Could suburban sprawl be good for segregation? Low-density neighborhoods more likely to stay integrated

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Racially and economically mixed cities are more likely to stay integrated if the density of households stays low, finds a new analysis of a now-famous model of segregation.

By simulating the movement of families between neighborhoods in a virtual "city," Duke University mathematician Rick Durrett and graduate student Yuan Zhang find that cities are more likely to become segregated along racial, ethnic or other lines when the proportion of occupied sites rises above a certain critical threshold—as low as 25 percent, regardless of the identity of the people moving in.

Their results appear online in *Proceedings of the National Academy of Sciences* and will be published in a forthcoming issue.

Efforts to understand residential segregation using mathematical models are not new. More than 40 years ago, Nobel Prize-winning economist Thomas Schelling devised a now-famous model of segregation in which families, living on a 2-D grid, make choices about where to live based on the characteristics of their neighbors.

In Schelling's original model, using checkers and dice, a simple artificial city consists of two groups of equal size, each of which prefers to live with a certain minimum proportion of neighbors like them.

Schelling showed that even people who are happy living in mixed neighborhoods, and only seek to avoid living in neighborhoods where they are in the minority, eventually reach a "tipping point" and move -– largely because the movement of other people from one neighborhood to the next changes the makeup in both locations in a way that initiates a chain reaction.

Schelling's finding—that even slight preferences can promote segregation—may help explain why residential segregation persists in American cities despite years of policies and programs to counteract it.

Using sophisticated computer simulation to replace Schelling's physical model, Durrett and Zhang modeled the behavior of two kinds of families, designated as blue and red, as they moved from one part of a city to the next in search of a neighborhood they consider "acceptable."

In their computer model, every family seeks to live somewhere where families of the other color make up no more than a given percentage of the neighborhood.

Their movements are governed by a simple rule: families that are happy with the makeup of their current neighborhood tend to stay put, while "unhappy" families are more likely to move. When a family decides to move, they can relocate to a vacant site in any neighborhood in the city.

By analyzing the model, the Duke researchers showed that reds and blues can happily coexist indefinitely as long as the density of occupied sites in each neighborhood remains low.

However, as soon as the density of households in a neighborhood exceeds a certain threshold -– in this case 25 percent of the available sites, regardless of color –- the city quickly becomes segregated. Before long, the reds start to cluster in red neighborhoods and the blues in blues,

until eventually the majority of families live in neighborhoods where almost all of their neighbors look like them.

Their results successfully confirm one of Schelling's main results—that cities can become segregated in a short amount of time.

The authors don't offer any explanations for why a real-life city might become segregated as it starts to fill in, but other researchers suggest this could be because higher-density neighborhoods tend to consist of a single type of housing.

The current version of their model assumes that reds and blues are in equal numbers, and every household has the same degree of intolerance, but in real-life cities everyone is different.

Applying their model to real cities, the authors say, would require analyzing a version that allows the proportion of reds and blues and their degree of intolerance to differ –- as is the case when one group prefers to be with their own color, and the other group is happy either way.

While their model is simple, it adds to a body of research aimed at understanding how neighborhoods might change in response to different factors thought to promote or maintain integration, and why some cities are more or less segregated than others.

More information: "Exact solution for a metapopulation version of Schelling's model," Durrett, R. and Zhang, Y. *Proceedings of the National Academy of Sciences*, 2014. www.pnas.org/content/early/2014/09/11/1414915111

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