

# The Complexity of Exclusion

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## Summary

Two decades have passed since South Africa celebrated its first democratic election and witnessed the emergence of a new country. However, the legacy of spatial segregation and economical exclusion persisted. Formulating an understanding of this phenomenon provides the basis for this research project. Using agent-based modelling, the study aims to analyse the complex composition of two societies and to demonstrate the potential for integrated future development.

**KEYWORDS:** segregation, complexity, agent-based modelling, integration

## 1. Introduction

The subjects of South African planning policy and complex social systems are both considered in the subsequent paper. The aim is to understand if and how urban planning policy considers the complexity of socio-economic disparity at a micro-scale. The following discussion focusses on the development of an agent-based model to study the dynamics of the study area and provides a concurrent focus on a specific part of planning legislation implemented to promote urban integration.

## 2. An Urban Policy for Renewal

Before transformation began in 1994, an extremely complex apartheid system managed and also strengthened underdevelopment in rural areas and urban degeneration and exclusion. In his State of the Nation Address of 2001, President Mbeki launched the Urban Renewal Programme (URP).

The main objective of the URP (National Urban Renewal Programme, 2006) was to enhance the fight against poverty and underdevelopment at a national scale. Hence, a number of predominant features provided for the formation to the programme. Firstly, focusing on poverty and the alleviation thereof was a clear objective. This resulted in “nodal localities” being identified to align with the areas in South Africa with the highest levels of poverty and underdevelopment. Secondly, the programme aimed to focus on the local and micro-economic development initiatives which enhance macro-economic progress at a national scale. Thirdly, it was a priority for the URP to establish enhanced coordination and integration of the delivery of services throughout national government, but more importantly at a local level too.

### 2.1. The Urban Node of Khayelitsha and Mitchell’s Plain

In the Western Cape, the government has identified the suburbs of Khayelitsha and Mitchell’s Plain as focus areas for the urban renewal initiative. Both of these areas are situated within the municipal boundaries of the City of Cape Town. Hence, the Urban Renewal Strategy (National Urban Renewal Programme, 2006) for these areas is implemented and monitored by the municipality’s Urban Renewal Programme Department. Ministers at a national level serve as national political URP leads,

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the premier of the Western Cape serves as provincial political lead for the URP and the executive mayor of Cape Town is the local political lead. The general objectives of the URP, for these areas, are to empower systematic and sustained interventions in order to address poverty and also to address under-development and socio-economic exclusion in Khayelitsha and Mitchell's Plain.

### 3. Methodology

The objective of the research study is to explore the complex dynamics of the above-mentioned communities and at the same time consider what the effect of existing segregation is. An agent-based model constructed on Thomas Schelling's concept of "preferential" segregation modelling (Schelling, 1971) is applied to the case study area and in addition the phenomenon of segregation by exclusion from opportunities is studied simultaneously. In this particular study the phenomenon of preferential segregation is considered only in terms of cultural choice and not racial prejudice. A good example is the development of the Delft neighbourhood in Cape Town where cultural integration was encouraged by the way housing was provided, but segregated interaction still occurred (Oldfield, 2004).

Furthermore, in studying the dynamics of different cultures and determining the levels of interaction, the study applies two major factors influencing residential patterns. Firstly, job opportunities are studied, as people from different societies might have different needs in terms of employment. Secondly, variation in existing housing and also the need for housing was studied, as it differs from household to household and will not necessarily be the same for one society/cultural group as a whole.

#### 3.1. Primary Data

Firstly, the study area boundaries were obtained in GIS format and contain the size and also the neighbourhood type of the study area. Census boundaries and local land use classification boundaries were also obtained to study the dynamics of the study area.

#### 3.2. Schelling model

As discussed before, the Schelling model of segregation forms a substantial part of the foundation of the model. Thomas Schelling (1969) developed the model to point out how even slight individual preferences and perceptions of difference can result collectively in segregation.

Initially, Schelling constructed a linear model (Figure 1) reflecting a population which was randomly displaced along a straight line. The agents (individuals) consisted of two different groups, which were represented by "circles" and "crosses".

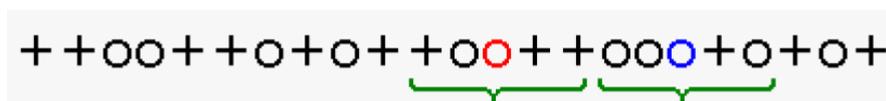
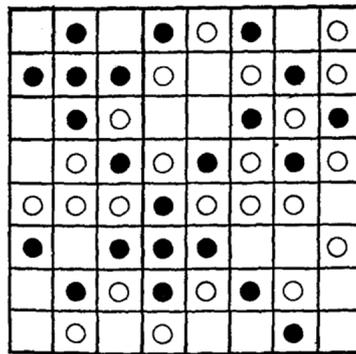


Figure 1 Schelling's Linear Model (Iozzi, 2008)

Schelling then supposed that each of these individuals wants at least half of his neighbours to be the same kind as him, while defining his neighbourhood to include the four nearest neighbours on either side of him. Hence, each individual wants to be surrounded by at least four of his own kind. When he is included it is evident that five out of nine individuals will then be of the same kind. Thus, unhappiness in the ratio of neighbours results in the agent moving to various positions, until happiness is experienced.

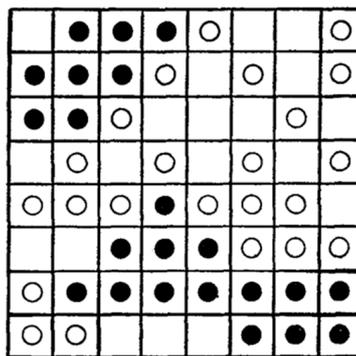
Following this model, a two dimensional model was constructed (Schelling, 1971 & 1978) and he divided the study area into a matrix of similar sized cells and left some vacant (Figure 2), while the

rest of the cells are randomly occupied by individuals from two different groups.



**Figure 2** Initial Condition of Schelling's Two-Dimensional Model (Schelling, 1974)

The movement rule was then established and dictated that an individual who is discontent with his neighbourhood (with less than 50% similar neighbours) will move to the nearest vacant location which will surround him with a neighbourhood that meets his need. The pattern resulting from this process reflected a highly segregated state (Figure 3).

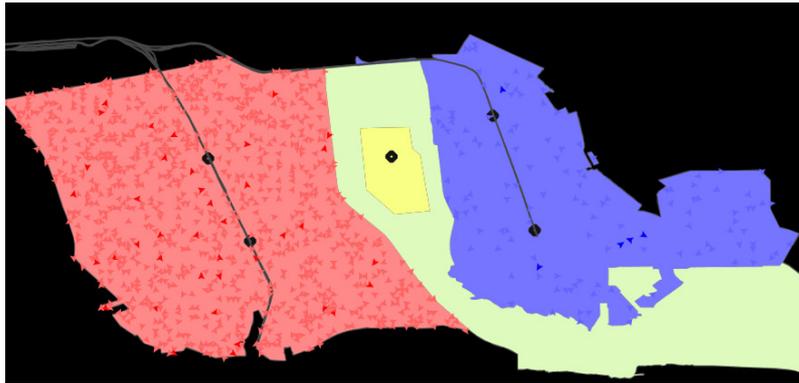


**Figure 3** Segregated Pattern as Outcome of Schelling's Two-Dimensional Model (Schelling, 1974)

#### 4. An Agent-Based Model for the Suburbs of Khayelitsha and Mitchell's Plain

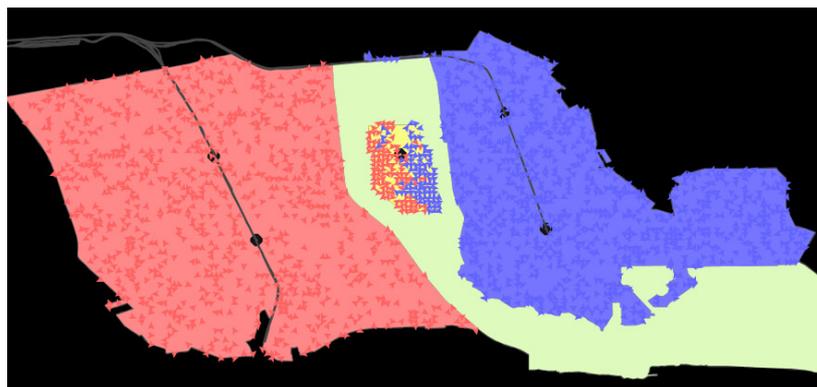
This project models the dynamics of two types of societies (agents) in the suburb of the City of Cape Town. The model proposes that each agent wants to ensure that it lives in proximity to its own culture. However, all agents also want to better their socio-economic circumstances. Thus, certain agents are happy where they live and others want to move closer to better opportunities, such as more affordable housing or better job opportunities. The unhappy agents of both cultures are portrayed as darker features, compared to the lighter coloured happy agents. The simulation shows how individual preferences at a local scale can influence community development and evolution at a larger scale.

Agents are initially located in their respective communities (Figure 4). Their neighbourhoods reflect GIS polygons obtained for these areas in reality and are the same colour as the agents. The green area between the two neighbourhoods represents vacant land and the yellow area contained within the vacant land represents a new housing and business development.



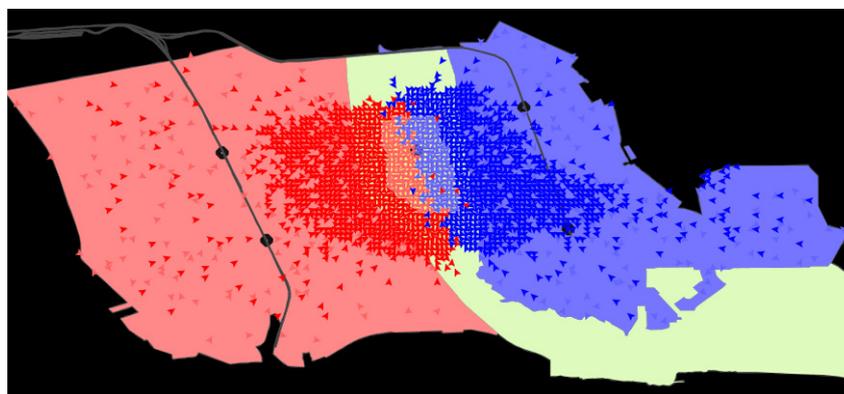
**Figure 4** Agents at Initial Setup Stage (blue agents represent the Black-African cultural group and the red agents represent the Coloured cultural group)

The first scenario that was tested reflected only 10% of the overall population having a desire to move to the new development. The outcome (Figure 5) reflects a small number of households moving to the new development and more importantly signs of integrated patterns. The reason for this is that the desire for a better home or employment outweighs the desire to live amongst neighbours of a similar cultural group.



**Figure 5** 10% of Overall Population Desiring New Development

The second scenario reflected 90% of the overall population having a desire to move to the new development. The outcome (Figure 6) reflects a large number of households moving to the new development and although a certain degree of integration is detected, it is quite evident that even a preference of less than 50% for the same culture result in distinct segregation.



**Figure 6** 90% of Overall Population Desiring New Development

## 5. Conclusion

Although the model presented in this paper is only in the initial stages of development (prototype), it demonstrates that agent-based modelling is the most effective method to simulate the complexity of the study area's societies. The next stages of the research project involves the analysis of international case studies of segregation modelling and also considers the expansion of the study area to include the full extent of the city of Cape Town.

## 6. Biography

Jacobus M. van Rooyen is a part-time PhD researcher at Birkbeck, University of London and in his fifth year of study. Interests include agent-based modelling of social systems, complex adaptive systems and the phenomenon of urban emergence.

Joana Barros is a lecturer in GI Science at Birkbeck, University of London and Jacobus' supervisor. Her areas of expertise are urban planning and modelling, more specifically agent-based and cellular automata models applied to urban systems and urbanisation in developing countries.

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