Editorial

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Theoretical filters: Reducing explanations in cities to their very essence

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Theory in any field reflects our abilities and intentions to extract specific meanings from any phenomenon in the quest to reduce our explanations to their bare essence. In this sense, theories abstract from an agreed reality throwing away that which appears irrelevant to the purpose in hand and only keeping what appears to be essential to good explanation. Developing, testing and then ultimately using good theory in any context thus depends on working with ideas that are not obstructed by anything that is not central to the purpose in hand. This may mean that much of what would appear to be relevant in other contexts for other purposes is abandoned, simply put on one side, as being unimportant to the particular abstraction of concern. This does not mean that theories always meet the criterion of parsimony for there may well be situations when the abstractions in question are extremely rich, containing many features and concepts that cannot be tested or are based entirely on assumptions that cannot be validated but nevertheless appear plausible. But in developing good theory, much of the reality we perceive must always be neglected in our search for the essential logic for which theory is being developed.

There are several perspectives on how elements of any reality might be filtered out from the key purpose of devising theory. In a previous editorial (Batty, 2011), I introduced Coleman's (1964) 'method of residues' which he illustrated by showing why it is necessary to filter out elements of human behaviour that are entirely deterministic in the environment in which that behaviour takes place. He showed that if we take a gravity model which represents the trade-off between how people respond to the attraction of some element at one location and the cost of reaching that location and engaging in that activity, often measured by distance, we need to factor out the effect of distance that simply determines why people must travel less at increasing distance from a place. This is because there are more places to visit. Even if distance did not make a difference to how people travelled, less would travel to a location at increasing distance from the place in question because there are an increasing number of places to travel to. This is an effect that needs to be factored out. Once this is done, and Coleman (1964) shows clearly how this can be expressed, the remaining residual travel pattern can then be explained by other variables. This is thus the 'residue' – what is left over when the gravitational effects are accounted for – that needs to be explained, and this is tantamount to filtering this out from the overall pattern. To an extent, we might say that the effect which is an obvious and deterministic element of the behaviour to explained, could be called the prior and once the filtering takes place, it is the posterior that needs to be actually explained (Batty and March, 1976).

This is quite a profound feature of theoretical explanation, and it has many different forms in different fields. In physics for example, quite frequently the starting point for a good theory is the assumption of randomness in spatial distribution which represents a kind of baseline on which reality is constructed. Randomness is not noise *per se* but a second

approach is to consider that the data we observe and use to validate theory embraces a kind of noise or even anomalous behaviour. Noise is quite easy to identify, but it requires real data to be compared to what we might consider normal data. In some cases, noise might be the routine and what is of interest for explanation is the anomalous. Much depends on context of course. If we are examining behaviour on transit systems for example, to explain routine behaviour and to model this, we must extract anomalous data from the set that we use. For example, disruption that occurs irregularly can be identified by examining the routine and manufacturing a synthetic routine set from the observed data, thus identifying the irregular data as the residue. It may be that the synthesised routine and the irregular residue both need to be explained by theory. To an extent, in thinking of urban theory, we are thinking in terms of explaining regularities in cities, although good theory should also at least point to the anomalous as worthy of explanation. There are no hard and fast rules about what should be filtered out or left in.

There is a vast array of possibilities for filtering out features from theory and its data and the most obvious of these deal first with real data. But one might also abstract from the reality immediately and produce data that is some transformation of the initial data in question. For example, we have published many papers in this journal which have applied notions about connectivity in cities associated with the genus of ideas called space syntax. This takes a city in terms of its spaces and articulates their interaction using lines of sight or unobstructed movement. These are not usually extracted using any deterministic algorithm because it is argued that in many instances, these lines are the product of a person's own cognition of the scene in question. There may be methods for defining such lines automatically but in either context, the lines in question are different from the initial data and in this sense they are an abstraction which is a simplification. The issue in such situations is how one might test the theory. As the transformed data are derived from the original data but in a non-routine fashion which usually cannot be automated, there is nothing against which to test the theory for the data is a kind of idealised theory. In this sense, the theory is an ideal type. It may not be without value even if it cannot be validated, but it is a massive filter of the reality from which it comes.

In some sense, a space syntax representation of a city as lines of sight is a kind of ideal city. It is abstract in comparison with the material of real cities in that it deals with an abstracted network but it is not so far from idealised geometries that have dominated city building and design since prehistory. In the modern age, everything from new towns to compact cities, from Corbusier's *City of Tomorrow* to Frank Lloyd Wright's *Broadacre City* are examples of theories that filter out most of actual reality but retain enough to transform them into ideal types which are the product of individualist and personal designs. A half-way house relates to idealisations of the reality that are predictions of the future. Our theories, never perfect representations of an actual reality when used to make predictions, take the simulated reality and assume that the future works the way the theory predicts. This is, to an extent, also an idealisation – it filters out all that cannot be explained by the model of the actual reality. It acts in the same way as all the approaches we have identified in transforming an actual reality into a theory which is always idealised in some sense.

My last example of the many that can be constructed for filtering out features, attributes and elements that do not pertain to the theoretical mission, relates to the development of digital virtual realities. At a recent conference on *Cities as Complex Systems*, Blumenfeld-Lieberthal and Portugali (2016) set out to explicitly model human behaviours in streetscape environments. They recognised immediately that streetscapes are often obstructed with many obstacles and peripheral objects that do not relate to the urban morphology in

question and they argue that such objects must be removed. To do this, they construct a virtual environment modelling the recognisable morphology of the real but stripped of all the bric-a-brac that they argue interferes with the way in which humans move in such environments. They have a theory of course that morphology is the main determinant of movement but to test it they must construct a data set in which the incidental is removed or filtered out. To an extent, all work on virtual environments from which real behaviour is to be constructed adopts this strategy but what is important is that the act of stripping out detail is formally acknowledged and routinised in terms of the way the theory is to be tested.

To an extent, what we are arguing here is that for a theory to be successful, it must be a simplification and of course, this is a very obvious, well researched and widely adopted point of view. But theory is more than this in that in its construction, there must be a conscious filtering of the data, removing that which is likely to interfere with the behaviours and processes the theory is intent on explaining. This may be a recursive process in that it may not be possible to achieve such filtering in one go and part of the art of building good theory is to ensure that this process is explicit, transparent and indeed convergent. In some senses, it is almost a process in which 'what if' situations represent the *modus operandi*, one in which counterfactuals are as important as the facts themselves for once data are filtered in this way, what we are left with are alternative histories. There is much more to say on this way of thinking but in the quest to build the best theories and the best models to help us grapple with the future of cities, the styles of theorising implied here are key to thinking about this future in constructive and focussed ways.

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