduate who's got a degree of knowledge, then I'm going to keep the terminology from overwhelming the concept, and I'm going to be trying to pull out the concept—the concept is the number one thing I want them to get, the terminology is number two. So I have a priority of how I want you to pick up this information.

There is a huge role for metaphor in explaining new concepts—it goes back to what I said about the 8- and the 80-year-old: finding the hooks of knowledge that they already have, using those, bringing those forward to say "okay, you have an understanding about this already, this is actually quite similar to this." If you are offered a new piece of information and you can immediately put it into your filing system or hang it onto one of those hooks in your mind, then you'll retain that information. But if I offer you a completely new piece of information for which you have no reference point, no hanging hook, it's like opening the hall closet. In there will be hanging hooks with specific functions. I'm going to put that on that hook, that on that hook, and that on that hook—hang on, here's something I ain't got no hook for, I'll just throw it in there. Outcome? It's going to get lost.

So I think a key concept in teaching—and this is what I believe communication is, be it written, verbal, oral, science, creative, whatever—is to ask who is my audience? What knowledge hooks have they got? How can I link this new information to those hooks?

We could do things differently. I think there is a huge need in the university for people to mentor others in writing, I think there's a need within the university for people who are in mentoring positions to know how to give feedback as

to why that section didn't work, why they've changed the writing. I mean, I can change someone's writing around but I can't necessarily explain to the person why I've done that. Just "because it reads better like that." I think that the willingness is there, the intelligence is there to do the research, but writing it up is the challenge. We could have writing groups; we could teach them how to write.

The only other thing I would say is I am passionate about writing.