**Fusion and Fragmentation: a Statistical Physicist’s Attempt to Understand Subcultures**

In 2017, *the Economist* published an article on linguistic diversity in Papua New Guinea; at the time of writing, the nation of about 8 million people had a collection of 839 actively spoken, indigenous languages. By contrast, our own islands of the UK have a grand total of 10 alive, indigenous languages. This number is even less if you disregard those languages which are not actively spoken as a first language. How can such a difference be possible? What structures, present and past, permit almost a thousand languages to be spoken on one island, and barely 10 on another?

The history of languages in the Papua New Guinea and the UK is unbelievably complex, controversial, and tragic. It is a history of colonialism, of oppression, and of globalization. But the processes at work are universal. Cultural erosion and the loss of subcultures to form larger, more homogenous groups is a seemingly unavoidable process, and one which we all face in one way or another. Understanding this process is essential if we are to fight the loss of cultural diversity, and this understanding should come not just from linguists and historians, but from people engaged in all kinds of academia. The perspective below is compact and shallow introduction to the perspective taken by statistical physicists to the problem of cultural dynamics. There is a sea of ideas which I do not have space to touch on, and an even larger ocean of topics which are still areas of active research. My hope with this work is not to provide some kind of comprehensive introduction to the statistical physics of cultural dynamics, but instead to provide an insight into what statistical physics is, how we use it, and what kind of approaches might yield be valuable to understand our ever-changing world of subcultures.

Let’s take a step back and first introduce statistical physics. The general interest of a statistical physicist is in systems of very many parts, where the *overall phenomenology of the system* is driven not by its individual parts but by interactions between these parts in very large numbers. While the parts themselves may (or may not) be simple, the overall behaviour of the system arises from millions of parts interacting, instead of from some intrinsic property of individual parts[[1]](#footnote-1). Furthermore, a statistical physicist tries to use mathematical methods to understand this kind of behaviour, and describe it quantitatively. So, the field is called *statistical* because it studies systems of very many parts, and physics because it uses mathematics to understand these systems.

Let me give an example. A single water molecule, consisting of one oxygen atom and 2 hydrogen atoms, is a relatively straightforward object, at least from an external perspective. It may bounce off other water molecules, and is lightly attracted to them if they’re close enough. However, if you take a collection of a billion billion billion of these water molecules, (which now slosh around), and cool them down to some exact temperature, they suddenly conspire to completely change in behaviour and instead form a rigid object called ice. How is it that this collective behaviour emerges from simple water molecules? Why does this *phase transition* happen suddenly, at a specific temperature, and not gradually? What is this thing we call temperature anyway? These are the kinds of questions which have been answered unbelievably successfully by the methods of statistical physics. These methods have been used to study not just water, but also magnets, stars, superconductors, and flocks of birds.

Paragraph 3: Axelrod model

Paragraph 4: Results of the Axelrod model (with home-made simulations)

Paragraph 5: Variants of the Axelrod model

Paragraph 6: The real world

Paragraph 7: Conclusion

(References)

(Appendix A: Mathematical Detail)

1. The word *emergence* has recently become fashionable in social sciences and philosophy. While it’s not quite true that statistical physics *only* studies emergent phenomena, the kinds of thing statistical physicists are interested in are well described by this word. [↑](#footnote-ref-1)