Modelling language shift in Carinthia, Austria

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Use of the minority language Slovenian in Carinthia, Austria, has been steadily declining over the past century. Despite supportive measures, language shift (speakers abandoning use of one language for another) is taking place which reduces cultural diversity. One way of monitoring this language shift on a large scale is using methods from the natural sciences where dealing with big sets of data is common. Language shift has previously been described by computer simulations based on models of diffusion from solid state physics.[1–3] Most of these simulations use differential equations derived from Fick’s laws of diffusion. We present a different approach: an agent-based model to simulate the action of individual speakers to model language shift over time and space in Carinthia.

Background

Use of the minority language Slovenian in Carinthia, Austria, has been steadily declining over the past century. Despite supportive measures, language shift (speakers abandoning use of one language for another) is taking place which reduces cultural diversity. One way of monitoring this language shift on a large scale is using methods from the natural sciences where dealing with big sets of data is common. Language shift has previously been described by computer simulations based on models of diffusion from solid state physics.[1–3] Most of these simulations use differential equations derived from Fick’s laws of diffusion. We present a different approach: an agent-based model to simulate the action of individual speakers to model language shift over time and space in Carinthia.

Our approach: An agent-based model

Speaker distribution at beginning

<table>
<thead>
<tr>
<th>67</th>
<th>0</th>
<th>0</th>
</tr>
</thead>
<tbody>
<tr>
<td>124</td>
<td>75</td>
<td>0</td>
</tr>
<tr>
<td>0</td>
<td>12</td>
<td>77</td>
</tr>
</tbody>
</table>

Gaussian spread function $S$

| 0.8 | 0.1 | 0.2 |
| 1.0 | 0.8 | 0.2 |
| 0.2 | 0.7 | 0.8 |

Spread probability $p = S \cdot H$

| 0.008 | 0.03 | 0.04 |
| 0.070 | 0.32 | 0.02 |
| 0.02 | 0.35 | 0.24 |

If $p >$ random number then speakers are gained

| 67 | 0 | 0 |
| 125 | 77 | 0 |
| 0 | 12 | 77 |

Language promoting factors

$H = \sum h_i \cdot H_i$

e.g., bilingual schools

Random numbers

Some results: change in Slovenian speakers in the district Völkermarkt

Gaussian spread $S$ only

bilingual schools

$h_1 = 0.8$

monolingual schools

$h_2 = -1$

Simulation (2 parameters in $H$ optimised for 1900)

Comparison

Real data

Conclusion

Language use and its spatio-temporal changes can be simulated with an agent-based model using only quantifiable parameters.

Language loss speeds up over time (more blue in graph = fewer speakers); optimization for a single period of time is not sufficient → time-dependent parameters

Discrete events influencing language use (e.g. wars) are difficult to incorporate in the model.

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