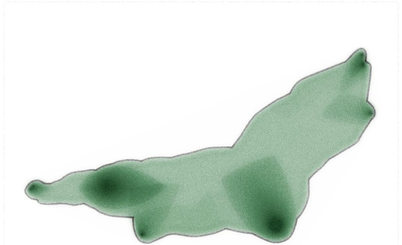
Aalto University

Spatial units of analysis

Use of activity space models in
environmental health promotion studies



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Use of activity space models in
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“Trivial questions sometimes require deep and expansive knowledge of the cosmos just to answer them.”

— Neil deGrasse Tyson, Astrophysics for People in a Hurry

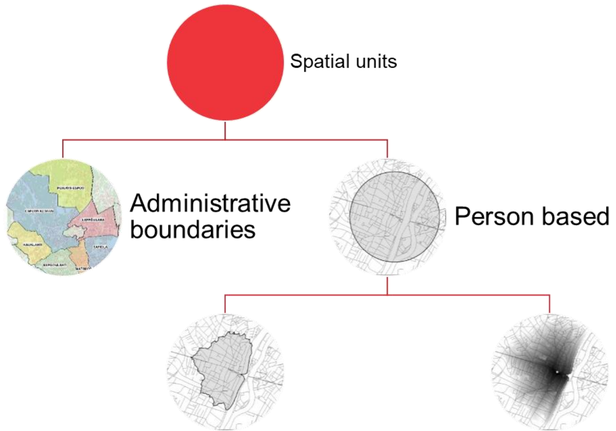
In this presentation

- What is a spatial unit?
- How can we model it?
- Why is this important?

Person and place based analysis

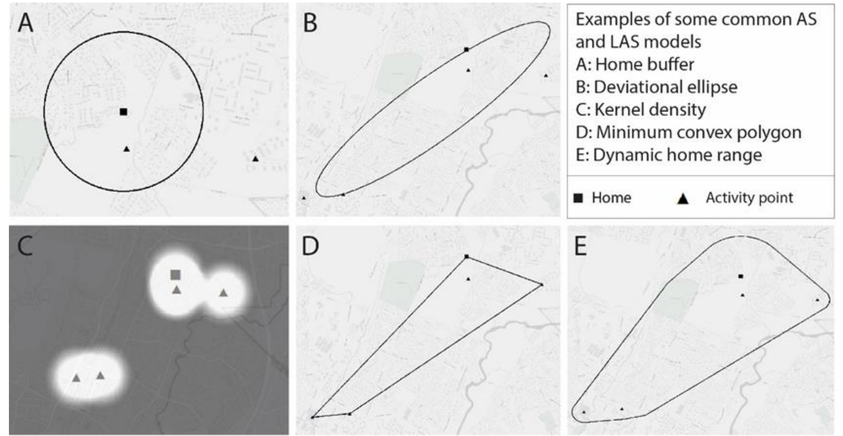
How can the **geographical context** affect people?

- Green structure
- Urban density
- Walkability
- …



Examples:

- **Administrative boundaries:**
  - **Postal areas**
  - **Census tracts**
- **Person based**
  - **Home buffers, Road network buffers, Kernel density estimation, standard deviational ellipses etc.**



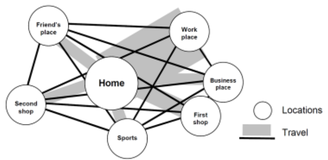
The uncertain geographic context problem (UGCoP):

- UGCoP (Kwan, 2012) refers to the problem that findings about the effects of area-based contextual variables on individual behaviors or outcomes may be affected by how contextual units (e.g., neighborhoods) are geographically delineated and the extent to which these areal units deviate from the true geographic context.

- It is a significant methodological problem because it means that analytical results can differ for different delineations of contextual units even if everything else is the same.

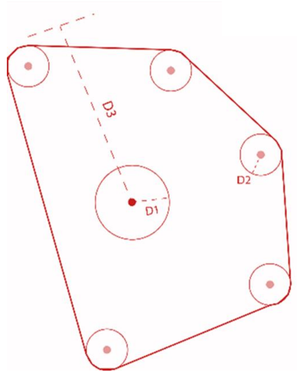
What is Activity space (AS)?

- Activity space is a set of geographically distributed locations which are physically contacted by individuals (Reynolds, 1971)
- First introduced in zoology (Burt, 1943)



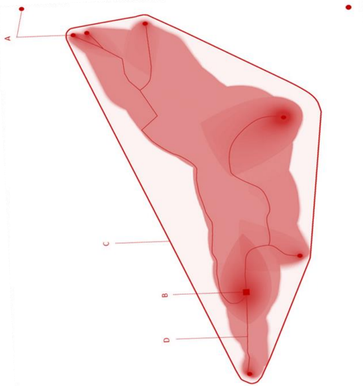
Schönfelder and Axhausen (2002)

Static buffer around home



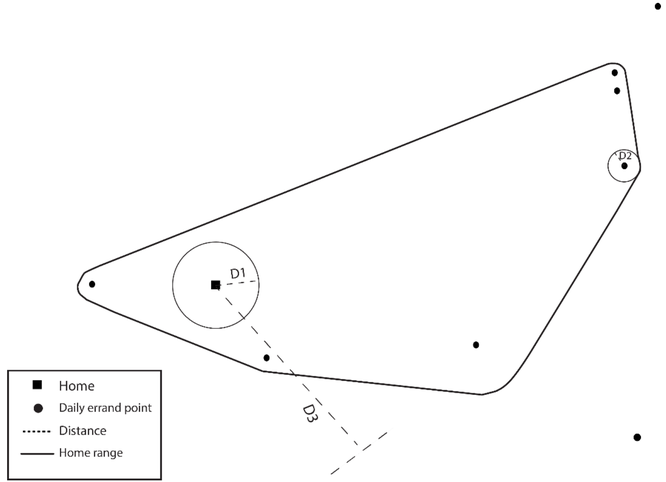
Dynamic home range model

(Hasanzadeh et al., 2017)



Individualized residential exposure model (IREM)

(Hasanzadeh et al., 2018)

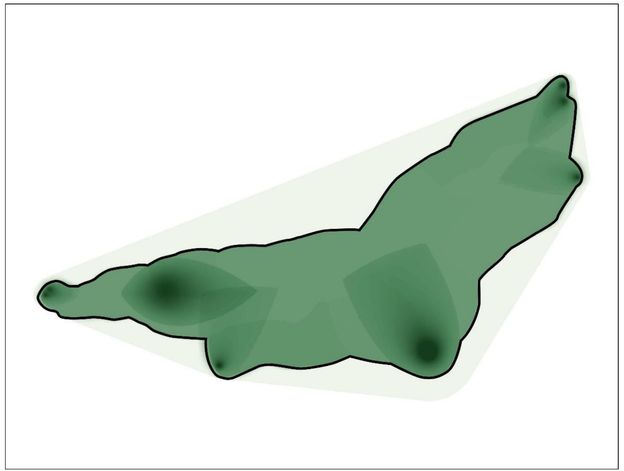


1: (Hasanzadeh, et al, 2017)

Improved models (I): Home range

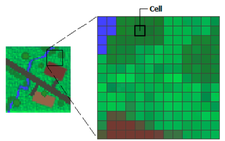
- A customized convex hull using three parameters: D1, D2, D3
- Systematically defined, individual specific

❑Are all areas equally accessible?
❑Are we equally exposed to all areas within our home range?



(Hasanzadeh, et al, 2018)

Improved models (II): An individualized residential exposure model (IREM)



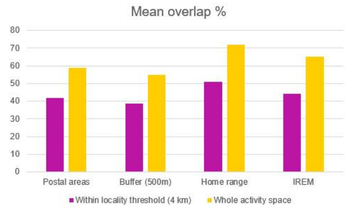
- The level of exposure can vary:
  - **Frequency** of visit, **mode** of transportation, **path** taken
- Activity space presented as raster
  - Weights assigned using the above three factors. Distributed using:
    A distance decay function (inverse distance weighting)
  - Spatially sensitive analysis of contextual factors

We can extract areas of high exposure

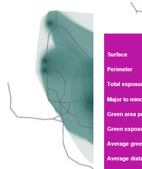
How does this all matter?

Why it matters?

- Different models offer different level of accuracy and accordance with reality
- Different phenomena may be relevant to study at different scales
- Different models can yield different results
- Advanced models can enhance analytical possibilities
- Models vary in their level of complexity



		Health	Functioning	QOL	Happiness
Postal areas	Greenness				
	Size of AS				
	Walkbility				
	Pedestrian/Cycling route				
Buffer (500 m)	Greenness				
	Size of AS				
	Walkbility				
	Pedestrian/Cycling route				
Home range	Greenness				
	Size of AS				
	Walkbility				
	Pedestrian/Cycling route				
IREM	Greenness				
	Size of AS				
	Walkbility				
	Pedestrian/Cycling route				



	Component 1 30%	Component 2 23%	Component 3 21%	Component 4 11%	Component 5 7%
Surface	.981*	-	-	-	-
Perimeter	.914*	-	-	-	.342
Total exposure	.956*	-	-	-	-
Major to minor axis ratio	-	-	-	-	.964*
Green area percentage	-	.910*	-	-	-
Green exposure ratio	-	.972*	-	-	-
Average green exposure	-	.959*	-	-	-
Average distance to DEP	-	-	.955*	-	-
Maximum distance to DEP	-	-	.931*	-	-
Percentage of DEPs inside neighborhood boundary	-	-	.857*	-	-
Number of visits to DEPs per month	-	-	-	.899*	-
Number of DEPs	.377	-	-	.818*	-
Average exposure	-	-	-	.853*	-

- Size of LAS
- Greenness of LAS
- Exteriority of AS
- Intensity of LAS
- Elongation of LAS

erature
literature

Two sides of the coin?!

Image curtesy of: **Andrew Grossman**

Questions?

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Read more:

Hasanzadeh, K. (2019). Spatial units of analysis: are there better ways?-An empirical framework for use of individualized activity space models in environmental health promotion research.

Hasanzadeh, K., Broberg, A., & Kyttä, M. (2017). Where is my neighborhood? A dynamic individual-based definition of Home zones. *Applied Geography*, *84*(C), 1–10. https://doi.org/10.1016/j.apgeog.2017.04.006

Hasanzadeh, K., Laatikainen, T., & Kyttä, M. (2018). A place-based model of local activity spaces: individual place exposure and characteristics. *Journal of Geographical Systems*. https://doi.org/10.1007/s10109-017-0264-z

Laatikainen, T. E., Hasanzadeh, K., & Kyttä, M. (2018). Capturing exposure in environmental health research: Challenges and opportunities of different activity space models. *International journal of health geographics*, *17*(1), 29.

Perchoux, C., Kestens, Y., Thomas, F., Hulst, A. Van, Thierry, B., & Chaix, B. (2014). Assessing patterns of spatial behavior in health studies: Their socio-demographic determinants and associations with transportation modes (the RECORD Cohort Study). *Social Science and Medicine*, *119*, 64–73.

Kwan, M.-P. (2012) The uncertain geographic context problem. Annals of the Association of American Geographers, 102(5): 958-968.

GIS tools and Python codes available:

Hasanzadeh, K. (2018). IASM: Individualized activity space modeler. *SoftwareX*, *7*, 138-142.