# Keeping up with the neighbours

An agent-based simulation of the divergence of the standard Dutch pronunciations in the Netherlands and Belgium

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• beginning of 20<sup>th</sup> century



- status, prestige
- anti-French



(Van de Velde et al. 2010)









Is it plausible that reduced contact between speakers from the Netherlands and Belgium resulted in a divergence between the standard pronunciations in both countries?







Is it possible that an increased pace of language change in Dutch speakers caused a divergence between the standard pronunciations of the Netherlands and Belgium?







Can we relate increased ethnocentrism in Belgian speakers to less adoption of Netherlandic innovations or even divergence?







Is it likely that increased media influence amplified the existing tendencies for language change (acceleration or inhibition) in Belgium?



# Simulations!

## Simulations

- plausibility in a synthetic environment
- virtual speakers ('agents')
- local behaviour
   ↓
  - system behaviour
- plausibility **only**



import sys

import mesa.batchrunner

class LanguageModel(Model): def \_\_init\_\_(self, agents\_no): super().\_\_init\_\_() self.agents\_no = agents\_no

def run(self):
 for agent in self.agents:
 agent.move()
 agent.speak()

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# Model design: architecture

- Python, using MESA
- model + visualisation

••	•	s BorderModel.py		
4 ►	BorderModel.py			+ 🔻
				10000 - Minor-
84	class Bo	rderAgent(Agent):		CONG-Dillion
		<pre>init(self, unique_id, influence_sphere, sound_mean, model, et</pre>	hnocentrism	Gullen
86		<pre>domestic_travel_chance=0.005, abroad_travel_chance</pre>	0.001):	Total and an owners
		<pre>super()init(unique_id, model)</pre>		CARDING-
		<pre>self.influence_sphere = influence_sphere</pre>		States Contractory and
		<pre>self.model = model</pre>		THE R.L
90				The second second second
91		self.sound = 1		
92		<pre>self.sound_repository = [] # Previously heard sounds</pre>		1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
93		<pre>self.adopt_modifier = 1 # How quickly does this agent want to ada</pre>		Transformer
94		<pre>self travel_urge = 1 # How much does this agent want to travel?</pre>		The second second
95		<pre>self.ethnocentrism = ethnocentrism # How nationalistic is this ag</pre>		Bill Starrown
96		sett.media_receptiveness = media_receptiveness # How receptive is		THEORY CONTRACT
9/		sett.nas_spoken = False # Has this agent spoken yet this step?		1100
90				
100		# is the agent travetting:		16 <sup>66</sup> .
101		colf travel_sphere - False # Harget sphere when travelting		
101		sech. clave c_alliveu = racse # has the agent alliveu at travet des		
103				
104		self.domestic travel chance = domestic travel chance # chance of a		Marcales and an and
105		self.abroad travel chance = abroad travel chance # chance of an a		and the second s
				Party states and states of
		<pre>self.init sound(sound mean)</pre>		and the second second
108				None Content
109		init_sound(self, sound_mean):		
110				
111		borders = { "left": sound_mean - <i>self</i> .model.sound_mean_interval,		CONVERSION CONCERNE
112		"right": sound_mean + self.model.sound_mean_interval	}	Timesta
113				Table State
114		IT borders["left"] < 0:		the second s
115		borders["tert"] = 0		- Marcane
D u	ine 81, Column 1		Tab Size: 4	Python



# Model design: space



- influence spheres
- based on Stanford & Kenny (2013)
- cities:



#### **Model design: populations**

- populations based on historical data  $\rightarrow 1/3000$
- Centraal Bureau voor de Statistiek / Jan Hertogen

	Dro	Bevolking op 1 Januari 1985.								
GEMEENTEN.	vin- ciën.	Per km². (Land).	Man- nen.	Vrou- wen.	Totaal					
Aagtekerke	Z.	88,0	378	365	749					
Aalsmeer	NH.	388,0	4 991	4 624	9 615					
Aalten	GLD.	141,6	5 974	5 704	11 678					
Aar (Ter)	ZH.	207,5	2079	1 956	4 035					
Aardenburg	Z.	126,9	1035	1 081	2116					
Aarle-Rixtel	NB.	192,7	1 252	1 540	2 792					
Abbekerk	NH.	96,6	390	365	755					
bbenbroek	ZH.	73,4	352	339	691					
Abcoude-Baambrugge	U.	99,3	774	844	1 618					
Abcoude-Proostdij .	U.	108,1	834	830	1 664					
chtkarspelen	F.	152,5	8 1 2 3	7 640	15 763					
chttienhoven	U.	73,4	425	369	794					
Adorp	GR.	67,0	755	726	1 481					
duard	GR.	67,9	1 047	1 012	2 0 5 9					
Akersloot	NH.	97,1	1 088	984	2 0 7 2					
Alblas (Oud-)	ZH.	87,1	612	571	1 183					
Alblasserdam	ZH.	679,7	3 254	3 006	6 260					
Alem c.a.	NB.	49,3	677	598	1 275					
Alkemade.	ZH.	266,2	3 247	3116	6 363					
Ikmaar	NH.	2 087,0	14 546	15 653	30 199					
Imelo	0.	876,3	16 680	17 296	33 976					
Almkerk	NB.	123,1	1977	1 867	3 844					
lphen	NB.	48,3	1 397	1 338	2 7 35					
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mbij	L.	355,4	1 049	1 1 1 7 2	2 221					
meide	ZH.	856,1	942	881	1 823					
meland	F.	34,8	1014	976	1 990					
merongen	U.	91,4	1 408	1 453	2861					
mersfoort	U.	1 885,2	21 688	22 594	44 282					
mmerstol	ZH.	1 706,7	513	511	1 024					
mmerzoden	GLD.	211,1	1 416	1 271	2 687					
Amstenrade	L.	644,1	942	913	1 855					
Amsterdam	NH.	5 213,9	378 256	403 404	781 660					

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	340	46024	Stekene	11,203	11,372	11,541	11,709	11,808	11,859	11,910	12,110	12,348	13,006	13,913	14,659	15,357	16,443	1
Ŀ	341	46025	Temse	20,144	20,308	20,473	20,637	20,703	20,702	20,702	21,191	21,803	22,427	23,288	23,541	23,844	24,544	
	419	60000	Luik	1,330,576	1,318,964	951,608	948,513	1,296,528	1,305,581 969,436	983,286	993,471	1,316,948	1,317,615	1,308,931	992,383	998,213	1,285,649	
	508	70000	Limburg	364,484	391,980	419,477	446,973	482,393	523,095	563,798	607,764	652,547	681,280	710,715	729,620	745,034	771,613	
2	509	71000	Arrondissement Hasselt	169,152	183,474	197,797	212,119	230,818	252,435	274,052	296,679	319,559	335,206	350,378	358,703	363,893	374,502	
	511	71004	Beringen	15.116	16.492	17.865	19,244	21,009	23.033	25.057	27.242	29,455	31.733	33,797	35.427	35,289	37.881	
	512	71011	Diepenbeek	5,635	6.243	6,850	7,458	8,231	9,114	9,996	11,189	12,459	13,755	14,835	15,790	16,211	16,681	
	513	71016	Genk	24,574	27,305	30,035	32,765	36,763	41,605	46,448	52,081	57,913	60,038	61,512	61,553	61,343	61,995	
	514	71017	Gingelom Holen	8,236	5,937	8,116	8,056	8,010	6.944	7,937	7,911	7,855	7,711	7,582	7,514	7,257	7,345	
	516	71022	Hasselt	31,073	34,081	37,085	40,098	43,825	48,031	52,238	55,812	59,228	62,011	64,439	65,432	65,094	67,485	
	517	71024	Herk-de-Stad	6,401	6,673	6,945	7,216	7,540	7,898	8,255	8,643	9,039	9,452	9,835	10,289	10,604	11,283	
	518	71034	Leopoldsburg	6,483	7,256	8,025	8,802	9,631	10,498	11,365	12,032	12,649	12,949	13,640	13,577	13,564	13,716	1
	520	71045	Neuwerkerken	3,316	3.440	3.564	3.687	4.021	4.495	4,968	5.170	5.303	5.350	5,736	5.881	5.947	6.163	
	521	71047	Opglabbeek	1,795	2,094	2,392	2,691	3,153	3,724	4,296	4,964	5,656	6,409	7,166	7,601	7,882	8,525	
	522	71053	Sint-Truiden	27,109	28,184	29,255	30,334	31,442	32,572	33,702	34,728	35,728	35,979	36,160	35,664	37,027	37,445	
	523	71057	Tessendeno	6,659	6.044	6,735	7,850	8,358	8,947	9,527	10,592	11,778	12,624	13,556	14,159	14,255	14,931	
	525	71057	Zutendaal	1,505	1,660	1,815	1,970	2,249	2,611	2,973	3,494	4,055	4,568	5,086	5,509	5,983	6,384	
	526	71069	Ham	4,215	4,550	4,885	5,220	5,638	6,111	6,584	7,175	7,794	8,104	8,460	8,663	8,736	8,913	
L.	527	71070	Heusden-Zolder	7,265	9,009	10,754	12,498	14,288	16,108	17,928	20,256	22,711	25,081	27,264	27,812	28,589	29,294	
	529	72003	Bocholt	5.332	5.801	6.271	6,740	7,198	7.649	8.099	8.663	9.255	9.628	9,991	10.379	10.833	11.397	
	530	72004	Bree	7,802	8,367	8,933	9,498	10,250	11,153	12,046	12,617	13,108	13,070	13,119	13,380	13,561	13,705	
	531	72018	Kinrobi	5,583	5,879	6,174	6,470	6,882	7,372	7,862	8,461	9,088	9,562	10,124	10,281	10,710	11,269	1
	632	72020	Lommel Monsolk	9,666	10,790	11,914	13,037	14,438	16,022	17,606	19,728	21,984	23,635	25,020	26,229	27,427	29,195	
	534	72025	Neerpell	6.069	6.447	6.825	7,203	7,736	8.373	9.011	10.039	11,166	11,768	12.515	13.293	13,896	14,758	
	535	72029	Overpelt	5,457	5,909	6,361	6,813	7,350	7,969	8,578	9,482	10,450	10,798	11,058	11,218	11,543	12,023	
	536	72030	Peer	5,993	6,411	6,825	7,248	7,953	8,849	9,745	10,270	10,703	11,279	11,903	12,725	13,356	14,622	1
	538	72037	Hamont-Achel Hechtel Eksel	6,358	6,947	7,535	8,124	8,701	9,270	9,839	10,295	10,722	11,431	9 169	9.451	9 791	13,102	1
	539	72039	Houthalen-Heichteren	3,691	5.091	6,490	7,890	9,791	12,025	14,259	17,205	20,328	22,146	24,567	25,797	27,062	28,435	
	540	72040	Meeuwen-Gruitrode	4,173	4,567	4,961	5,355	6,903	6,554	7,205	8,108	9,075	9,689	10,452	10,936	11,419	11,995	
	- 441	72041	Dilsen-Stokkam	8 505	9 163	9.820	10.478	11 294	12.216	13 138	13773	14 337	14.831	15 389	16 506	16.854	17 379	d

#### Model design: travel

#### agents can travel to other spheres

• gravity model (Trudgill 1974)



Lang. Soc. 2, 215-246. Printed in Great Britain

#### Linguistic change and diffusion: description and explanation in sociolinguistic dialect geography

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#### ABSTRACT

Linguistic geography has remained relatively unaffected by recent developments in sociolinguistic theory and method and theoretical georgaphy. In this paper it is argued that insights and techniques from both these disciplines will be of value in improving descriptions of geographical variation in language, and that these improvements will in turn lead to more adequate explanations for certain of the social and spatial characteristics of linguistic change. Evidence in fovour of a sociolinguistic tenchodology and new cartographic techniques in dialect geography is drawn from empirical studies in urban dialectology. In East Anglia, England, and rural dialectology, in Norway. (Sociolinguistic variation, dialectology, linguistic change. British English, Norwegian.)

William Labov's Social Stratification of English in New York City has made a number of very important contributions to linguistic theory and practical: Among these are the development of the concept of the linguistic variable, which has provided linguists with a means of measuring and describing gradient and variable linguistic features, and the adoption of certain aspect of sociological methodology (particularly sampling and social class index construction), which has permitted a detailed study of the covariation of linguistic and social phenomena. This in turn has enabled us to achieve a clearer understanding of the nature of the relationship between language and various osciological parameters, and increased our knowledge about the social setting of linguistic change. In this paper I want to argue that he linguistic variable, together with a number of methodological and theoretical insights from human geography, can similarly improve our knowledge of the relationship between language and arguing and geographia as setting of linguistic change.

In section 1 I shall suggest some reasons for considering the improvement of

<sup>[1]</sup> Iam very grateful indext or R. L. Hodgart, who first interested me in the topic of this paper, and to Arm Kiell Flohdik, who first introved me in the study of Norweign, and without whom the Brunhanes survey would have been inpossible. I am also grateful to the large number of poople who commented on earlier versions of this paper, specially E. Afendras, C. J. Bailey, D. Bickerton, R. W. Fasold, A. K. Foldvik, W. N. Francis, T. Higerstrand, P. Haggett, B. Jernudd, W. Laboy, A. McIntoh, F. R. Palmer, S. T. Trudgill and J. C. Wells. My thanks are also due to Ingeborg Hoff for her help with appets of the Norwegian data.

# Model design: speaking

adjacent / occupying same cell = talk



• exemplar exchange





- exemplar = value between 0 and 1
  - diphthongisation, voicelessness of fricatives...

## Model design: speaking



unrealistic?



systematic reduction of abroad travel rate
Belgian and Dutch agents will come across each other less

# moving target

- increase of number of exemplars
- hearer saves sound once more than once
  - faster evolution
- difficult to influence the system  $\rightarrow$  local changes





- media influence
- Dutch agents: sounds from *Randstad area*
- Belgian agents: sounds from *Brabant* (<sup>3</sup>/<sub>4</sub>) + *Randstad area* (<sup>1</sup>/<sub>4</sub>)

(Instituut der Nederlandse Uitzendingen 1982, 15)

- individually defined, since receptiveness for media innovations seem to be person-bound (Stuart-Smith & Timmins, 2009)
- sound saved? ~ media receptiveness
  - varied across entire population

What effect do the alternations have on the sound evolution in Belgium?





- lack of contact can lead to divergence
- abroad travel rate = domestic travel rate

5000

#### • not unrealistic

(NOS Afdeling kijk- en luisteronderzoek and BRT Studiedienst 1983, 21, 48)





- pace of sound shift in NL did not seem to have an influence on Belgian sound evolution
- hard to model: exasperation
- pace alone is not enough

#### Results



- higher BE ethnocentrism = less NL adoption
- divergence possible after BE contact with NL was reduced
- scaled ethnocentrism = little effect on divergence → positive gatekeeping?







- any media influence always causes convergence for BE
- media theory plausible in convergence situations



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