JEREMY MILES

Why I study...

Statistics

I AM as interested in people as pretty much every other psychologist. I chose to study psychology, rather than any other science, because it was about something that was big and real and tangible, and that I felt I could relate to. I considered biology and chemistry, but they were about molecules and cells, and tiny stuff which I couldn't see, and it was harder to see their relevance. I wanted to study a science of stuff I could see and interact with – so the science of people's behaviour was just the ticket. But how did I get into statistics?

The first thing that helped me to become interested in statistics was partly because of a (white) lie that I told (I don't think the other players in this drama know the facts of this tale, so I hope it does not come as too much of a shock to them if they read this). As an undergraduate I had not been especially interested in the statistics module – I consider this to be a failing of mine, not the lecturer (Chris Leach, who was excellent, and has now moved on to even better things). Like many students, I didn't see the relevance of studying statistics and didn't really apply myself to it, so I scraped through the various assignments and exams, without getting any glory. After university, I wondered what I should do, and started to teach psychology in a college of further education, primarily to A-level students, but also on some other courses. My head of department, at the interview, asked if I could do statistics; this was an interview so of course I lied and said 'yes'. The reply was 'good, because nobody else can'.

There's nothing like having to teach something to make you learn it, so I went home and read the first edition of Hugh Coolican's book *Research Methods and Statistics in Psychology* (I was very glad for the existence of that book), and I ended up being 'the person who understood statistics'. The other lecturers would occasionally come to me for assistance ('What's a degree of freedom?' was one memorable question which I had no ability to provide an answer to).

Now, there is a lesson to be learned here about the value of honesty, because my deceit followed me when I started as a research assistant with Patrick McGhee (now at the University of Central Lancashire) in the fledgling psychology department at the University of Derby. My previous head of department had written me a reference, and in it had stated something along the lines of 'Jeremy is good at statistics'. So, a week or so after I started my supervisor asked me if I could carry out a factor analysis (after all, he was told by a trusted source that I was good at statistics). Hmmm… factor analysis. In the days when I did my undergraduate studies, using SPSS did not involve pointing and clicking, it involved FTP and Unix and Telnet and Vi (if you've never heard of Vi, be pleased) and crossing the road to another building to collect a printout which said 'error 3454' or something similarly helpful – there was none of this looking at the output on the screen nonsense. So, factor analysis had been a step too far. I'd looked at it, some of the people I'd studied with had done it, but I hadn't. So, time to swallow another book – this time, *Computing for Psychologists*, by Robert West, and within a couple of weeks I was happily factor analysing away.

'The problem with statistics is that it is hard'

There was a problem. Factor analysis is also known as exploratory factor analysis for a reason. It is there for exploring your data, to see what is there. The factor analysis I was doing was on a questionnaire designed to measure mood – the UWIST Mood Adjective Checklist. The authors had separated mood into different dimensions. They had said that happiness was not necessarily the opposite of anger, these were separate dimensions. They had also said that arousal comes in two dimensions – energetic arousal is the good sort of arousal, which helps you to do stuff you are excited about. Tense arousal is the bad sort of arousal, which makes you, well, tense. They had also said that these were separate things. This question of whether the things were different or not seemed to me an empirical question, which required an empirical test.

But exploratory factor analysis, as an exploratory technique, cannot provide the answers to those questions. Instead (as West's book told me) I needed to do a confirmatory factor analysis. West's book suggested I go to the computer services department, and ask if they had a programme called LISREL. So, I dutifully trotted off to the computer services department at Derby University (which was, if I recall correctly, the only university at the time that had gone straight from college of higher education status to university status) and asked 'do you have a programme called LISREL?' 'Errr… what's that stand for?' They replied. 'LInear Structural RELationships.' They looked at me blankly, and I went on my way (now I would just type this into my favourite web search engine, but this was also in the days before the world wide web and Google).

This was the start of a pattern. It seemed that every interesting theoretical question that I wanted to address in my PhD required some sort of tricky statistical analysis. I went on a course in LISREL, run by Brendan Bunting and Mark Shevlin, at the University of Ulster – this had an enormous influence on my way of thinking about psychology (and Mark and Brendan have remained collaborators. After the course, I contacted them daily with questions about my statistical models, and,

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Jeremy's blog: *www.jeremymiles.co.uk/learningstats*
Thom Baguley's Psychological Statistics blog: *www.psychologicalstatistics.blogspot.com*
David Howell's (author of *Statistical methods for psychology*) homepage: *tinyurl.com/f57h7*
Andy Field's (author of *Discovering statistics*) homepage: *www.sussex.ac.uk/Users/andyf*

unfortunately for them, I still do). Here was an analysis technique that did not constrain us in the ways of most analysis techniques. I did not need to design analysis and studies so that it fitted into a straitjacket of what you might call 'conventional' statistics. Using LISREL (and similar programmes) frees you from the constraints of analysis of variance (although you can still do analysis of variance if you want to).

When you are freed from the constraints of analysis of variance, you can suddenly find that you can think about psychological theory in more sophisticated ways – the theory and the design feed each other. For example, in collaboration with Beata Kozak and Jan Strelau (2005), I used structural equation modelling in a twin study to try to understand the extent to which measures of coping style were correlated for genetic reasons and for environmental reasons. Without the knowledge that this was a hypothesis that could be tested, we would never have considered it as a research question. Mark Shevlin, Viv Brunsden and I (1998) examined whether factor loading for the *Satisfaction With Life Scale* were different in males and females. Again, it's not a hypothesis you would necessarily consider, unless you knew that it was possible to analyse.

'Many authors believe that the use of *p*-values is fundamentally flawed'

I then learned about other statistical techniques – in particular multilevel modelling and item response theory, which again enabled us to think about design and analysis in new and exciting ways. If we want interventions to change behaviour, we should be looking at how people change, and what factors are able to predict who changes, and how. But how do you do this with regression or analysis of variance? The answer is: you don't. You need an appropriate analysis technique – if you want to answer these interesting and important questions, you need to use multilevel models and/or structural equation models.

Other aspects of statistical analysis fascinate me. Our science is built on statistics, but how many of us truly understand it? Do you think that you can prove that the null hypothesis is true? Do you think that you can prove it is false? Does a high correlation mean high agreement? Does homogeneity of variance really matter? Why did Fisher (of the *F* in ANOVA) not speak to Pearson (of the correlation) or his son? Can you define what a *p*-value means? (Most people can't; it's not the probability that the null hypothesis is true but many psychologists believe that it is – Haller & Kraus, 2002.) Many authors believe that the use of *p*-values is fundamentally flawed, many more believe it is at least problematic (see Clark-Carter, 2003).

The problem with statistics is that it's hard. We tend to think that it stays still, but it doesn't. A glance at what's added to SPSS every year shows that. Last year it was complex samples, next year it's generalised estimating equations and generalised linear models – if you don't know what those are, there are hypotheses you can't even think about. You think you've grasped ANOVA and significance, and then someone (like me) tells you that you need to start learning about effect size and power.

What I'm saying is that, to understand psychological research, as both a researcher and a consumer of that research, you need to understand statistics. And if you don't know about statistics, a whole world of psychological research is hidden from you. How can learning about that world fail to be exciting?

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