Space & Crime

Macro and micro scale spatial analyses tools indicating vital street life and urban safety

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Two divergent views:

• Oscar Newman’s *defensible space* policies with close and impermeable environments
• Jane Jacobs’ ideas on *open and permeable* environments for inhabitants and strangers
Two ideologies

• Newman advocates the inhabitants as natural police for strangers as intruders. The stranger is perceived as a source of danger.

• Jacobs advocates the strangers as well as inhabitants of the natural police mechanism. Here the stranger is perceived as a source of safety.
Research on urban layout and crime vulnerability over the two past decades has been long on ideology but short on evidence!

- Some empirical research supports the one direction, and others the other direction
- Providing detailed evidence has so far been controversial
Methodology – how to analyse urban SPACE?

- Space syntax (spatial structure)
- Urban morphology (spatial pattern)
- Place character analyses (place character)
Wat is Space Syntax?

• Space Syntax What space syntax measures is the two primary *all-to-all* (all street segments to all others) relations.

• On the one hand it measures the *to-movement*, or accessibility, potential, of each street segment with respect to all others.

• On the other hand it measures the *through-movement* potential of each street segment with respect to all pairs of others.
From an urban point of view, space syntax is four things

- A question of representation of urban space
- A family of techniques for analysing cities as the networks of space formed by the placing, grouping and orientation of buildings
- A set of techniques for observing how these networks of space relate to functional patterns such as movement, land use, areal differentiation, migration patterns and even social wellbeing and malaise
- A set of theories about how urban space networks relate in general to the social, economic and cognitive factors which shape them and are affected by them.
The definition of **SPACE**

- **Intrinsic properties of space**: Built form and meaning
- It is the volume and texture of the walls shaping urban space that are at issue.
- We have many words for describing spaces of this kind: „a narrow street, a massive building ect“
Extrinsic properties of space

- Topological relationships
- Difficult to describe with words
- The use of models
- Volume, size and metric distance is not at issue. It is the spatial relationship
- Built form and function
The content inside its buildings

The intrinsic description of its public spaces

- Public building
- Shop and retail
- Dwelling

- Side street
- Back street
- Main street
Calculating axial integration:

Mean depth for each axe (MD):

\[ MD = \frac{\text{sum depth}}{k} - 1 \]

- \( k \) = number of axes in a system.
- sum depth = the topological depth from each axe to all other axes.
- \( D_k \) = diamond value.

Calculating the back street axe:

\[ (MD) = \frac{\text{sum depth}}{k} - 1 = \frac{50}{16} - 1 = 3.333333 \]

Real asymmetry (RA) = \( 2(\frac{MD}{k} - 1) = 2 \cdot (3.333333 - 1) = 2 \cdot 2 = 4 \)

Real relative asymmetry (RRA) = \( \frac{RA}{k} = \frac{4}{16} = 0.25 \)

Integration value of the back street: \( 1/RRA = \frac{1}{0.25} = 4 \)

- Back street
- Side street
- Main street

Sum Depth: 50

Calculating the side street axe:

\[ 0 \times 1 = 0 \]

- Depth:
  - \( 3 \times 3 = 9 \)
  - \( 2 \times 7 = 14 \)
  - \( 1 \times 5 = 5 \)

Sum depth = 28
Calculating the main street axe:

$$\text{MD} = \text{sum local depth} \cdot \text{local} - 1 = \frac{19}{13} - 1 = 1.58333333$$

$$\text{Real asymmetry (RA)} = 2(\text{MD} - 1)k - 2 = 2\left(\frac{19}{13} - 1\right) - 2 = 0.10606060606$$

$$\text{Real relative asymmetry (RRA)} = \frac{\text{RA}}{Dk} = \frac{0.10606060606}{0.276} = 0.38427755819$$

Local integration value of the main street: \(\frac{1}{\text{RRA}} = \frac{1}{0.38427755819} = 2.6022857143\)

Calculating the back street axe:

$$\text{MD} = \text{sum local depth} \cdot k - 1 = \frac{7.5}{1.5} - 1 = 1.75$$

$$\text{Real asymmetry (RA)} = 2(\text{MD} - 1)k - 2 = 2\left(\frac{7.5}{1.5} - 1\right) - 2 = 0.5$$

$$\text{Real relative asymmetry (RRA)} = \frac{\text{RA}}{Dk} = \frac{0.5}{0.352} = 1.4204545455$$

Local integration value of the back street: \(\frac{1}{\text{RRA}} = \frac{1}{1.4204545455} = 0.7039999998\)
Shallow angle of incidence

Angular weighting used in Meanda

Angular weighting used in Depthmap

Sharp angle of incidence
Difference between distance and radius

• Topological distance – the issue of fewest turn
• Geometrical distance – the issue of fewest angular deviation
• Metrical distance – the issue of shortest distance
Difference between **distance** and **radius**

- **Topological radius** – the issue of the number of turns from a street **axe**
- **Geometrical radius** – the issue of the degree of angular deviation from a street **segment**
- **Metrical radius** – the issue of the metrical radius from a street **segment**
Topological radius: $R=2$: two direction changes away from the thick line

Topological radius: $R=2$: two direction changes away from the segment

Metrical radius: $R=3$: 3 units away from the point
The Burglar‘s perception of the built environment

How burglars explore their neighbourhood
An area's social and spatial composition influences burglary rates in built environments.

- Finding out **HOW** requires data about Burglar’s home addresses
- …and the spatial features of the homes they intruded
Data of 39 caught burglars obtained

- In 32 of the 39 cases the burglar lives within a radius of 3 km away from the homes they burgled.
- In most cases, burglars operated in those areas in their neighbourhood that are spatially most segregated and that have a most broken up street net.
A burglar is a space explorer who seeks for all the possibilities an area can offer when he operates

- The critical point is to enter and escape the homes with stolen goods without getting noticed.

- Therefore the burglar must know the local spatial conditions in a neighbourhood very well.
To what extent is the burglar a *local* in different kinds of areas?

- **Traditional urban** areas have the advantage that the burglar can mingle himself with the visitors and that the escape routes are many. The disadvantage is the high number of people in the streets all the time.

- **Post War areas** have the advantage that there are few people in streets, while the disadvantage is the way a burglar can be recognised by inhabitants and in some cases the escape routes are few.
The principle of the middle scale areas in the historic urban areas

The principle of the middle scale areas in the post war urban areas

Section of the Pijp area – an example on a historic urban area

Bijlmer area – an example on a post war urban area
Burglars have detailed local knowledge of the areas they operate

• It seems not only to depend on knowledge about when people and their neighbours are not present in their homes, but also on the spatial conditions on where these homes are located.

• The more burglars living in an area, the higher burglaries rates - but in the most spatially segregated and unconstituted streets in an area.
Space matters

• Not the density of entrances but inter-visibility is significant.

• Burglars favour invisible break inn points invisible on account of high fences and hedges or of few neighbours across the street.

• As regards escape possibilities, unconstituted footpaths and segregated streets are preferred. The same pertains to spatially broken up street structures with no natural surveillance.
Approach for Gouda and Alkmaar

• Spatial integration analyses of the street net
• Registration of pedestrian and car traffic flow in some areas
• Detailed spatial studies of entrances location and angle, and their degree of intervisibility
• Detailed spatial studies of access to backgardens
• Detailed studies of break inn points and escape routes possibilities
What is missing in space syntax in order to study degree of urban safety in urban areas?

- Micro spatial conditions – like a target’s degree of exposure to neighbours and the street
- Spatial means to measure micro spatial relationships between private and public spaces
- Correlation number of targets and degree of local integration and topological depth from main routes
The **micro** scale spatial relationships at issue in urban studies

- **Inter-visibility** of windows and doors
- their inter-relationship to street segments
- **density of entrances** of private houses connected to streets
- **topological depth** between various kinds of private and public spaces
- **degree of constitutedness** of street segments
- **degree of visibility** from windows to parking lots
Jane Jacobs

- **Short urban blocks** contribute to more people in the streets
- **Eyes on the streets** from the buildings located along it ensure safety for inhabitants and strangers
- An urban area must have a sufficiently **dense concentration** of people.
Jan Gehl - Life between houses

• Posibilities for people to stay or sit in public spaces
• The ways entrances are oriented towards public space
• Spatial possibilities for social interaction
The aim of this inquiry is to **quantify** the various topological spatial properties on the relationship between **buildings** and **streets**.

- the individual properties had to be **observed**
- correlated to the other spatial properties on a **micro** as well as **macro** scale level
- correlated with **crime distribution** and the **location** of various **functions** in urban areas
Find urban areas with a large variation in spatial set-up and social composition of dwellers.

- In total 1,168 street segments were observed and 25 different spatial features registered on the spot.
following **micro** scale features are taken into account:

- topological depth between private and public space
- degree of inter-visibility of entrances and windows,
- degree of constitutedness,
- street form,
- street function,
- the density of entrances connected to the street,
- inter-visibility from windows on parking lots, and
- degree of territoriality
Topological depth between private and public space

- Entrances zero topological step away from a street
- Entrances one topological steps away from a street
- Entrances two topological steps away from a street
- Entrances three topological steps away from a street

Legend:
- House or building
- Private space with connection
- Semi private space with connection
- Public street
The direct connection of entrances to the street

- In traditional urban areas, housing entrances are faced *direct* to the street, while in post War urban areas one has to walk through *semi* private or semi public spaces before one find the entrances.

- Moreover, in post war detached houses the entrance is more *on the side* of the house than direct to the street
Constitutedness and un-constitutedness

- A street's degree of constitutedness depends on how building entrances are connected to a street
- degree of **adjacency** and **permeability** from buildings to public space
UNconstituted street
Constituted street
Examples on constituted streets

Examples on unconstituted streets
- Voorkant
- Achterkant
- Zijkant
- Onbekend
Inter-visibility and density of entrances to streets
High density of entrances connected to a street does not always imply high inter-visibility

• There is a distinction in the way entrances constitute streets and in the way they are inter-visible to each other.

• The way entrances and windows are positioned to each other influences the probabilities for social control.
Intervisible street
Not Intervisible street
High density of entrances not visible to one another

Low intervisibility of entrances
A high visible street
75% intervisibility

A medium visible street
50% intervisibility

A low visible street
25% intervisibility

A non-visible street
0% intervisibility

High density of entrances inter-visible to one another

Intervisible streets with low density of entrances

Low intervisibility and density of entrances

Low density of entrances, no inter-visibility
Combinations of micro and macro spatial measurements

- The angular segment based analyses – to identify the main routes through urban areas
- Segment connectivity
- Local integration
- Topological depth from main routes
Spatial properties

- **Axman** – the traditional space syntax measures
- **Depthmap** – include the angular analyses
- Manuel analyses – the topological depth from main routes – plus all the micro spatial measurements
Topological depth from main routes
The principle of the middle scale areas in the historic urban centres

The principle of the middle scale areas in the post war urban areas
Topological depth GOUDA
Topological depth ALKMAAR
The statistical correlations

- The **deeper** a segment is situated inside an urban area, the **greater** the **topological depth** between private and public space.
- Along the **main routes** **through** urban areas, most entrances are **directly** connected to the street.
- When changing direction two times from the main routes, the average topological depth for entrances is 2 while it is 3 in all street segments that are located more than six topological steps from the main routes.
Crime RATES and RISK

- Cul-de sac OR traditional street?
## Primary risk band analyse

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Burglaries from dwellings

\[ R^2 = .770, \text{Sign.} = .000 \]

\[ R^2 = .519, \text{Sign.} = .044 \]

\[ R^2 = .646, \text{Sign.} = .016 \]
Theft from cars

Topologische diepte

Intervisibiliteit op de parkeerplaatsen in %

Lokale integratie

$R^2 = 0.4317$

$R^2 = 0.3219$

$R^2 = 0.2914$
Top. depth + intervisibility

\[ \text{Rsq} = 0.9512 \]
The location pattern of SHOPS

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<tr>
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Total 0.09 1157

Shops are located on depth= 0 and depth = 1. Sign. = .003
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Sign=.000
# Topological Depth of Entrances

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Sign = .000

The closer one is to the main routes, the more private spaces are directly connected to the streets.
Report
STREET FUNCTION

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<tr>
<td>Total</td>
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<td>1160</td>
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Sign=.000

The topologically deeper one moves away from main routes, the more the area consists only of dwellings.
### Report

#### Dwelling types

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Sign = 0.000

Row houses can be mostly found in the middle of the local areas, while detached houses and two family homes area are the local areas’ edges.
Report
Indivisibility between windows in %

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Sign=.000
Report
Inter-visibility dwellings-parking places in %

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<th>Mean</th>
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Total 37,43 1077

Sign=.000
Recent planning of dwelling areas in Europe

• Seems to like the small scale development
• However, the way entrances constitute and face the streets seems to be forgotten….
• Seems to be essential in order to ensure urban liveliness and safety….
Different types of crime requires different types of space

- Picpockets operate in busy shopping streets
- Purse snatchers operate in streets with many escape routes
- Burglaries operate in segregated dwellings in unconstituted streets with good escape routes
- Car criminals operate in empty streets
- Rape and street robberies occur in unconstituted streets
Thus, burglars do not understand defensible space...!!!
9 spatial principles of safe urban design

A van Nes
1. Main route well integrated and well connected to local streets. The local streets have 1-2 direction changes from the main routes.
2. Entrances connected directly to streets and intervisible to each other
3. Avoid streets with blind walls, in particular in the streets that are directly connected to...
4. Enhance shop or business function on ground floor level instead of storage place. Windows and doors need to be directly connected to the streets.
5. Have a network street net instead of a street structure, where the main route is
6. Main routes going through the local centres instead of around them
7. If not possible to make inter-visible streets, then make them at last constituted.
8. And make sure that the topological depth between private and public space is short.
9. A main route well connected to all streets in a neighbourhood generates a variation of micro businesses instead of a car-based shopping centre.
Continuïteit routing

Centrum
Bestaande situatie

Blauwe loper
Nieuwe kruising Proosdijstraat
Blauwe loper loop zichtbaar door gelijkwaardige kruising
Continuïteit in route blauwe loper, route door het groen Verblijfsruimte met lokaal programma, zitplekken, buurthuis, speelobjecten
Hoofdroute auto gaat hoek om blauwe loper recht door
Potenties voor vitaal straatleven en bedrijvigheid
Continuïteit in route blauwe loper
Verblijfsruimte met programma, brede stoepen, hoekpanden, mobiele eenheden, mogelijkheid voor verblijven

Fietsstraat
dichte plinten vervangen
Plein: nieuwe kruising Ruttensingel
Blauwe loper loop zichtbaar door, gelijkwaardige kruising
Ontmoetingspunt voor wijk- en stadsverkeer
Stadsvoorzieningen als fitness, cafe
Doorbraak maakt hoekpanden, brede trottoirs en verblijfsruimte mogelijk.
fig. 10a Toegankelijkheid Vroonermeer op lokaal niveau (autoverkeer)
fig. 11 Verbondenheid - autoverkeer
achterkanten aan hoofdas

stedelijk karakter (stenig beeld)

landelijk karakter (groen en grote voortuinen)
fig. 18 Woninginbraken 2009 t/m 2012 en verbondenheid.
fig. 19 De relatie tussen diefstal uit en vanaf personenauto’s 2009 t/m 2012 en verbondenheid.
fig. 20 De relatie tussen (brom)fietsdiefstal 2009 t/m 2012 en verbondenhed van het autonetwerk.
fig. 21 Mishandeling 2009 t/m 2012 en vitaal straatleven
fig. 22 Overlast jeugd 2009 t/m 2012 en vitaal straatleven
fig. 23a Bestaande situatie toegankelijkheid op stadsschaal

fig. 23b Toegankelijkheid op stadsschaal van de Leopoldstraat neemt toe
fig. 25a Verbondenheid bestaande situatie

fig. 25b Verbondenheid van de Leopoldstraat neemt toe
fig. 29a. Verbondenheid, bestaande situatie

fig 29b De verbondenheid van straten rondom de flats in Zuid en op de weg naar het station nemen toe.
bestaand ontwerp

voorkanten aan het lint
fig 38. Voorkanten aan het lint in Vroonermeer-Noord
fig. 38 potenties vitaal straatleven op de kruising van het lint en de brug
Conclusions

• The social composition of the dwellers, their lifestyles and wishes are also important factors in choosing the priority of improvements.

• Spatial parameters play a role in the socio-economic performance of a neighbourhood.

• It is about how the spatial layout contributes to
  - generate a reduction of criminal opportunities,
  - shape a natural social control mechanism between inhabitants and visitors,
  - shape opportunities for meeting
  - location of micro scale businesses inside the area.
Conclusions

• Urban project developers nowadays tend to build with high density or high floor-space-index and propose large variations of urban functions (dwellings, offices etc) in these areas.

• However, the degree of inter-connectivity and the topological shallow public-private interface is often forgotten.

• All these activities depend on how the spatial configuration is on the street plinth or built up street sides.

• Therefore, there is a need to bring micro scale spatial relationships on the research, policy making as well as the design agenda in the urbanism discipline.
Challenges for further research

• This inquiry is based on a study of only 1,168 street segments in two local areas in two Dutch cities

• Add the micro scale spatial relationship component to the software development!

• More evidence is needed!
Thank you....

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