EDITORIAL

Random walks and Poisson sequences

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Jon Ogborn

University College London Institute of Education, UK

E-mail: j.ogborn@btinternet.com

The original papers

The papers 'Randomness at the root of all things', 1 (Ogborn *et al* 2003 *Phys. Educ.* **38** 391) and 2 (Ogborn *et al* 2003 *Phys. Educ.* **38** 398) were written by Jon Ogborn, Mick Brown and Simon Collins in 2003.

The commentary

This pair of papers arose out of intensive discussions with Mick Brown and others about how to handle random processes in the Advancing Physics A-level course for which I was leading the development team. Mick Brown was a very active member of the Advancing Physics working groups, and gave us invaluable advice and ideas. The papers also reflect my own personal career-long interest in the teaching of statistical physics, starting in the late 1960s with work on *Unit 9 Change and Chance* for the Nuffield Advanced Physics course.

A number of concerns came together to stimulate the thinking that went into these papers. First, how would we deal with handling experimental uncertainty? Second, and only seemingly unconnected, how would we present the fact that all quantum processes involve a random element, and what experimental evidence could we offer of this very fundamental fact? In the background, and not mentioned in the papers, was the use of the Boltzmann factor $\exp(-\varepsilon/kT)$ as the probability of extracting energy from a heat bath at temperature T. Indeed, as the papers begin by stating, we were concerned at the general lack of substantial ideas about random phenomena, both in education generally and in A-level physics in particular.

Thinking about these things I became more or less obsessed with understanding Poisson sequences. Derivations in books fell into two classes: clumsy and complex combinatorial arguments via the binomial distribution versus very elegant but highly abstract arguments from first principles. Neither seemed appropriate to our needs, Mick Brown suggested to me that there must be an argument of the random walk variety, and after several false starts I hit upon the 'timid traveller' idea presented in the paper. I still entertain faint hopes that this idea was original, though it seems unlikely to be so.

Simon Collins took up the challenge of devising experiments to test the results, notably Rutherford's test of the randomness of radioactive alpha decay, and succeeded brilliantly with familiar school apparatus including the newly arrived data-loggers.

The second paper, going more deeply into the Poisson distribution, was motivated most strongly by my own desire to better understand this very fundamental idea, with the simplest arguments possible. Even so, it is probably too much for general consumption, though I'm personally very pleased to have it to hand, and hope that a few others may feel likewise.

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Jon Ogborn directed the Institute of Physics' Advancing Physics project, and is Emeritus Professor of Science Education, University College London Institute of Education.

