

The public health threat of physical inactivity
should be addressed in urban design





Contribution of physical activity to health aspects

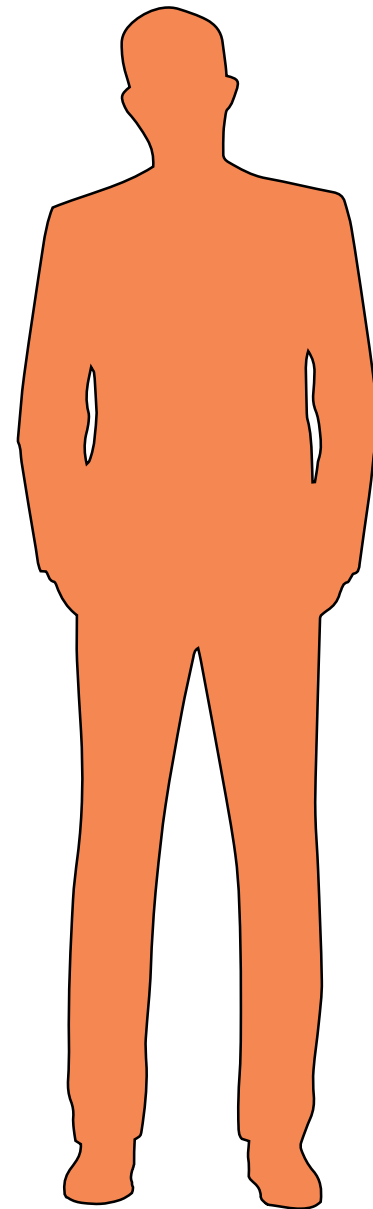
Symptoms of depression

Coronary heart disease

Brest cancer

Diabetes

Colon cancer

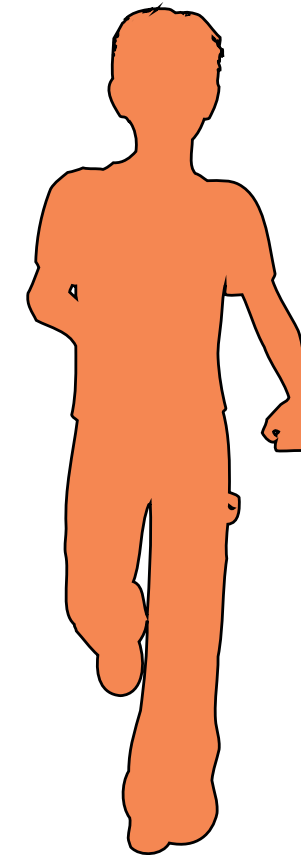


High blood pressure

High blood sugar

Overweight

Adults



Muscle strength

Bone structure

Overweight / Body mass index

Fitness

Symptoms of depression

Children

(based on Gezondheidsraad, 2017, p.17; p.21; WHO, 2010)

Dutch physical activity guidelines

Adults



2,5 uur per week
matig intensief bewegen



2x per week
spier- en botversterkende
activiteiten

Children

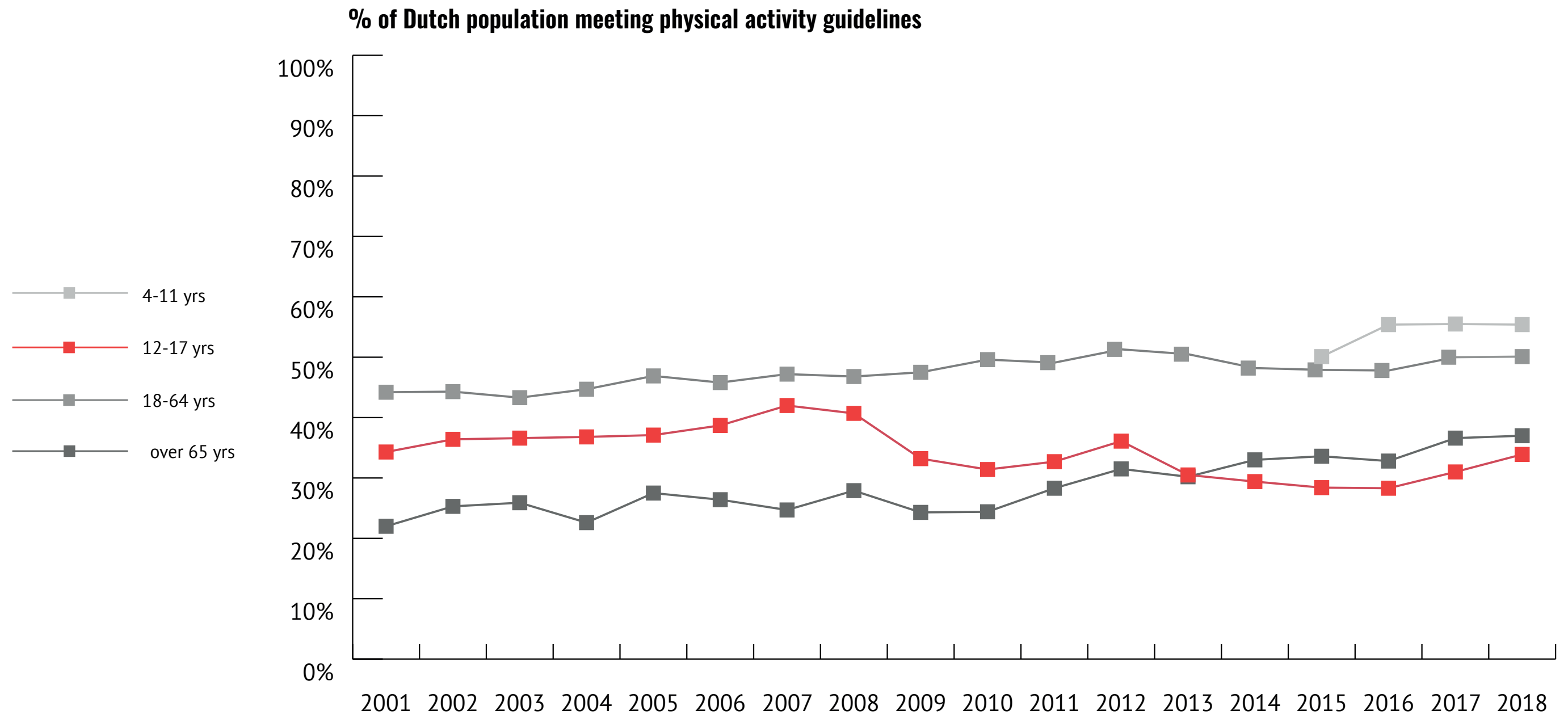


1 uur per dag
matig intensief bewegen



3x per week
spier- en botversterkende
activiteiten

Adolescent population is too inactive



Based on data from CBS & RIVM, 2018; CBS, 2019.

Physical activity research shows inconsistencies



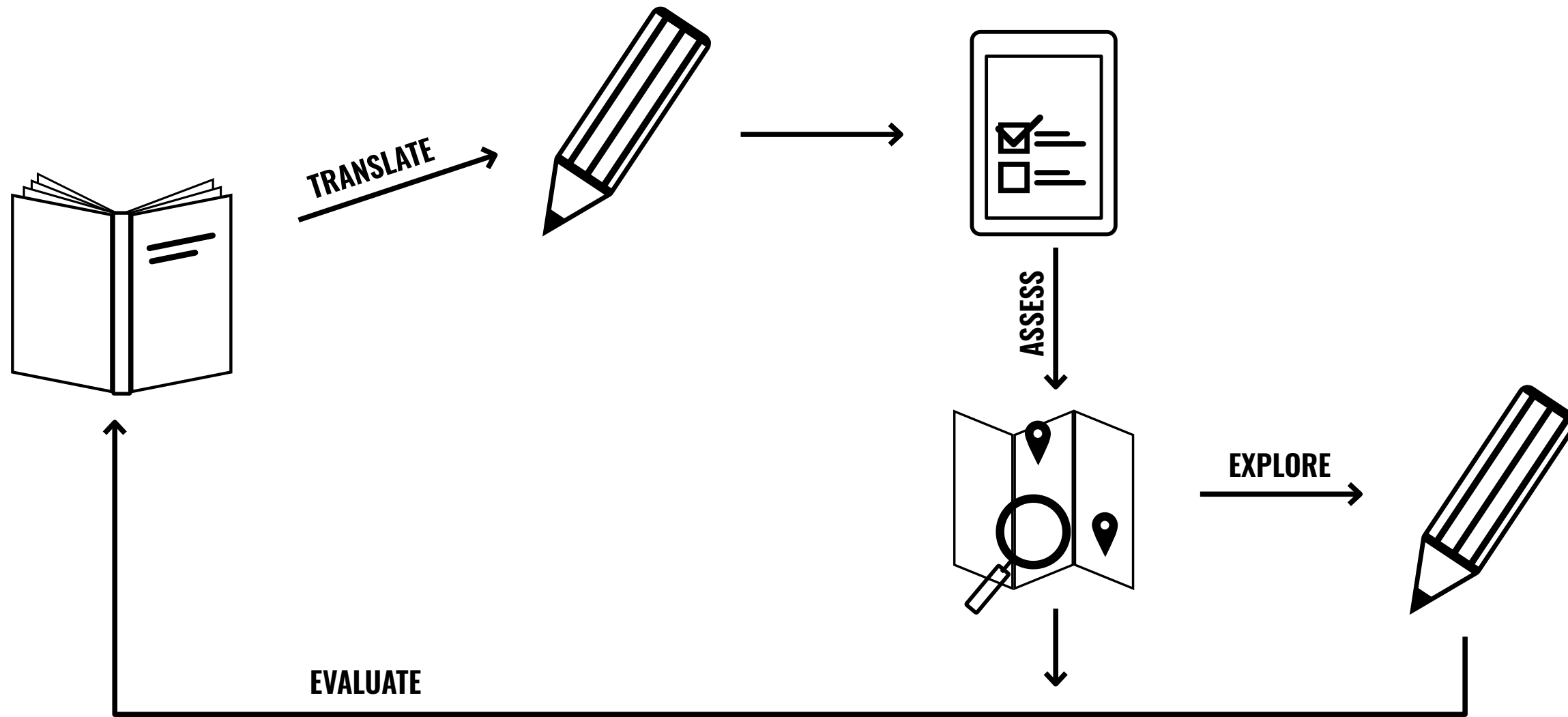
How can the public space in Westland, the Netherlands, be adapted to better meet the spatial demands of adolescents for physical activity behaviour?

Urban Design for Physical Activity

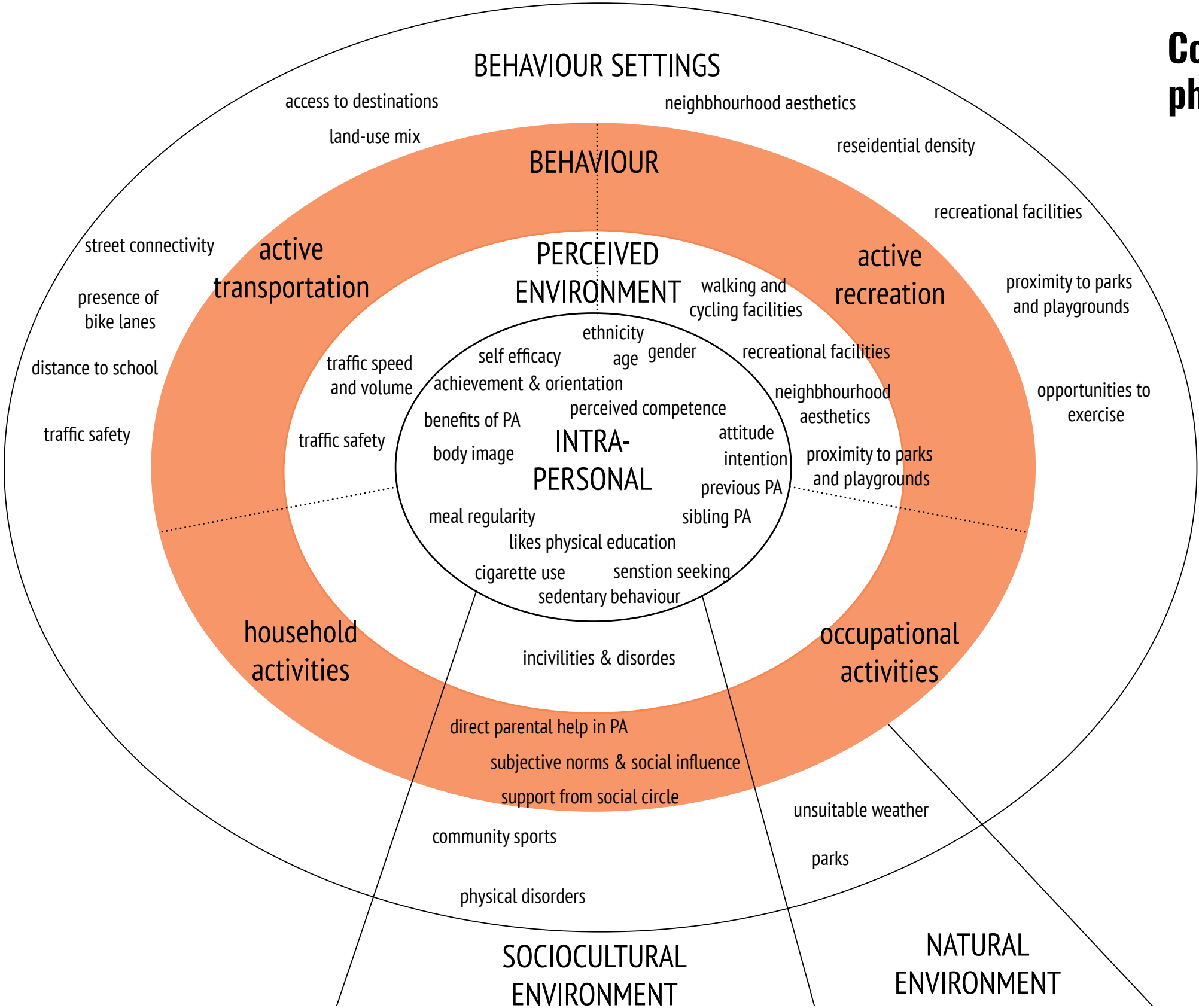
An exploration of the use of quantitative statistics to determine the role of the urban design of public space in stimulating adolescents to be more physically active in Westland, the Netherlands

Graduation
p r e s e n t a t i o n

Susanne van Rijn
November 19, 2020



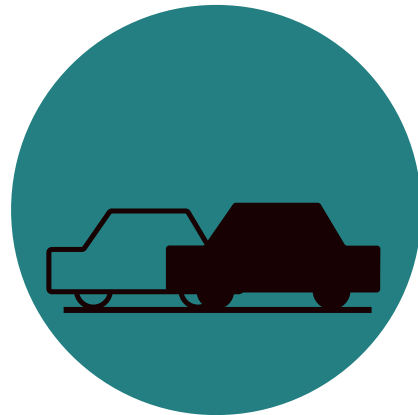
Complexity of (adolescent) physical activity behaviour



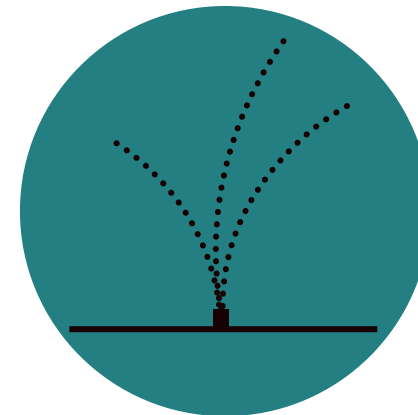
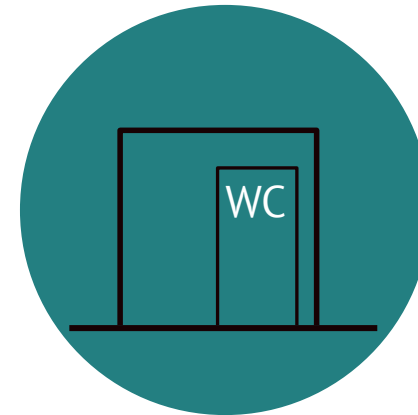
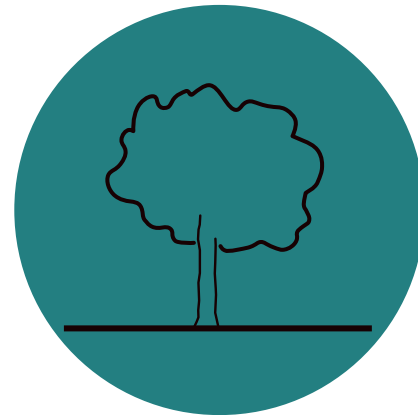
(based on Ding, Sallis, Kerr, Lee, & Rosenberg, 2011; Davison & Lawson, 2006; Sallis, Prochaska, & Taylor, 2000)

Spatial attributes

direct surroundings of the public space



structure and quality of the public space itself



(perceived) safety



Spatial attributes | Proximity to home



more than a five minute ←————→ less than a five minute walk



Spatial attributes | Physical barriers



roads you have to wait for to cross \longleftrightarrow only small roads around the public space



Spatial attributes | Opportunities for physical activity



little to no opportunities to be active \longleftrightarrow a lot of opportunities to be active



Spatial attributes | Paths through public space



only paths around public space \longleftrightarrow paths around and through public space





little to no vegetation and little variety ←————→ **a lot of vegetation and high variety**



Spatial attributes | Water features



absent \longleftrightarrow present

Spatial attributes | Seating facilities



absent \longleftrightarrow present

Spatial attributes | Public toilets



absent \longleftrightarrow present

(Hering, n.d.)



Spatial attributes | Secluded areas



there are places where you are invisible \longleftrightarrow you are visible throughout the entire public space



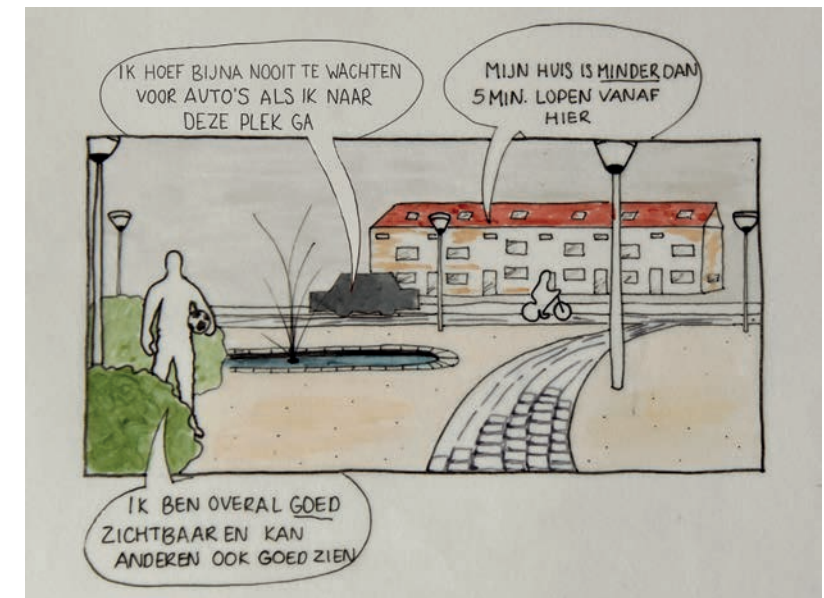
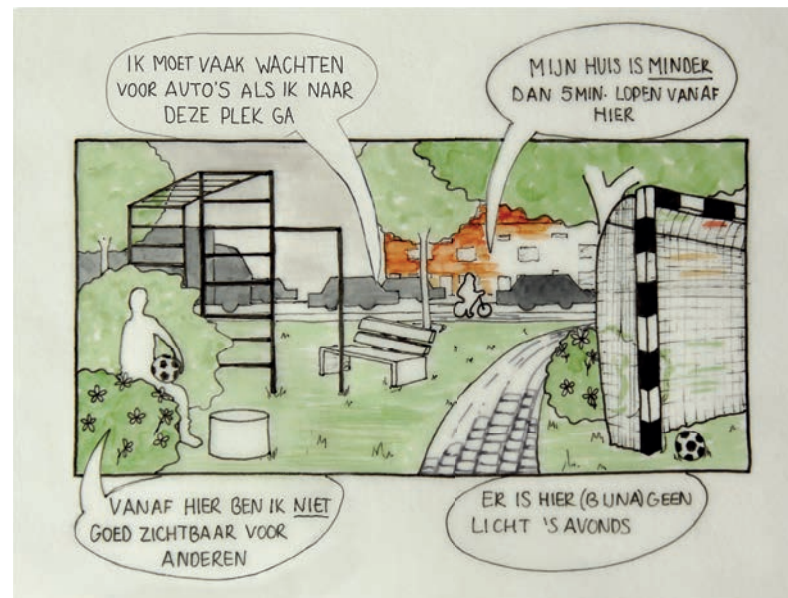
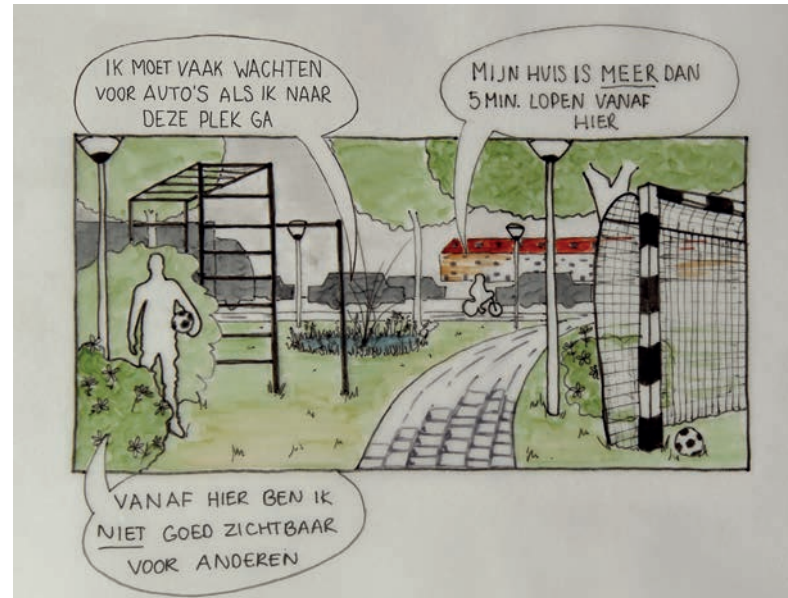
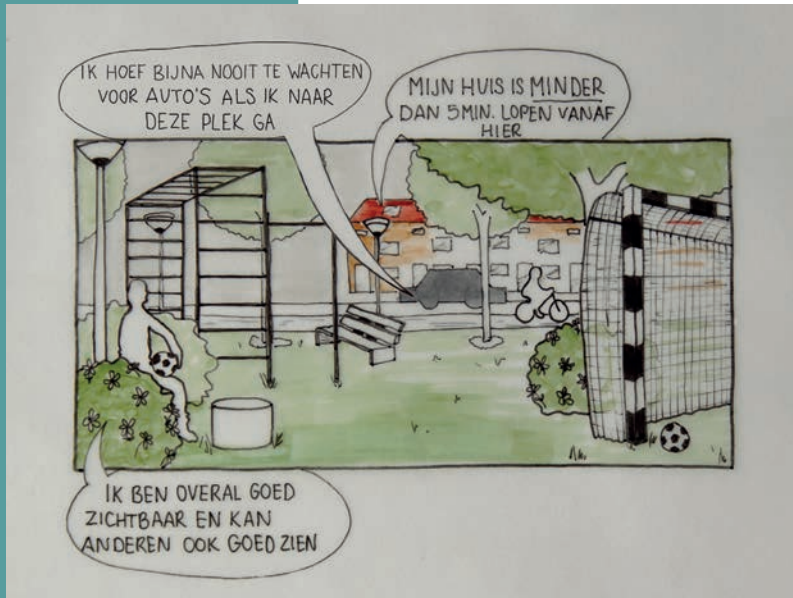
Spatial attributes | Lighting in public space



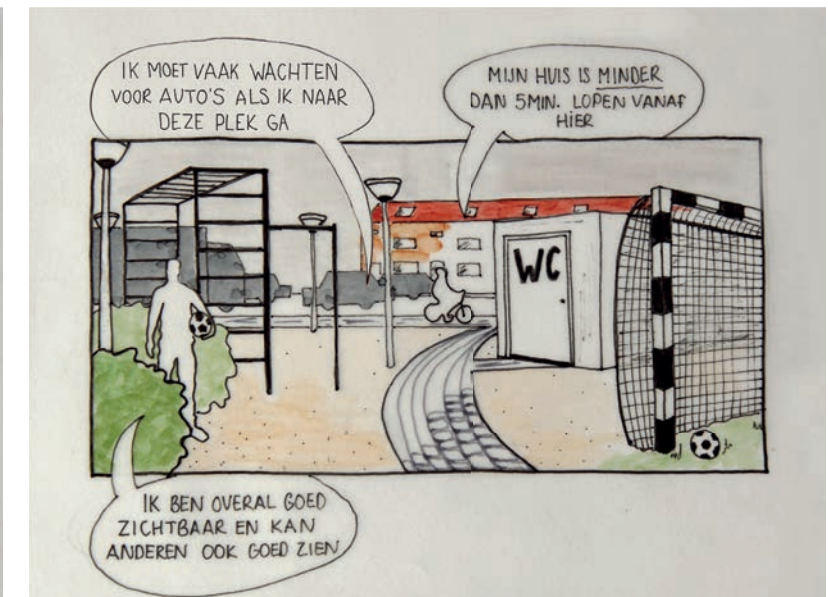
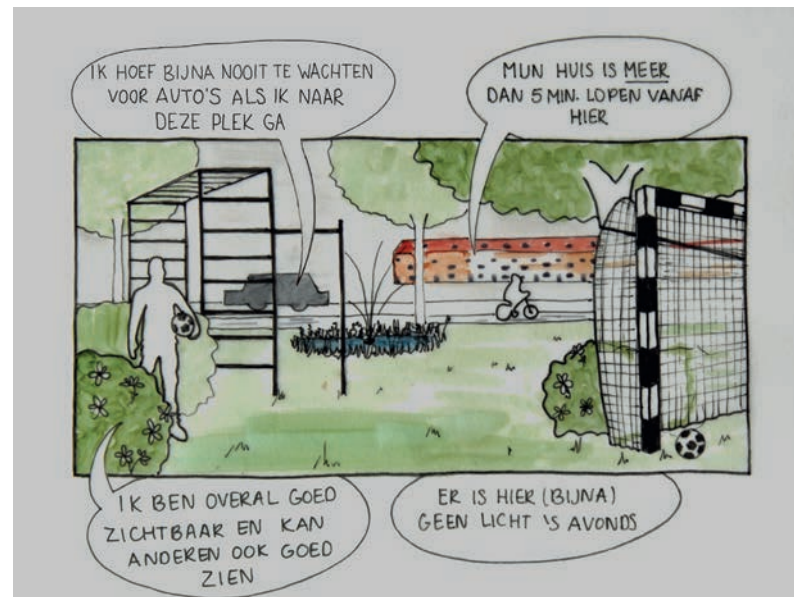
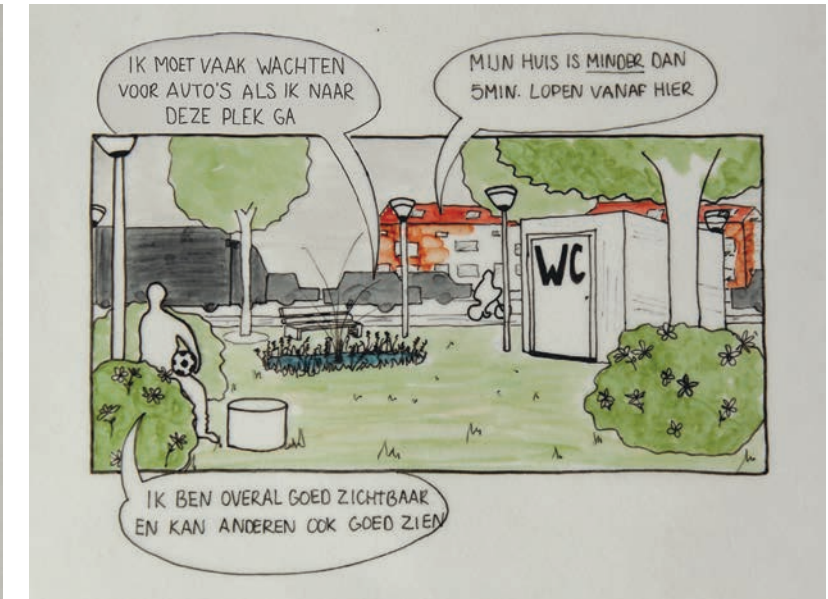
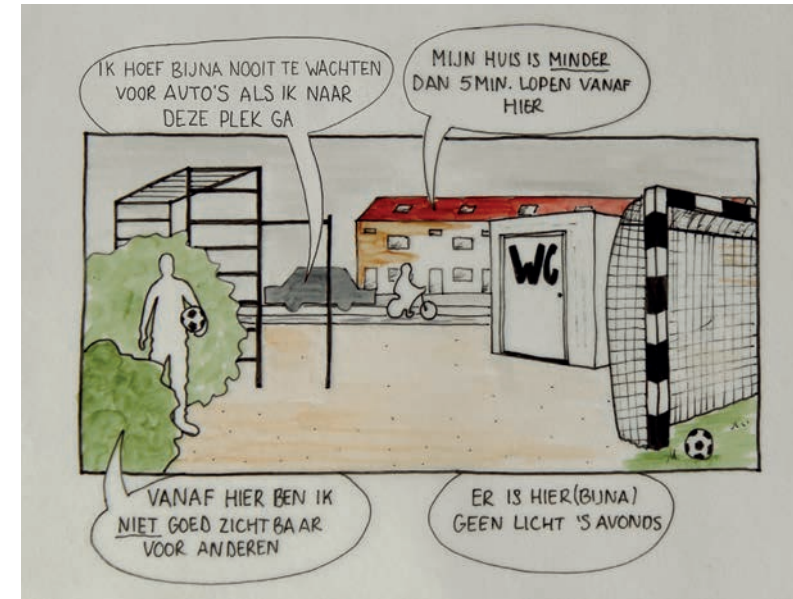
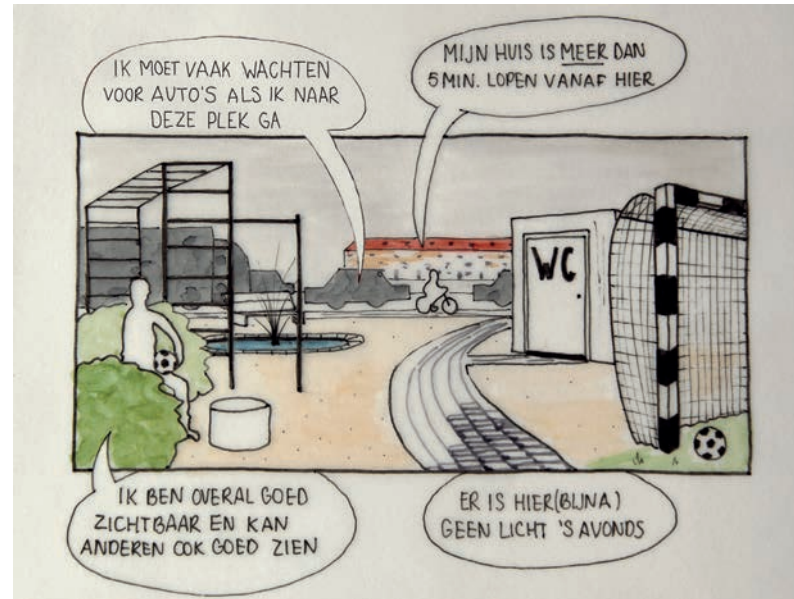
a large share of the public space has no lighting \longleftrightarrow the entire space is well-lit



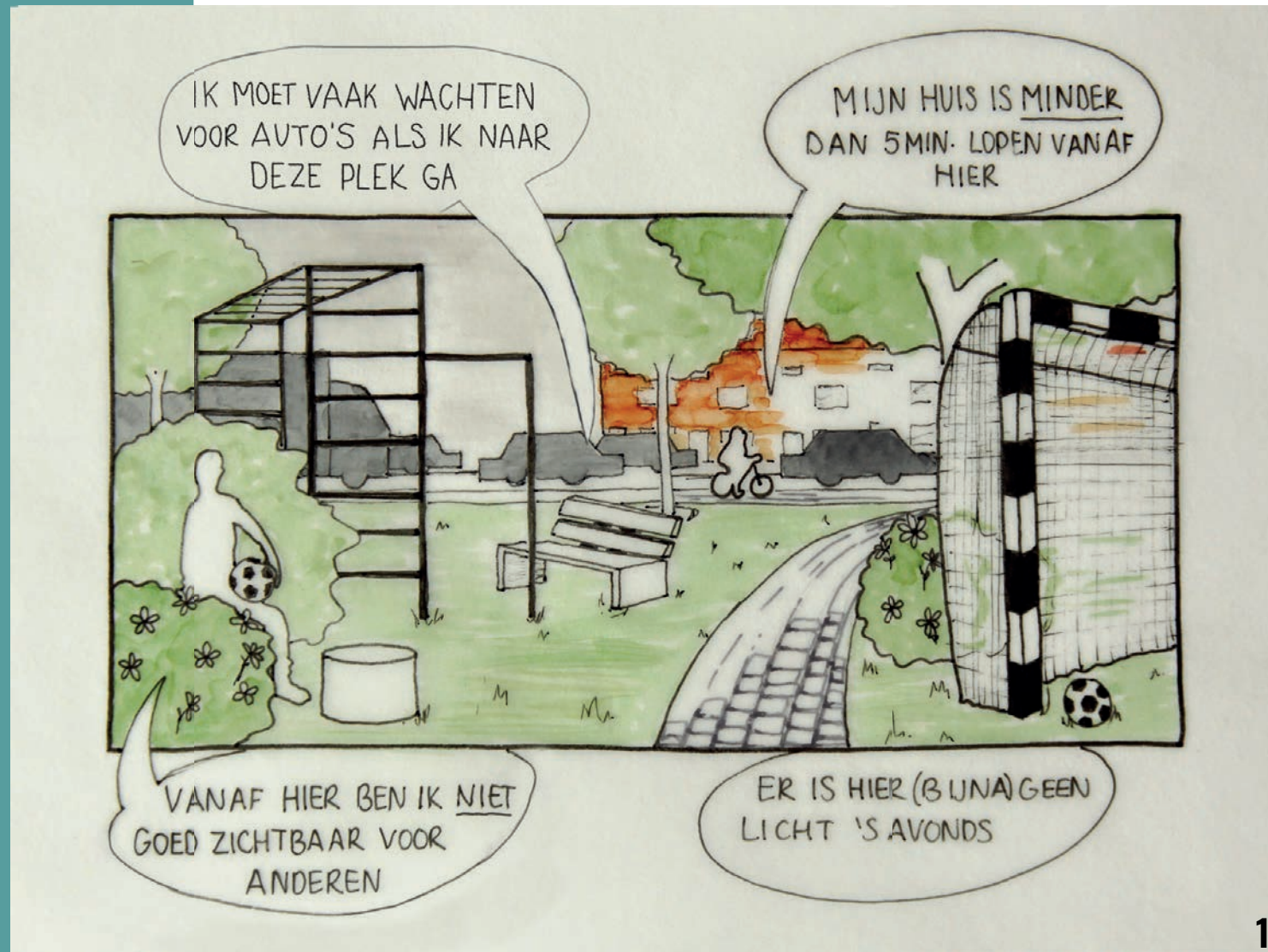
Representation of public space for conjoint experiment



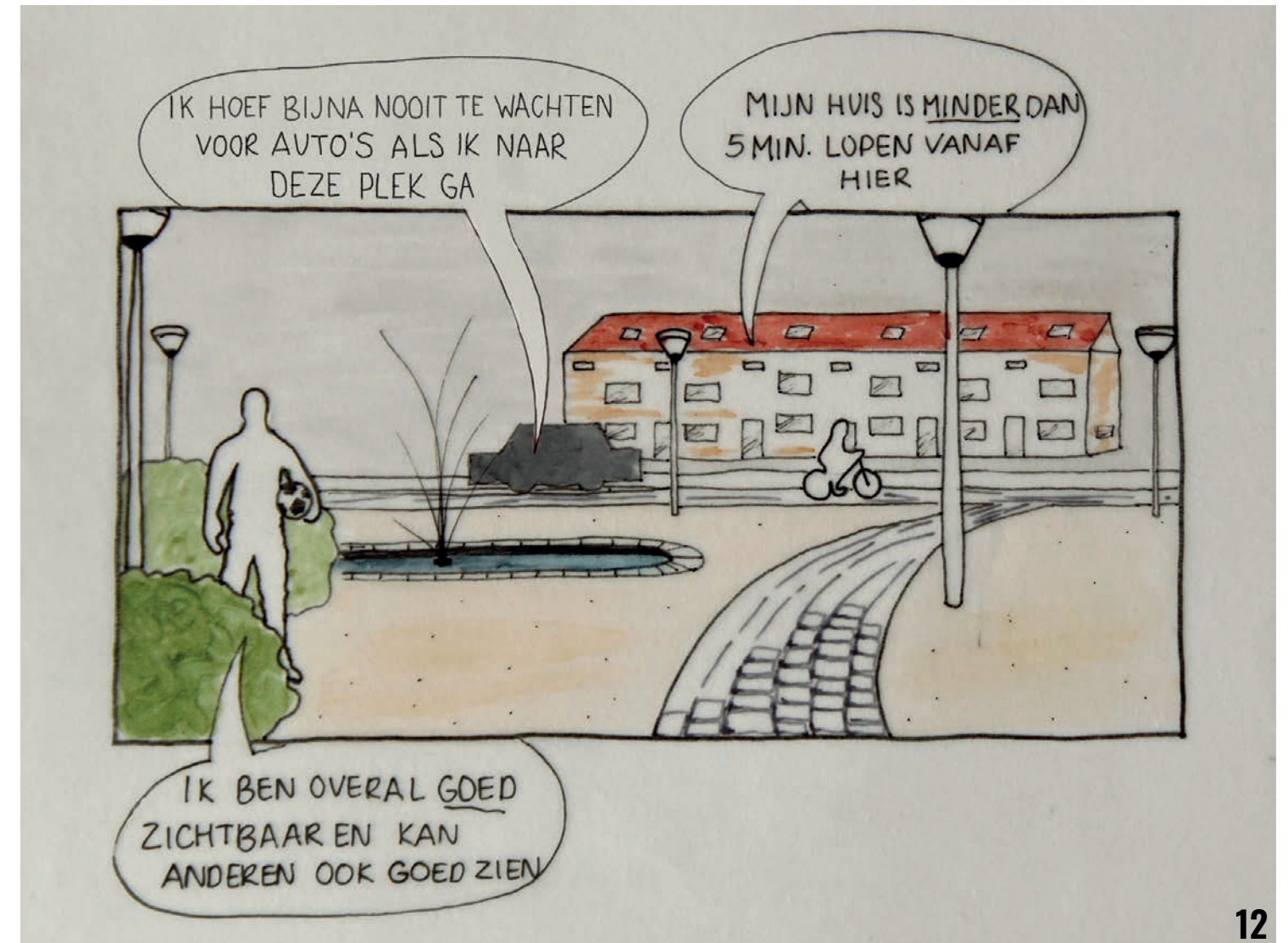
Representation of public space for conjoint experiment



Which one do you prefer to be active in?



Conjoint experiment as part of the survey



- A. profile 1
- B. profile 12
- C. neither one of those

1 | Relative importance of each alternative

2 | Relative importance of each spatial attribute

3 | Total utility of each alternative

Alternative	Name	β	Significance
No choice	ASC_P0	0 (fixed value)	
4	ASC_P4	1.6	2.22E-09*
15	ASC_P15	1.54	4.72E-08*
3	ASC_P3	1.5	3.81E-08*
1	ASC_P1	1.48	1.23E-08*
9	ASC_P9	1.46	8.82E-08*
6	ASC_P6	1.45	0.000000172*
5	ASC_P5	1.39	9.35E-08*
7	ASC_P7	1.38	0.000000125*
12	ASC_P12	1.35	0.000000241*
2	ASC_P2	1.33	0.000000116*

1 |

Sample	309		
Rhosquared	0.223		
Attribute	Level	β	Significance
Vegetation	little to no green and little variety	-0.403	0.000000846*
Opportunities for physical activity	little to no opportunities to be active	-0.368	0.0000142*
Physical barriers	only small roads alongside the public space (no waiting time)	0.255	0.00275*
Proximity	home is further away than a 5 minute walk	-0.169	0.0458*
Lighting	the entire public space is well-lit	0.152	0.0733*
Water	water features present	-0.125	0.123
Secluded areas	people are visible throughout the entire public space	0.097	0.239
Paths	paths only around the public space	0.0617	0.463
Seating	seating facilities absent	0.0492	0.556
Toilets	public toilet facilities present	-0.0133	0.871

2 |

Alternative	Utility function	Utility value
15	V15	3.134733557
3	V3	2.297958496
1	V1	1.938157049
4	V4	1.87997421
11	V11	1.625244874
5	V5	1.621321596
13	V13	1.469123792
2	V2	1.398821022
7	V7	1.359599719
16	V16	1.256977203
12	V12	1.120733744

3 |

**Results of the conjoint experiment
sample = 309**



0.403**

Presence and variety of vegetation



0.368**

Presence of opportunities to be active



0.255**

Absence of roads to wait for



0.169**

Home within walking distance



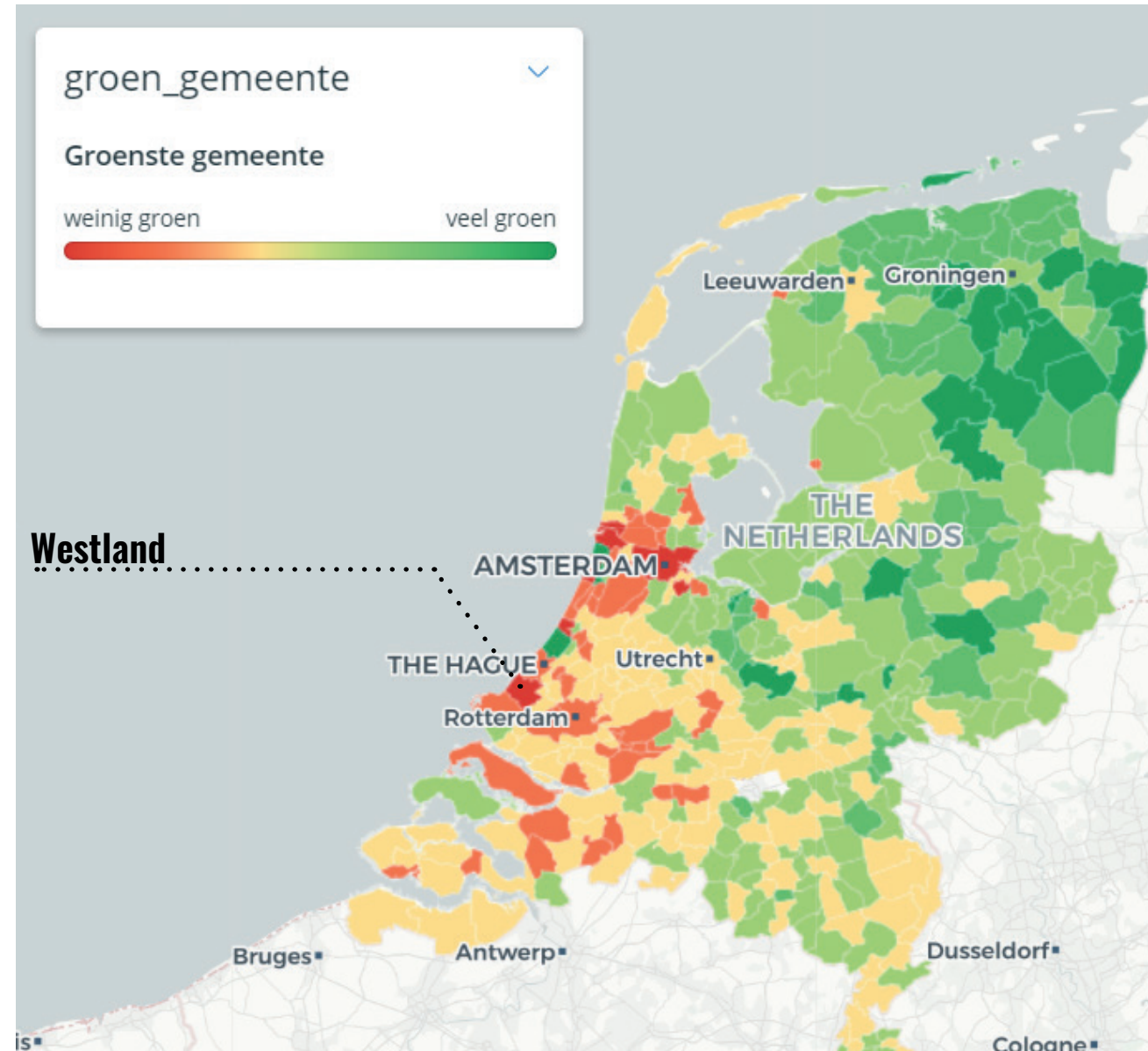
0.152*

Presence of lighting

* significant with $p < 0.1$ ** significant with $p < 0.05$

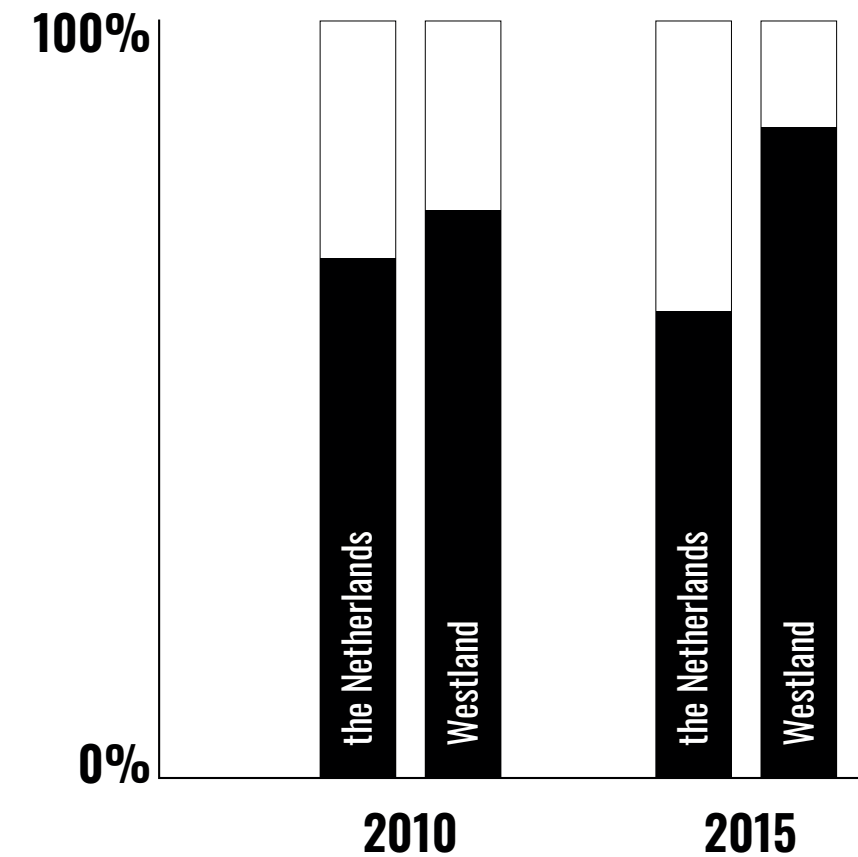
Case: Westland, the Netherlands

Westland least green municipality in the Netherlands



(Wageningen UR, Carto, & RTL, 2017)

adolescents in Westland are less active than average

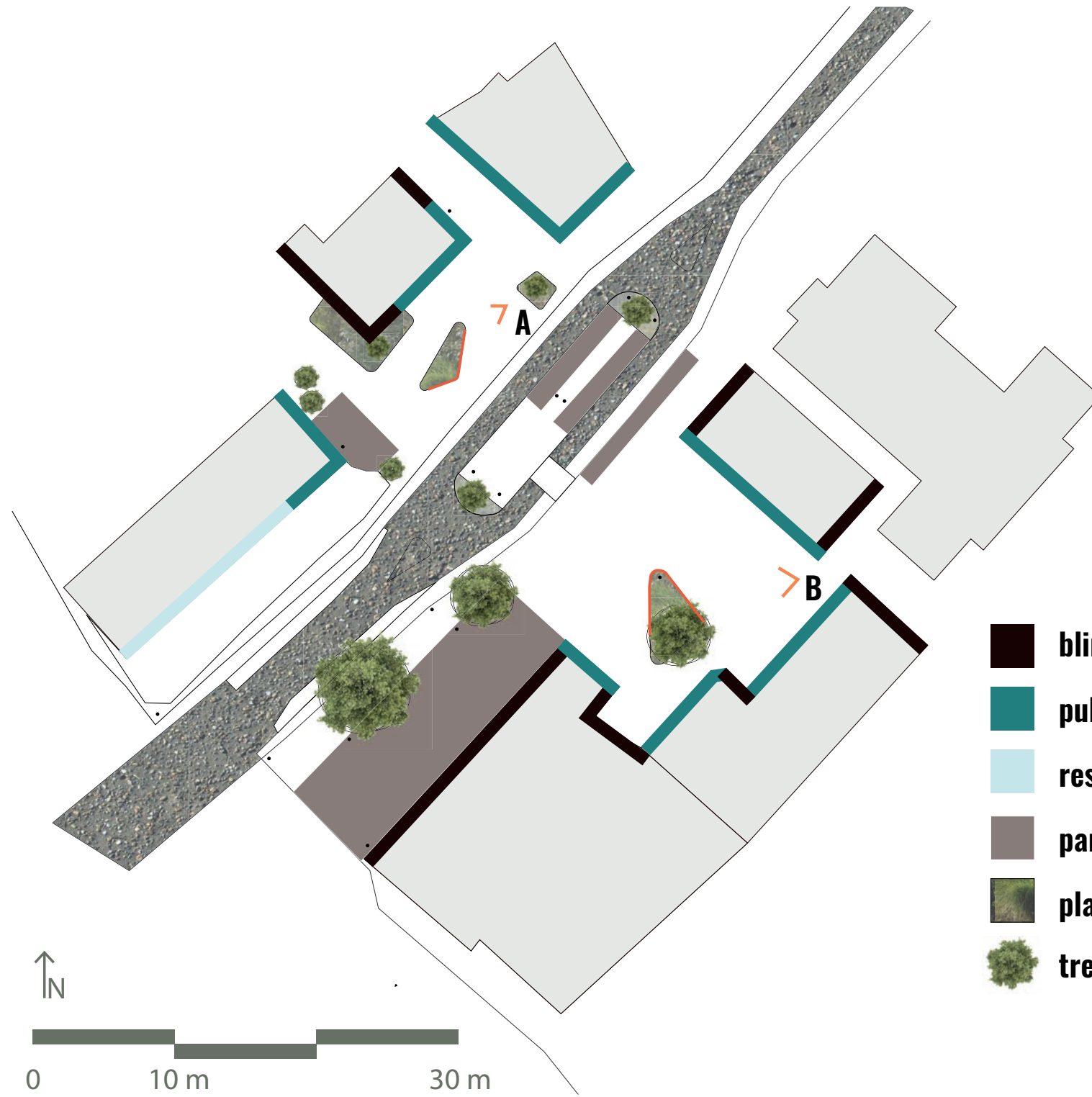


(based on Keetman, Veltman, Dekkers, Rooseboom de Vries, & Berns, 2016; CBS & RIVM, 2018)

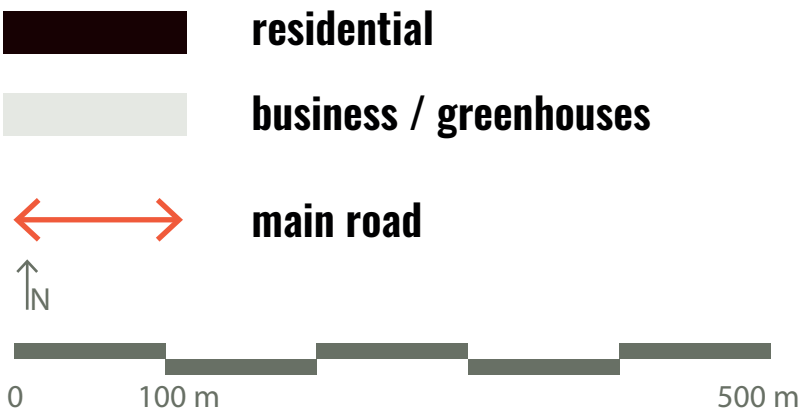
Selection of public space for transformation within Westland



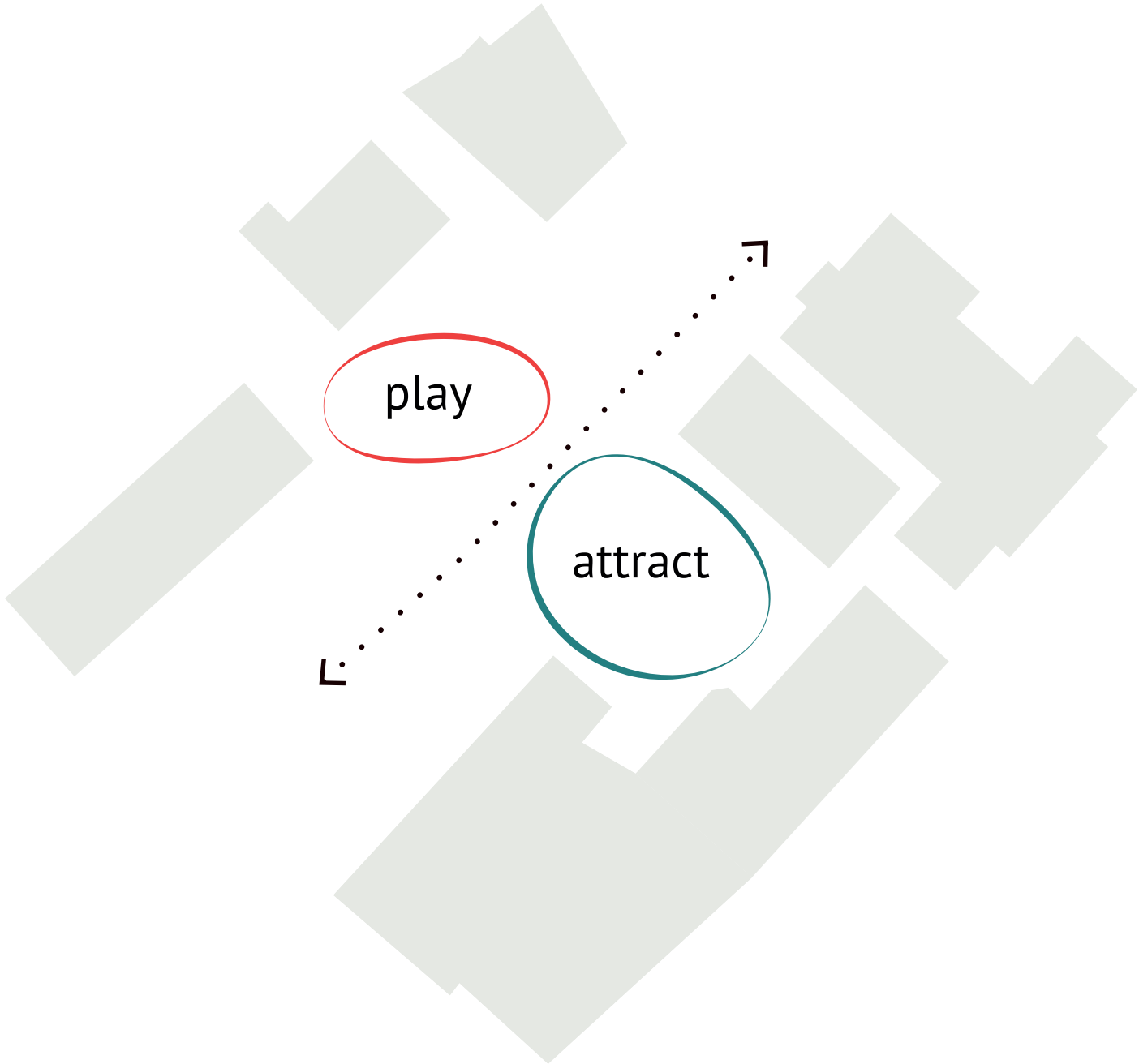
Fitness for adolescent physical activity | Facilities



Fitness for adolescent physical activity | Proximity and physical barriers



Transformation of public space | Concept



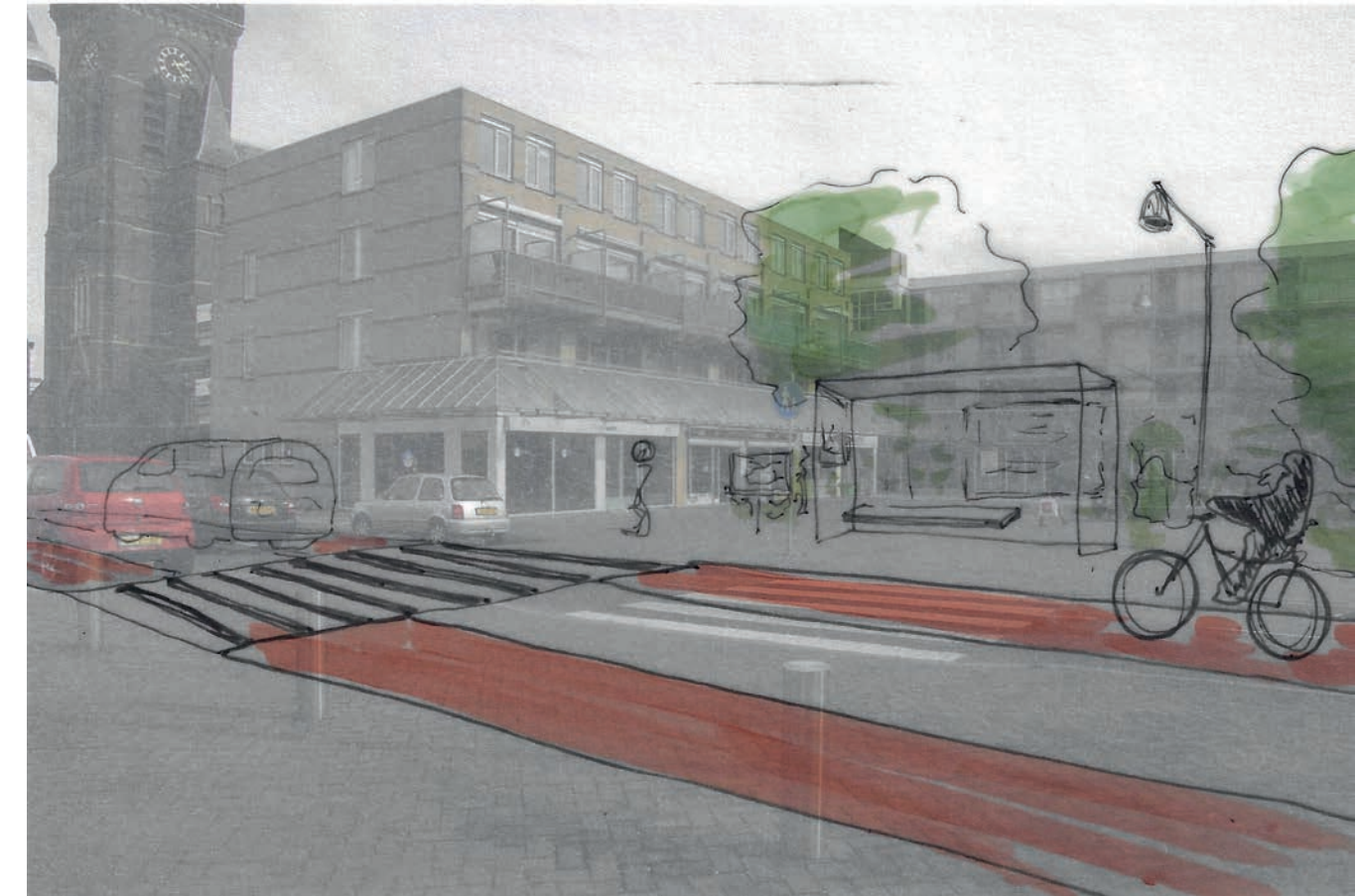
Decrease negative impact of road

Increase opportunities to be active



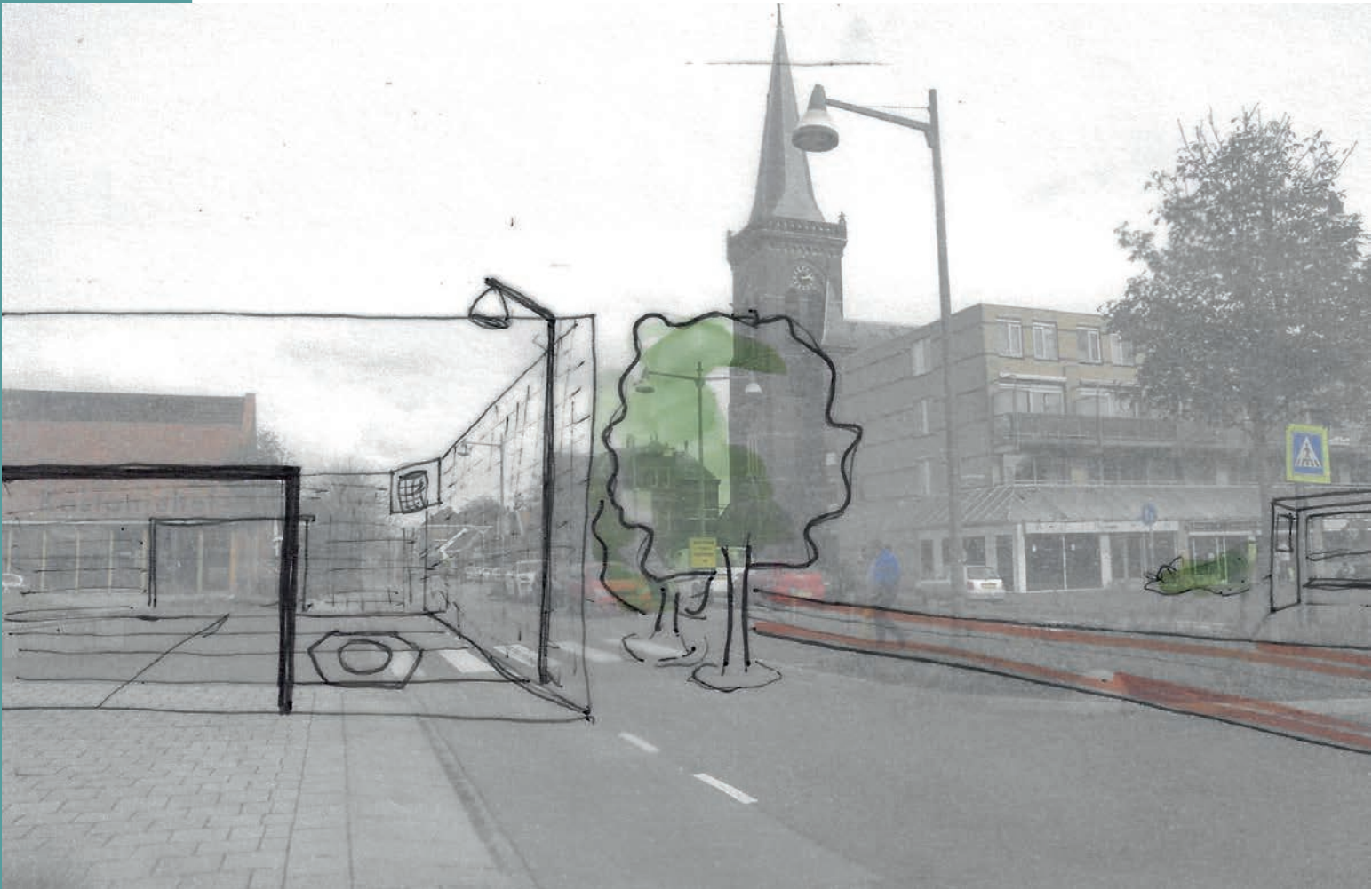
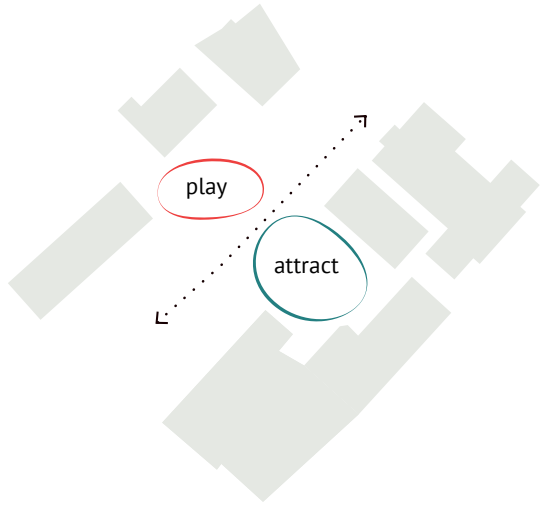
-  tarmac road
-  cycling path
-  brick pavement
-  vegetation
-  parking
-  bus stop
-  lighting
-  seating

Decrease negative impact of road

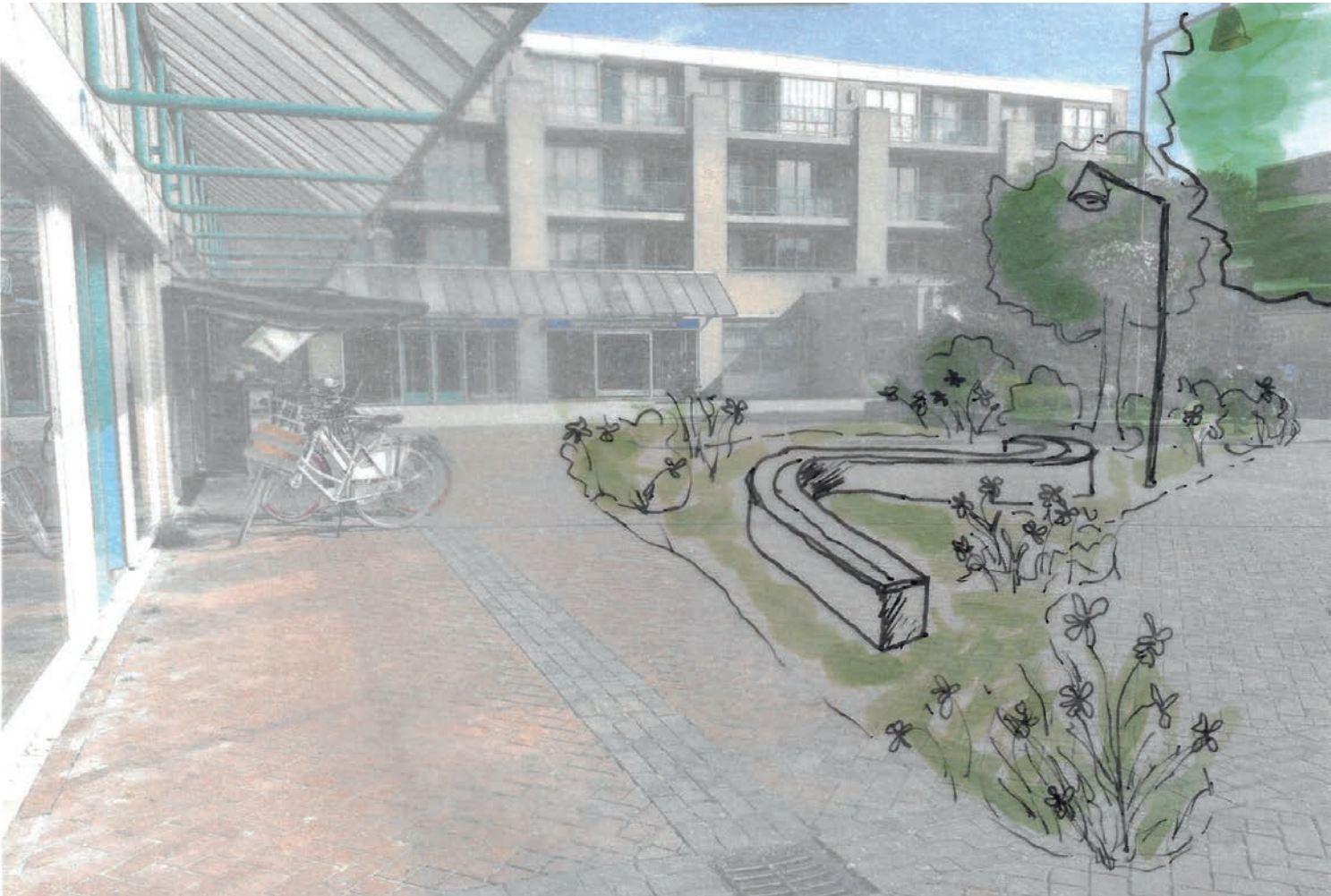


road has same appearance as rest of the square

Increase opportunities to be active



add multifunctional sports field close to community center





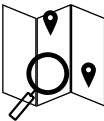
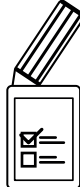

adding green space to make attractive and a destination

How can the public space in Westland, the Netherlands, be adapted to better meet the spatial demands of adolescents for physical activity behaviour?

- **choice based conjoint analysis as a method to create input for urban design**
- **embed transformation in local conditions of the space**
- **new and existing urban fabric ask for different approaches**

thank you

How can the public space in Westland, the Netherlands, be adapted to better meet the spatial demands of adolescents for physical activity behaviour?

	sub question	objective		method	outcome
THEORY	(1) What spatial aspects of the public space are related to adolescent physical activity behaviour?	(1) identify spatial dimension of physical activity behaviour (2) develop understanding of complexity of physical activity behaviour		literature review on (1) adolescent physical activity behaviour and (2) environmental correlates of adolescent physical activity behaviour	(1) adapted ecological model explaining variables influencing adolescent physical activity behaviour and (2) collection of spatial aspects to analyse and design with
	(2) How can green public space influence physical activity behaviour?	inform survey, spatial analysis, and design recommendations			
CONTEXT	(3) How can choice based conjoint analysis help define important spatial aspects of adolescent physical activity behaviour?	to explore if choice based conjoint analysis can be used and how it can be implemented in urban design		digital survey among adolescents	concluding remarks on use of choice based conjoint analysis in urban research and design
	(4) How does the selected public space facilitate or hinder adolescent physical activity behaviour?	assess selected space		spatial analysis of spatial attributes defined in sub questions 1 and 2 using maps and photographs	collection of maps, drawings, and photographs for a variety of types of public space, showing the current state and its fitness for adolescent physical activity behaviour
	(5) What spatial attributes could motivate adolescents to become more physically active in outdoor public space?	identify specific spatial aspects important in this context		survey on spatial demands to use public space to be physically active, using research by design; informed by sub question 2	conclusion on relative importance of spatial attributes for adolescent physical activity behaviour
INTERVENTION	(6) How can a specific public space in Westland be adapted conform the research findings to better accommodate adolescent physical activity behaviour?	visualise and communicate possibilities to intervene in public space		research by design, informed by user preferences and prior studies	transformation of existing public space and derived general recommendations

EXTRA | Set up conjoint experiment

Composition of profiles based on Basic Plan #3 by Addelman as used in Steenkamp (1985)

attribute	profile	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
vegetation		0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	1	0
physical barriers		0	0	1	1	0	0	1	1	0	0	1	1	0	0	1	1	1	0
opportunities PA		0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1
cycling and walking paths		0	1	1	0	0	1	1	0	0	1	1	0	0	1	1	0	1	0
proximity to home		0	0	1	1	0	0	1	1	1	1	0	0	1	1	0	0	1	0
lighting		0	1	0	1	1	0	1	0	0	1	0	1	1	0	1	0	1	0
secluded areas		0	1	1	0	1	0	0	1	1	0	0	1	0	1	1	0	1	0
water features		0	1	1	0	0	1	1	0	1	0	0	1	1	0	0	1	1	0
seating		0	0	1	1	1	1	0	0	0	0	1	1	1	1	0	0	1	0
public toilets		0	1	0	1	1	0	1	0	1	0	1	0	0	1	0	1	0	1

Attribute levels and randomised coding

vegetation in the public space [VEGETATION]

- 1 = a lot of vegetation and variation
- 1 = no to little vegetation; little variation

physical barriers [BARRIERS]

- 1 = roads around public space that people have to wait for to cross
- 1 = small and quiet roads only surrounding the public space

opportunities to engage in physical activities [OPPORTUNITIES_PA]

- 1 = a lot of different opportunities
- 1 = little to no opportunities

cycling or walking paths [PATHS]

- 1 = cycling and walking paths surrounding and through the public space
- 1 = cycling and walking paths surrounding the public space only

proximity to home [PROXIMITY]

- 1 = less than a 5 min walk
- 1 = more than a 5 min walk

lighting in the public space [LIGHTING]

- 1 = a large share of the space has no lighting
- 1 = the entire public space is well-lit

secluded areas in the public space [SECLUDED_AREAS]

- 1 = there are places where you are invisible for the surroundings
- 1 = from all places you are visible from the surroundings

water features in the public space [WATER]

- 1 = absent
- 1 = present

seating in the public space [SEATING]

- 1 = present
- 1 = absent

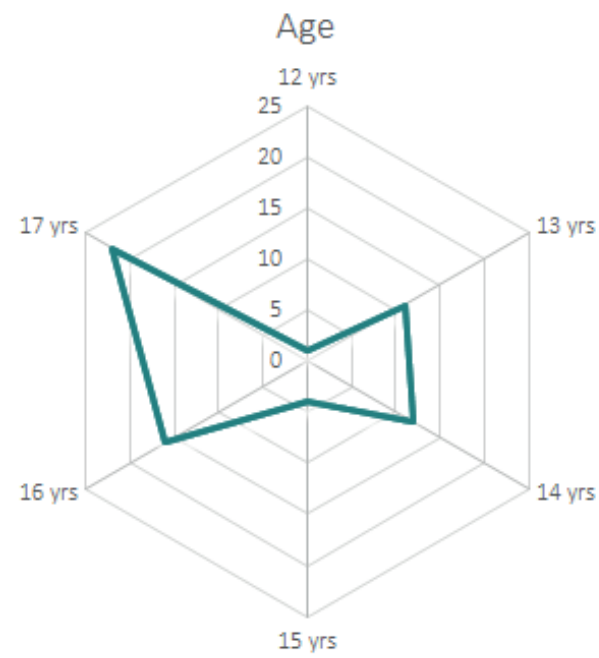
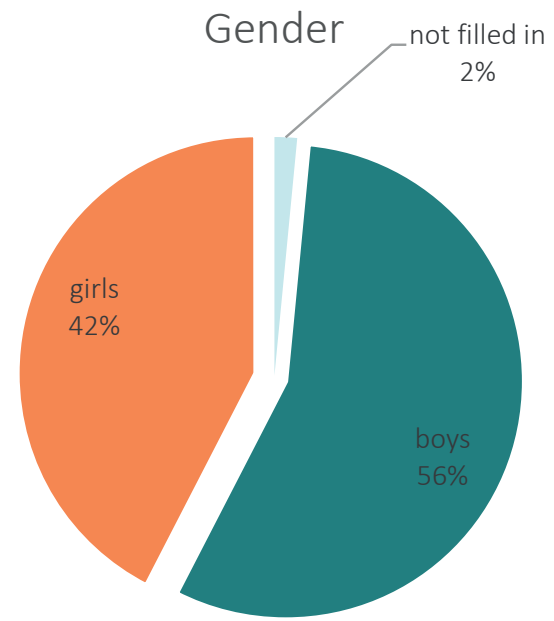
public toilets in the public space [TOILETS]

- 1 = absent
- 1 = present

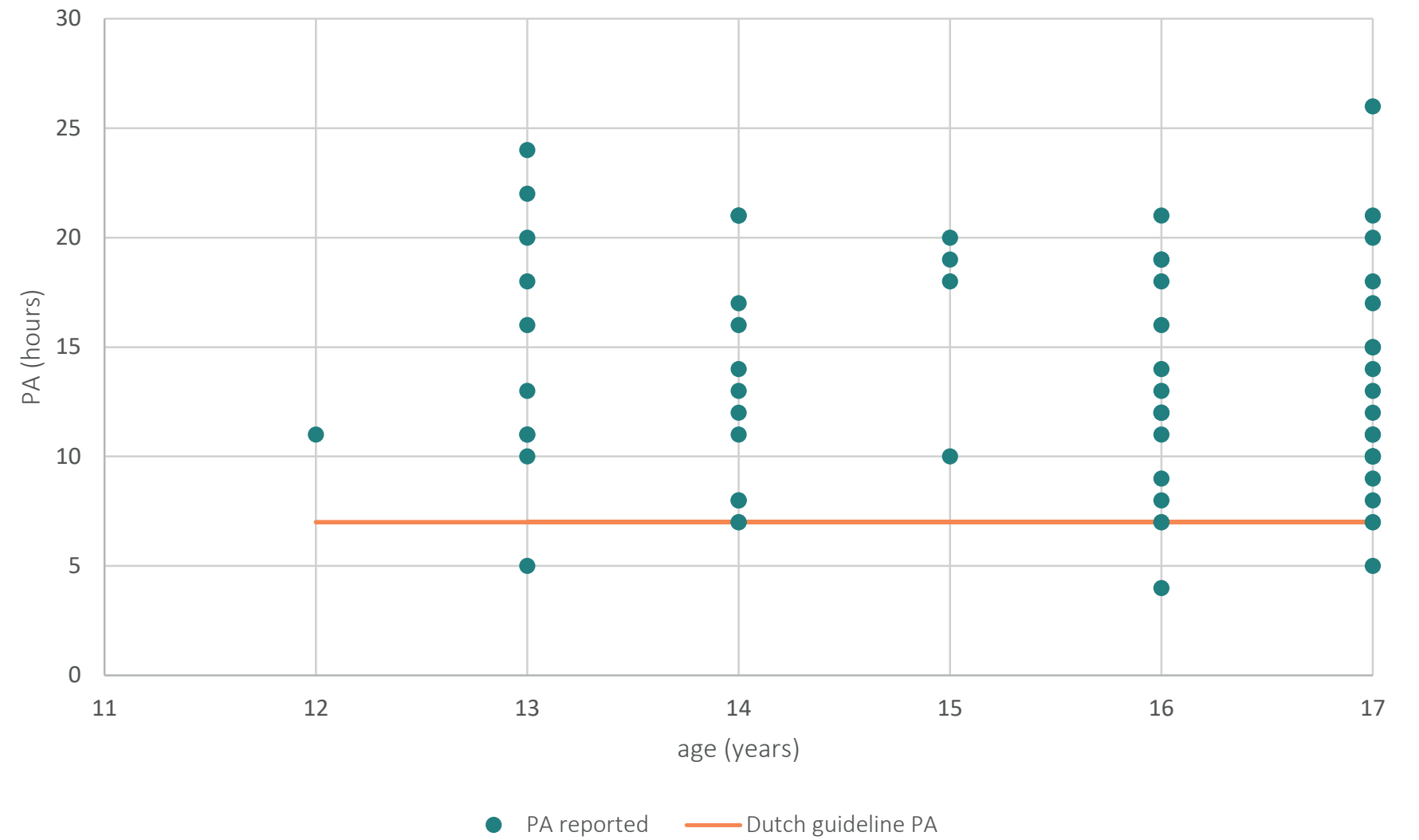
EXTRA | Profiles for conjoint experiment

profiles >	1	2	3	4	5	6	7	8
VEGETATION	veel groen + variatie	veel groen + variatie	veel groen + variatie	veel groen + variatie	weinig tot geen groen, weinig variatie	weinig tot geen groen, weinig variatie	weinig tot geen groen, weinig variatie	weinig tot geen groen, weinig variatie
BARRIERS	fysieke barrières op je route	fysieke barrières op je route	alleen kleine wegen, niet wachten	alleen kleine wegen, niet wachten	fysieke barrières op je route	fysieke barrières op je route	alleen kleine wegen, niet wachten	alleen kleine wegen, niet wachten
OPPORTUNITIES_PA	veel verschillende mogelijkheden	weinig tot geen beweegmogelijkheden	veel verschillende mogelijkheden	weinig tot geen beweegmogelijkheden	veel verschillende mogelijkheden	weinig tot geen beweegmogelijkheden	veel verschillende mogelijkheden	weinig tot geen beweegmogelijkheden
PATHS	wandel- en fietspaden rondom én door OR	alleen wandel- en fietspaden rondom OR	alleen wandel- en fietspaden rondom OR	wandel- en fietspaden rondom én door OR	wandel- en fietspaden rondom én door OR	alleen wandel- en fietspaden rondom OR	alleen wandel- en fietspaden rondom OR	wandel- en fietspaden rondom én door OR
PROXIMITY	huis is dichtbij	huis is dichtbij	huis is ver weg	huis is ver weg	huis is dichtbij	huis is dichtbij	huis is ver weg	huis is ver weg
LIGHTING	grote delen onverlicht er zijn plaatsen waar je onzichtbaar bent vanuit de omgeving	de hele OR is goed verlicht je bent overal goed zichtbaar vanuit de omgeving	grote delen onverlicht je bent overal goed zichtbaar vanuit de omgeving	de hele OR is goed verlicht er zijn plaatsen waar je onzichtbaar bent vanuit de omgeving	de hele OR is goed verlicht je bent overal goed zichtbaar vanuit de omgeving	grote delen onverlicht er zijn plaatsen waar je onzichtbaar bent vanuit de omgeving	de hele OR is goed verlicht er zijn plaatsen waar je onzichtbaar bent vanuit de omgeving	grote delen onverlicht je bent overal goed zichtbaar vanuit de omgeving
SECLUDED_AREAS	afwezig	aanwezig	aanwezig	afwezig	afwezig	aanwezig	aanwezig	afwezig
SEATING	aanwezig	aanwezig	afwezig (grasveld telt hier niet als zitelement)	afwezig (grasveld telt hier niet als zitelement)	afwezig (grasveld telt hier niet als zitelement)	afwezig (grasveld telt hier niet als zitelement)	aanwezig	aanwezig
TOILETS	afwezig	aanwezig	afwezig	aanwezig	aanwezig	afwezig	aanwezig	afwezig
profiles >	9	10	11	12	13	14	15	16
VEGETATION	weinig tot geen groen, weinig variatie	weinig tot geen groen, weinig variatie	weinig tot geen groen, weinig variatie	weinig tot geen groen, weinig variatie	veel groen + variatie	veel groen + variatie	veel groen + variatie	veel groen + variatie
BARRIERS	fysieke barrières op je route	fysieke barrières op je route	alleen kleine wegen, niet wachten	alleen kleine wegen, niet wachten	fysieke barrières op je route	fysieke barrières op je route	alleen kleine wegen, niet wachten	alleen kleine wegen, niet wachten
OPPORTUNITIES_PA	veel verschillende mogelijkheden	weinig tot geen beweegmogelijkheden	veel verschillende mogelijkheden	weinig tot geen beweegmogelijkheden	veel verschillende mogelijkheden	weinig tot geen beweegmogelijkheden	veel verschillende mogelijkheden	weinig tot geen beweegmogelijkheden
PATHS	wandel- en fietspaden rondom én door OR	alleen wandel- en fietspaden rondom OR	alleen wandel- en fietspaden rondom OR	wandel- en fietspaden rondom én door OR	wandel- en fietspaden rondom én door OR	alleen wandel- en fietspaden rondom OR	alleen wandel- en fietspaden rondom OR	wandel- en fietspaden rondom én door OR
PROXIMITY	huis is ver weg	huis is ver weg	huis is dichtbij	huis is dichtbij	huis is ver weg	huis is ver weg	huis is dichtbij	huis is dichtbij
LIGHTING	grote delen onverlicht je bent overal goed zichtbaar vanuit de omgeving	de hele OR is goed verlicht er zijn plaatsen waar je onzichtbaar bent vanuit de omgeving	grote delen onverlicht er zijn plaatsen waar je onzichtbaar bent vanuit de omgeving	de hele OR is goed verlicht je bent overal goed zichtbaar vanuit de omgeving	de hele OR is goed verlicht er zijn plaatsen waar je onzichtbaar bent vanuit de omgeving	grote delen onverlicht je bent overal goed zichtbaar vanuit de omgeving	de hele OR is goed verlicht er zijn plaatsen waar je onzichtbaar bent vanuit de omgeving	grote delen onverlicht er zijn plaatsen waar je onzichtbaar bent vanuit de omgeving
SECLUDED_AREAS	aanwezig	afwezig	afwezig	aanwezig	aanwezig	afwezig	afwezig	aanwezig
SEATING	aanwezig	aanwezig	afwezig (grasveld telt hier niet als zitelement)	afwezig (grasveld telt hier niet als zitelement)	afwezig (grasveld telt hier niet als zitelement)	afwezig (grasveld telt hier niet als zitelement)	aanwezig	aanwezig
TOILETS	aanwezig	afwezig	aanwezig	afwezig	afwezig	aanwezig	afwezig	aanwezig

Survey sample | EXTRA



Duration of physical activity in hours per week



Relative importance of spatial attributes | EXTRA

Sample	309		
Rhosquared	0.223		
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Vegetation	little to no green and little variety	-0.403	0.000000846*
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Seating	seating facilities absent	0.0492	0.556
Toilets	public toilet facilities present	-0.0133	0.871

β -coefficients of each attribute with corresponding attribute level. * = $p < 0.1$

Relative importance of alternatives | EXTRA

Alternative	Name	β	Significance
No choice	ASC_P0	0 (fixed value)	
4	ASC_P4	1.6	2.22E-09*
15	ASC_P15	1.54	4.72E-08*
3	ASC_P3	1.5	3.81E-08*
1	ASC_P1	1.48	1.23E-08*
9	ASC_P9	1.46	8.82E-08*
6	ASC_P6	1.45	0.000000172*
5	ASC_P5	1.39	9.35E-08*
7	ASC_P7	1.38	0.000000125*
12	ASC_P12	1.35	0.000000241*
2	ASC_P2	1.33	0.00000116*
10	ASC_P10	1.3	0.00000342*
16	ASC_P16	1.3	0.00000118*
14	ASC_P14	1.28	0.00000082*
11	ASC_P11	1.26	0.00000172*
8	ASC_P8	1.21	0.0000109*
13	ASC_P13	1.19	0.00000672*

β -coefficients of alternatives as compared to the no choice alternative.

Calculated utility | EXTRA



Alternative	Utility function	Utility value
15	V15	3.134733557
3	V3	2.297958496
1	V1	1.938157049
4	V4	1.87997421
11	V11	1.625244874
5	V5	1.621321596
13	V13	1.469123792
2	V2	1.398821022
7	V7	1.359599719
16	V16	1.256977203
12	V12	1.129722344
14	V14	1.061135057
9	V9	0.694389288
8	V8	0.496473899
6	V6	0.344027977
10	V10	0.313063039
0	V0	0

Calculated utilities for each alternative (profile).