Afterword to Certain Measures

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I once co-authored a scientific paper[1] that used computer simulations to study the behaviour of a crowd of people evacuating an enclosed space during an emergency (in our case, a nightclub on fire, based on a real-life incident). We used a technique known as *agent-based modelling*, which treats systems as groups of interacting autonomous entities (or agents). By giving each agent in the system a set of simple rules (e.g., walk quickly away from fire, find the nearest exit) and allowing them to move around and communicate in a simulated environment, we investigated the overall system-level behaviour (in our case, the tragic formation of a fatal crush of bodies at the nightclub's exit).

An early version of the paper was picked up by a high-profile technology blog, which wrote a short piece about it[2]. We were quite pleased to see this coverage, until we got to the Comments section at the bottom. One of these started with

'Are people billiard balls?'

It then went on to say "Truly wonderful progress has been made in recent years in modeling the crowd behavior of billiard balls, noticing that loosely fits human behavior in fires in night clubs and then uncritically applying that to building design. Does that sound sensible to you? Or would you rather have some understanding of *why* people behave as they do in certain critical settings?"

Although the author of the comment rather missed the point of our paper, we had to admit that their criticism of the general methodology was pretty much spot-on. That is, our technique for detecting crush (which was the main thrust of the work) was fine in a well-constrained environment, where the agents in the system have very few options. Given the system we were modelling, it was pretty much inevitable that a crush would develop, because the simulated agents were relatively mindless. Or, as our critic put it, "[the authors have] shown conclusively that a bunch of people heading in the same direction will result in a crush. What will Science prove next?"

Of course, in the real world, people generally aren't mindless. As Sean O'Brien makes clear in *Certain Measures*, "People are not automata"; that is, machines following set rules of behaviour. Rule-following billiard balls, if you like. It used to be the case that "the crowd" was understood in terms of "the concepts and assumptions of the natural sciences"[3]; the reductionist ambition, as Drury and Stott explain, was "the fantasy of a unifying 'life science', whereby the behaviour of human crowds and all other collective phenomena – from bee

[1] Harding, P., Gwynne, S. & Amos, M**.** (2011) Mutual information for the detection of crush. *PLOS ONE* **6**(12): e28747, doi:10.1371/journal.pone.0028747.

[2] http://www.technologyreview.com/view/420272/the-problem-of-predicting-crowd-crush/

[3] Drury, J. & Stott, C. (2011) Contextualising the crowd in contemporary social science. *Contemporary Social Science* **6**(3), 275-288.

swarms to social innovations – can be adequately captured by a single set of biologically grounded simple rules." In *War and Peace*, Tolstoy considers bees, ants and herds as metaphors for human behaviour, but rejects the notion that a reductionist, top-down dissection of the collective can ever yield useful insights. Rather, he "seemed to suggest a way in which the chaos of individual choices and acts could rationally be subsumed in the more ordered intentions of animals in a swarm"[4]. As Tolstoy himself argues, "It is beyond the power of the human intellect to encompass *all* the causes of any phenomenon. But the impulse to search into causes is inherent in man's very nature. And so the human intellect, without investigating the multiplicity and complexity of circumstances conditioning an event, any one of which taken separately may seem to be the reason for it, snatches at the first most comprehensible approximation to a cause and says 'There is the cause'."[5]

"The multiplicity and complexity of circumstances…" In this, Tolstoy anticipates the anti-reductionist, bottom-up study of *emergence*; the process by which large-scale patterns or behaviours form as the result of interactions between smaller entities (or agents), none of whom, in themselves, possess those properties. This *non-essentialist* view – that the *collective* makes history, is an important stance, as it reflects the historical issues with crowd control that O'Brien so deftly subverts.

Around the same time that *War and Peace* first appeared, fear of the "mob" in post-revolutionary France was one motivating factor behind Haussman's radical redesign of the city's streets. As Drury and Stott observe, narrow thoroughfares were replaced with wide-open spaces that gave potential revolutionaries little scope for guerilla tactics. At the same time, "crowd science" emerged as an attempt to explain the behaviour of massed individuals. The predominant view was that the crowd was inherently "stupid" and prone to violence and destruction, due to its reliance on instinct and emotional contagion. As Drury and Scott have it, "That stupidity led to self- defeating behaviour that needed to be suppressed, defeated or controlled if 'civilised' society were to survive". Unfortunately, the establishment's opinion of the crowd has changed little since the late 19th Century; crowds are still something to be "controlled".

But apparently self-defeating behaviour provides a useful scapegoat in the event of tragedy; following the Hillsborough disaster of 1989, the police initially blamed massed football fans for forcing a gate and causing the subsequent crush that led to 96 deaths. Several inquiries have since revealed the true cause - a total failure of event management by the police and local authorities.

Of course, as O'Brien observes, "out-of-control" crowds also have their uses; the moral panic that followed the 1992 Castlemorton free party gave an ideal excuse for the introduction, two years later, of the Criminal Justice and Public Order Act, which was broad enough to allow the government to target not just ravers, but hunt saboteurs, road protestors and squatters. In *Certain Measures*, a Christmas "riot" is used to justify the introduction of emergency measures, and a crackdown on a New Year welfare rights protest. But in

[4] Miller, R.F. (2010) Tolstoy's peaceable kingdom. In *Anniversary Essays on Tolstoy* (Donna Tussing Orwin, ed.), pp. 52-75, Cambridge University Press.
[5] Leo Tolstoy (2009) *War and Peace*. Penguin edition.

O'Brien's dystopian (near-)future, the fatal incident is not merely seized upon by opportunistic politicians, it is *actively engineered*. Those of us who are interested in crowd safety now understand that raw technologies such as agent-based modeling are only useful if they are combined with consideration of group dynamics, psychological factors and risk analysis to *inform* event planning and management. Simulation is but one tool in an over-arching view of crowds that incorporates issues of geography, decision support, training, education, monitoring and so on[6].

But what if the event in question is intended to fundamentally *undermine* safety, as in O'Brien's story? Here, we see how simulations may be combined with "real world" interventions in order to generate a tragedy. "This crowd in this place at this time and under these conditions meets with these intensifying constraints and, with a little help, sets about destroying itself." In this case, it makes sense to reduce to a minimum the number of variables in the equation. Block the exits, force a crush; the crowd must revert to its reified, 19th Century state, a single organism to be goaded and eventually provoked into self-destruction. The crowd once again becomes a fluid mass of insensible particles, left to boil in their kettle until the inevitable explosion occurs.

[6] G. Keith Still (2014) *Introduction to Crowd Science*, CRC Press.