Health and Quality of Life context in soundscape research

Restoration as a health outcome

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COST

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1

Preface

- The association between soundscape and health is not immediately obvious
- And evidence that there is one is weak/if not non-existent
- Despite the many obstacles it is worthwhile exploring the value, feasibility and potential approaches and methods of this linkage

- Key concepts in this are quality of life and restoration
- And the key question: how does the (sound) environment around us contribute to our wellbeing and health by enabling us to restore from daily stress …….(sound as a recource, sound as an amenity, Brown, 2010).

Outline

I Why important ?

II Theories of restoration:

- ✓ perceptions and cognitions
- ✓ behaviour
- ✓ restorative places
- ✓ context/activities/soundscapes
- ✓ stress research

III Measurement

IV Evidence

V A way ahead and the missing links

Why important?

- Increasing attention for the restorative function of quiet areas where (mental) health effects are concerned.
- But few studies place the relationship between noise and (mental) health in a broader context of soundscapes and environmental quality.
- Evidence available primarily based on laboratory studies and few epi studies (Maas) .
- Address primarily the restorative effects of natural recreational areas outside the urban environment (Hartig et al., 1991; 2003; Ottosson & Grahn, 2005; Rodiek, 2002).
- Role of pleasant sound environments in this process has been understudied.
- As a consequence it is not possible to answer the question what the prerequisite characteristics are for urban environments in order to contribute restoration after stress.
- Little formal policy regulation addresses these amenities in Europe and elsewhere.

What is restoration?

- Dictionary: The act of restoring or bringing back to a former place, state, , station, or condition; the fact of being restored; renewed, reestablished.

- Pederson & Persson Waye: Restorative experience refers to the degree in which an environment can aid recovery from mental fatigue and attentional capacities.
- Staats (2003) Wallenius, (2004). Inhibited restoration/ lack of stress recovery: considered as important for mental as well a physiological recovery and long term health.*
- Gidlöf et al. Pychological restoration is access to places where one can relax, unwind, feel content and undisturbed.

 * Important factors: perceived control /nd Noise sensitivity

Definition >>>>

- Attention restoration theory (see e.g. Kaplan& Kaplan, Hartig, Staats, Brosschot)

  Distinguishes four necessary components of restoration:

  1. being away: psychological distance from the demands and routines in which people use the directed attention capacity

  2. fascination: attention is captured by aspects of flora and fauna

  3. extent: degree and scope of exploration on the environment

  4. compatibility: match between what the person wants to do and must do

  these elements are seen as the mediators of the relation between the physical environment and restoration.

Moser's congruence concept

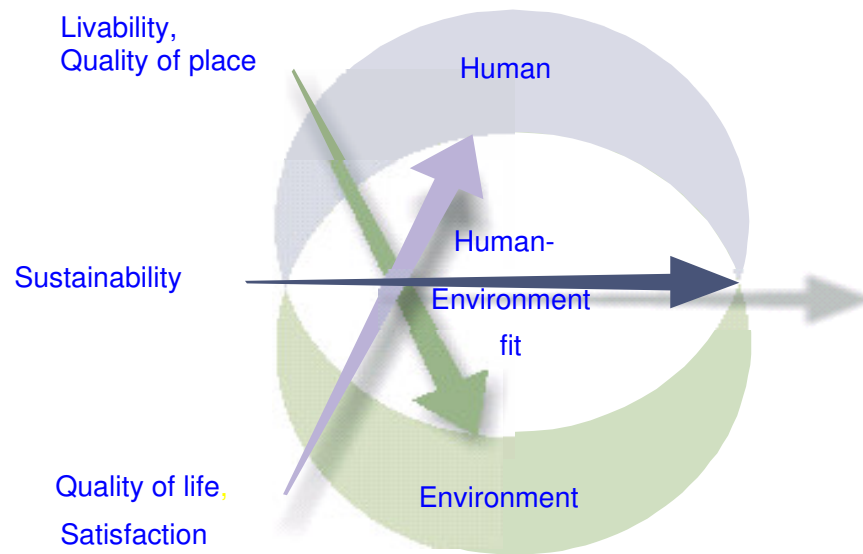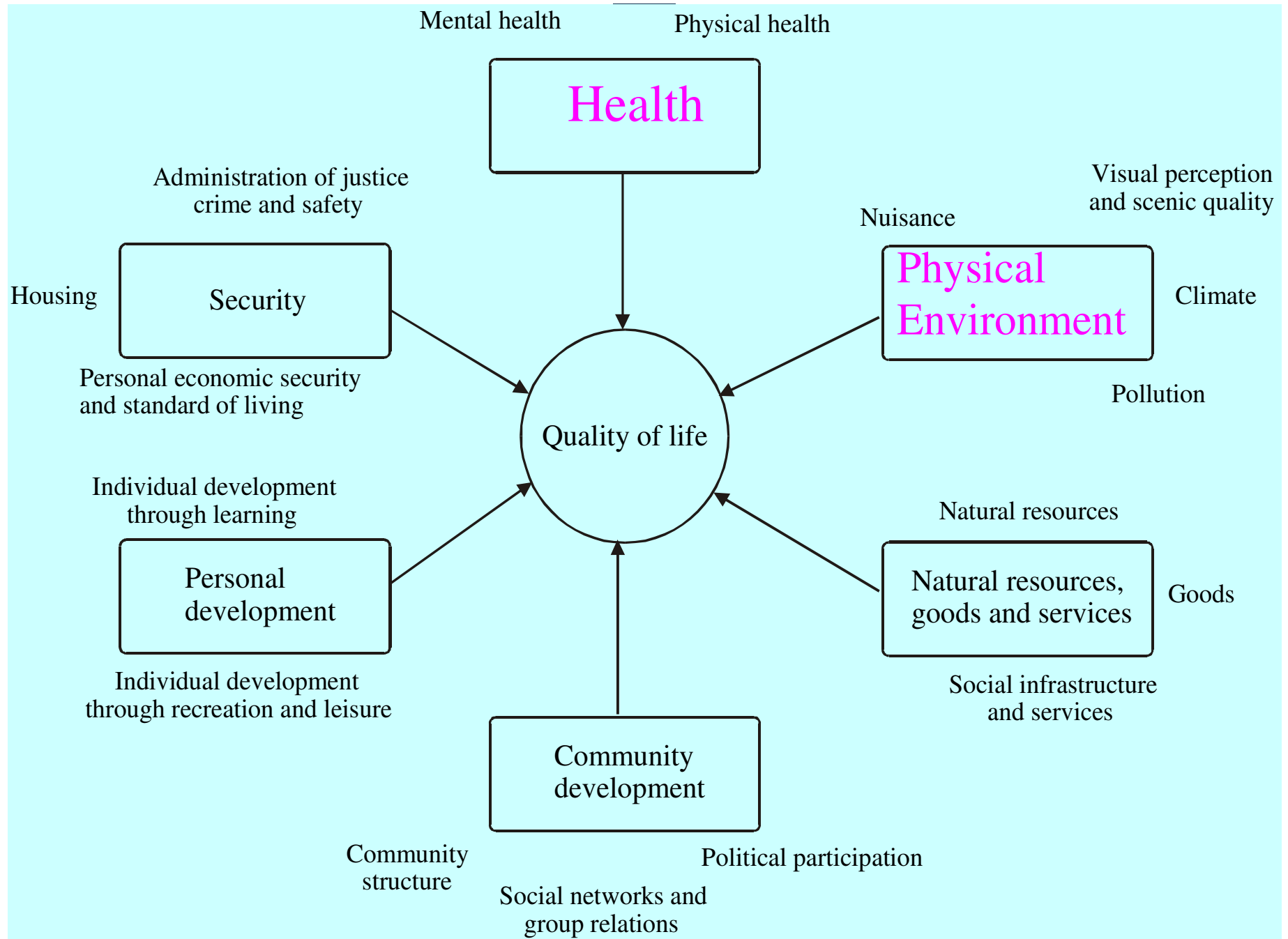4. compatibility: match between what the person wants to do and must do

- Congruence: the interrelation between the individual and his or her (residential) environment, considering the match between individual life satisfaction and objective standards of living.

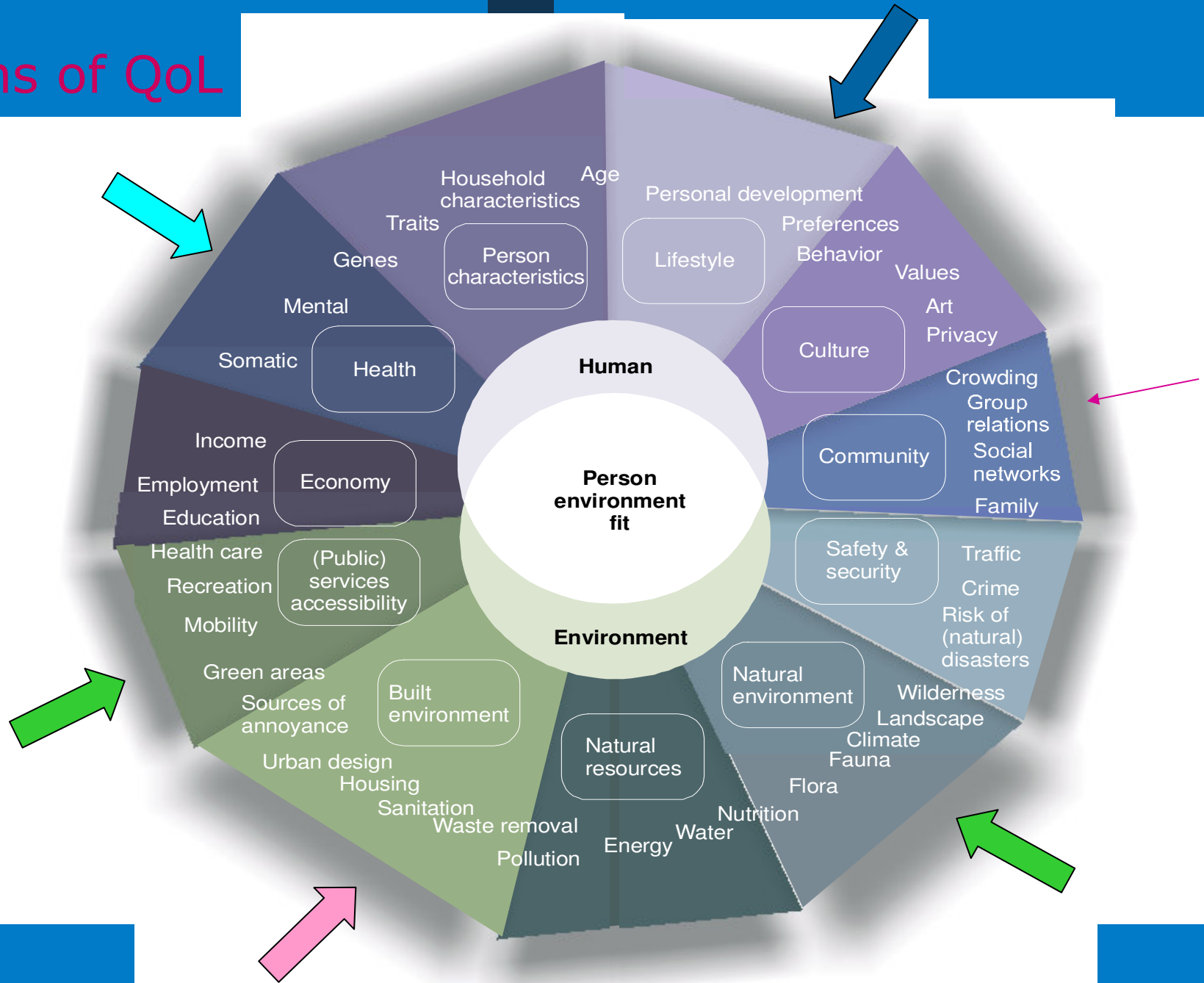|		Expression of discomfort/annoyance	
		High	*Low*
Exposure to bad environmental conditions	*High*	Case 1: disturbance due to overt effects	Case 2: subjective well-being
	Low	Case 3: disturbance due to perceived inadequate environmental qualities	Case 4: congruence between objective an subjective condition of well-being

Perspectives on human-environment fit

Livability, Quality of place

Human

Sustainability

Human- Environment fit

Quality of life, Satisfaction

Environment

Mental health   Physical health

Health

Administration of justice
crime and safety

Nuisance

Visual perception
and scenic quality

Housing

Security

**Physical
Environment**

Climate

Personal economic security
and standard of living

Pollution

Quality of life

Individual development
through learning

Natural resources

Personal
development

Natural resources,
goods and services

Goods

Individual development
through recreation and leisure

Social infrastructure
and services

Community
development

Community
structure

Political participation

Social networks and
group relations

Domains of QoL

Human

Household characteristics · Age
Personal development
Preferences
Behavior
Traits
Person characteristics
Genes
Lifestyle
Values
Art
Privacy
Mental
Culture
Somatic
Health
Crowding
Group relations
Social networks
Community
Family

Person environment fit

Income
Economy
Employment
Education
Safety & security
Traffic
Health care
(Public) services accessibility
Recreation
Crime
Risk of (natural) disasters
Mobility
Environment
Natural environment
Green areas
Built environment
Wilderness
Sources of annoyance
Landscape
Climate
Urban design
Natural resources
Fauna
Housing
Flora
Sanitation
Nutrition
Waste removal
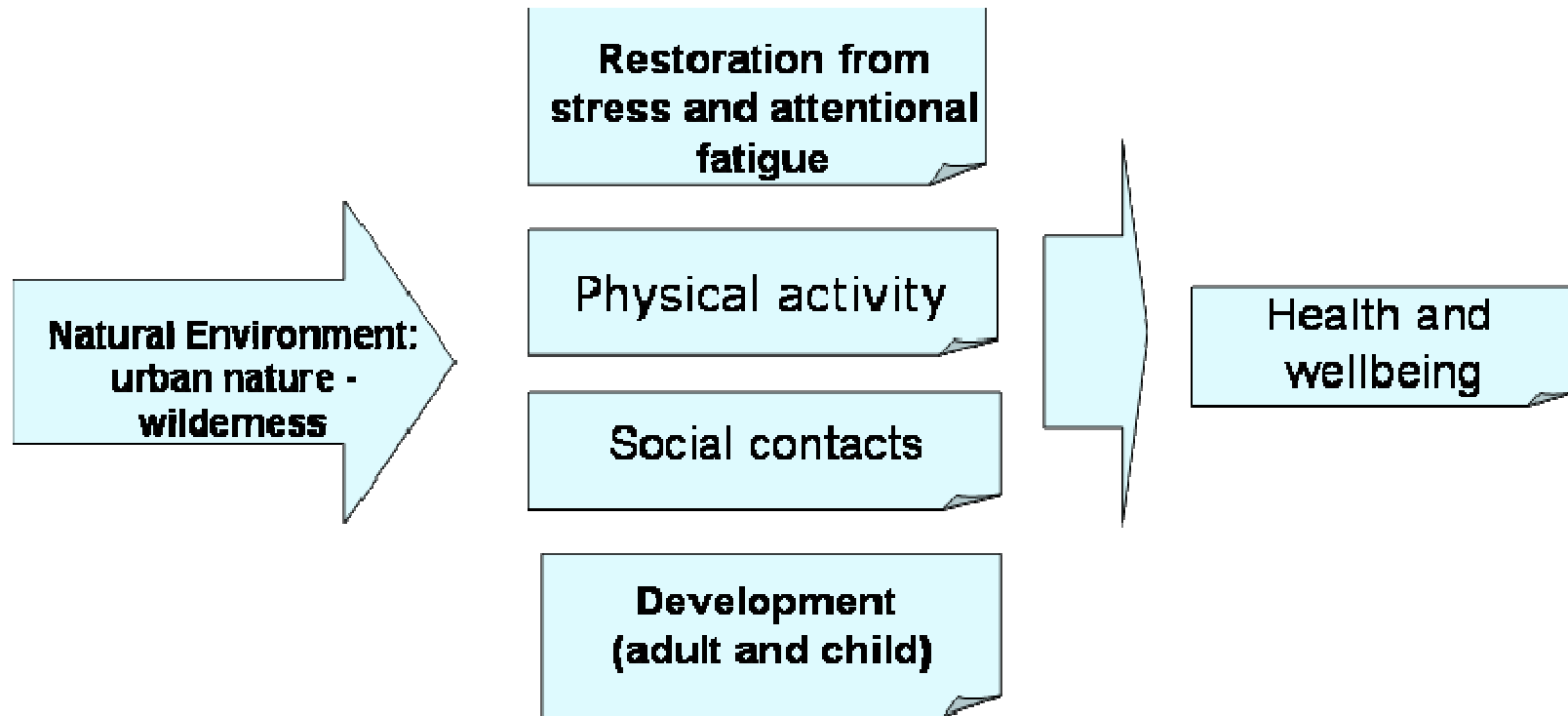Energy · Water
Pollution

10

Models

- Health as outcome
- Behaviour as outcome
- Quality of Life as outcome
- Stress
- Combination health, behaviour and restoration

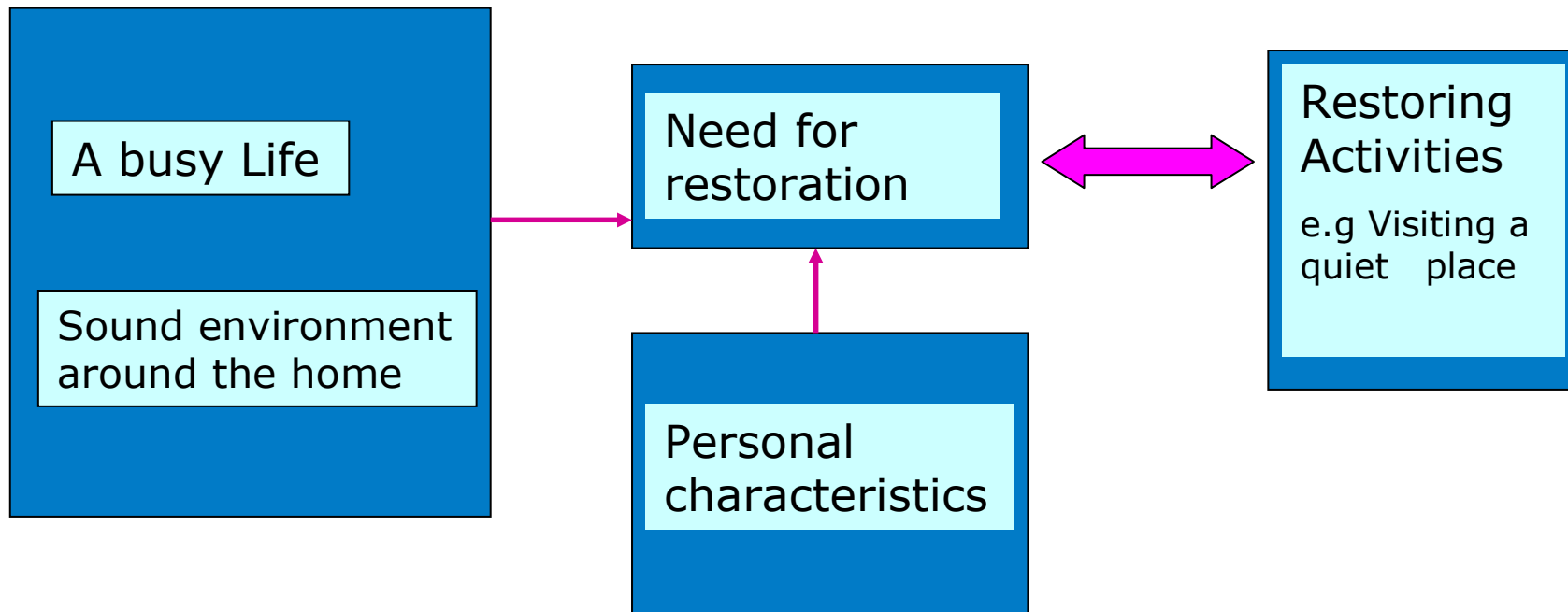# Natural Environment and Health
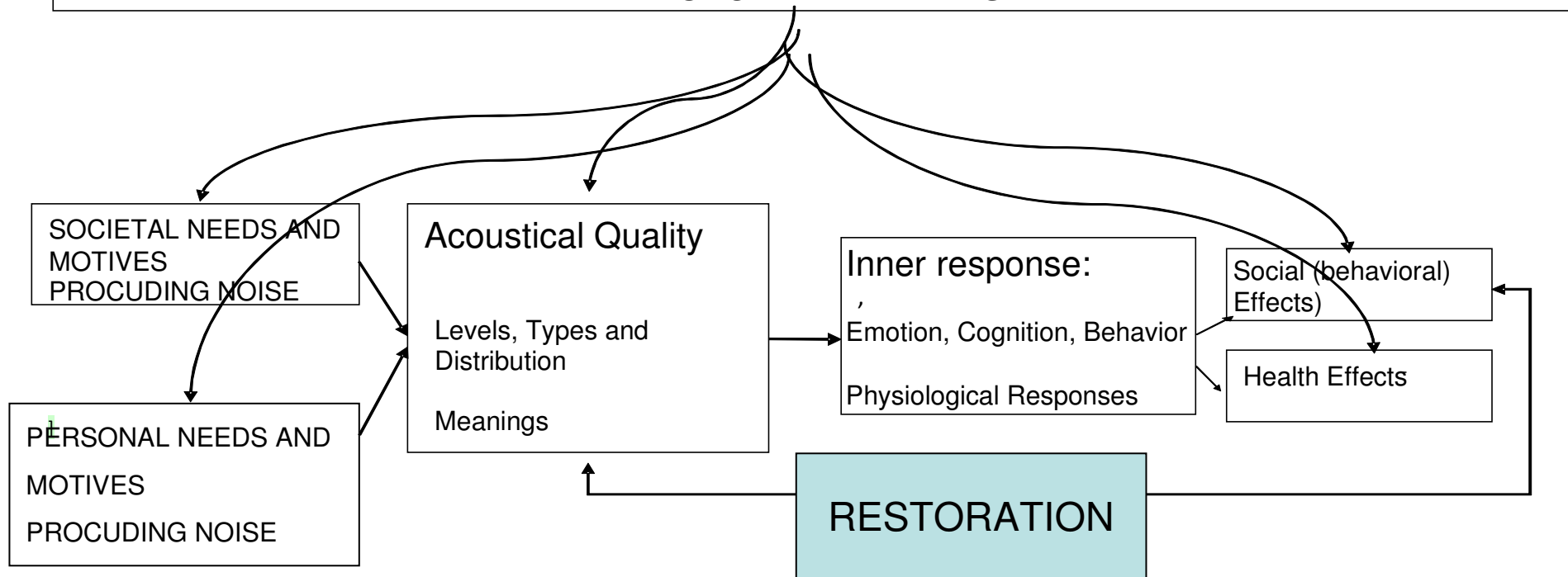

Source Dutch Health Council (2004)
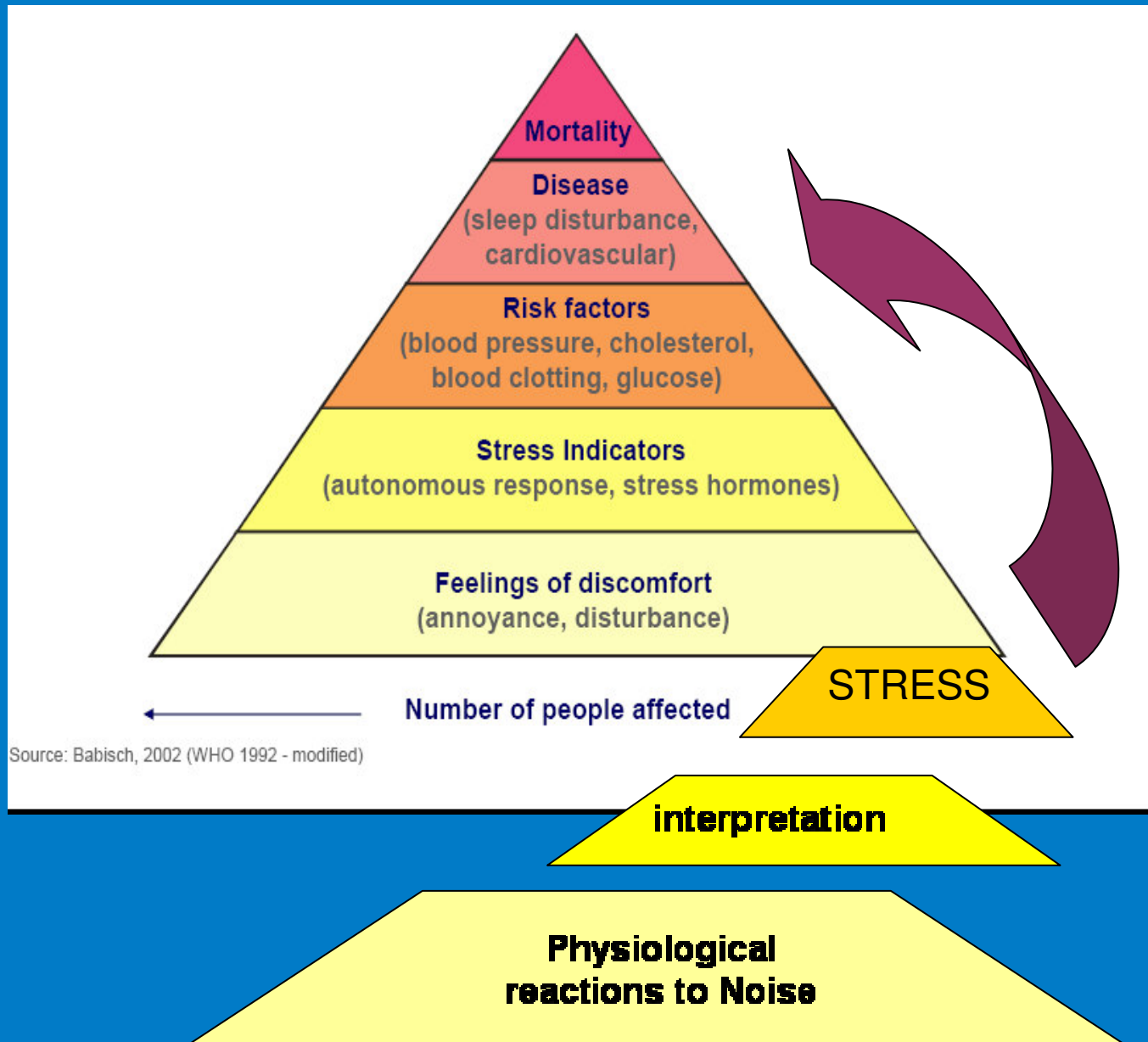
Model: Need for Quiet (Frits van den Berg, 2010)

A busy Life

Sound environment around the home

Need for restoration

Personal characteristics

Restoring Activities

e.g Visiting a quiet place

POLICY AND PLANNING

SOCIETAL NEEDS AND MOTIVES PROCUDING NOISE

Acoustical Quality

Levels, Types and Distribution

Meanings

Inner response:

,

Emotion, Cognition, Behavior

Physiological Responses

Social (behavioral) Effects)

Health Effects

PERSONAL NEEDS AND MOTIVES PROCUDING NOISE

RESTORATION

Source Devilee, Maris, van Kamp, 2010)

Health

Mortality

Disease
(sleep disturbance, cardiovascular)

Risk factors
(blood pressure, cholesterol, blood clotting, glucose)

Stress Indicators
(autonomous response, stress hormones)

Feelings of discomfort
(annoyance, disturbance)

Number of people affected

Source: Babisch, 2002 (WHO 1992 - modified)

STRESS

interpretation

Physiological reactions to Noise

Methods: Types of indicators per dimension of environmental quality (adapted from Woudenberg, 2000)

Basic quality	Housing size and qol
	Social safety
	Social Cohesion
	Appearance
Physical quality	Space
	Green area/
	Noise, Air pollution
High quality	Amenities
	Access to Amenities

Preferences (in NL)

MOST IMPORTANT	Housing size and quality
	Social safety
	Social Cohesion
	Appearance
	Space
	Green area
	Noise pollution
	Amenities
	Playgrounds
	Air pollution
LEAST IMPORTANT	Reachability of amenities

pleasant sounds????

Exemplary Measurement

- Payne/ Hartig (restoration questionnaire)

- Gidlöf (Psychological Restoration)
- Persson Waye: perceived restoration)
- Vd Berg (Need for quiet, visits quiet area, satisfaction quiet area0
- Perceived Soundscapes (Berglund et al)
  - 2 dimensions

Nordh, Hartig et al., 2009

Characteristics of restorative environments
- There is much to explore and discover here
- This place is a refuge from unwanted distractions
- I would be able to rest and recover my ability to focus in this environment
- I like this environment

  – Questions asked after description of a scenario

Psychological restoration in Stockholm study (Berglund, Gidlöf et al)

1. When I am at home indoors/outdoors it is...

	Never	Sometimes	Often	Always
a) Calm	[ ]	[ ]	[ ]	[ ]
b) Quiet	[ ]	[ ]	[ ]	[ ]
c) Noisy	[ ]	[ ]	[ ]	[ ]
d) Disturbing	[ ]	[ ]	[ ]	[ ]

and variations on this in the RANCH study

EVIDENCE:

● Does restoration require the absence of urban noise?

– Beside the immediate restorative effects, there may be long-term effects of access to environmental amenities in the immediate living environment.

– Some evidence on health restoring effect of green neighbourhoods (e.g. Maas, 2009)

– Which other environmental aspects are important and in specific sound qualities?

Influence of quiet and tranquility

- Wallenius (2005): of special importance: disturbed daily activities which should provide restoration or demanding concentration (e.g. sleeping, relaxing, reading or studying).

- Guite et al. (2006): stress the need to intervene on both design and social features of residential areas to promote mental well-being

- There is anecdotal evidence that people (especially NS) migh profit from a balanced variation of noisy and quiet areas in urban environments,

Need for Quiet and Mental Health

- Recent analysis of data from a neighbouthood survey showed that the score on the mental health scale (Rand 36) is associated with:
  - A larger need for quiet.
  - More visits to quiet areas.
  - Lower satsifaction with access to quiet
  - After adjustment for: gender, age, quetelet index, ethnicity, eudeation, workstatus, level of urbanisation, noise and noise sensitivity

  - [source van Kempen, van Kamp, Kruize]
  - Comparable with findings of Frits van den Berg

Perception of acoustic quality, in relation with severe annoyance, need for and use of quiet area, physical and mental health and use of medication*

Outcome →	Perception acoustics qol	Needs and behaviour		
	Live in busy road	Often visits quiet area	Unsatisfied access to quiet area	Need to visit quiet area
	OR (95%Bthi)	OR (95%Bthi)	OR (95%Bthi)	OR (95%Bthi)
Severe annoyance Road traffic	5,95 (4,04 – 8,78)[†]	1,51 (1,14 -2,02)[†]	2,27 (1,54 – 3,35)[†]	3,56 (2,50 – 5,08)[†]
Subjective Health	ns	ns	0,55 (0,41 – 0,75)[†]	0,79 (0,65 – 0,96)[†]
Non specific physical symptoms	1,04 (1,02 – 1,06)[†]	1,02 (1,00 – 1,03)[†]	1,06 (1,03 – 1,08)[†]	1,05 (1,03 – 1,07)[†]
RAND36 Mental Health	0,99 (0,99 – 1,00)[†]	0,99 (0,99 – 1,00)[†]	0,98 (0,98 – 0,99)[†]	0,98 (0,98 – 0,99)[†]
Hypertension	ns	ns	ns	ns
Use of medication (CVD, Depression, tranuilisers	ns	ns	ns	ns

*adjustment for gender, age, queteletindex, ethnicity, occupational status, education, urbanisation† χ2 was statistisch significant bij α < 0,05; OR = Odds Ratio, 95%Bthi = 95% confidence Interval

Source van Kempen et al, in press
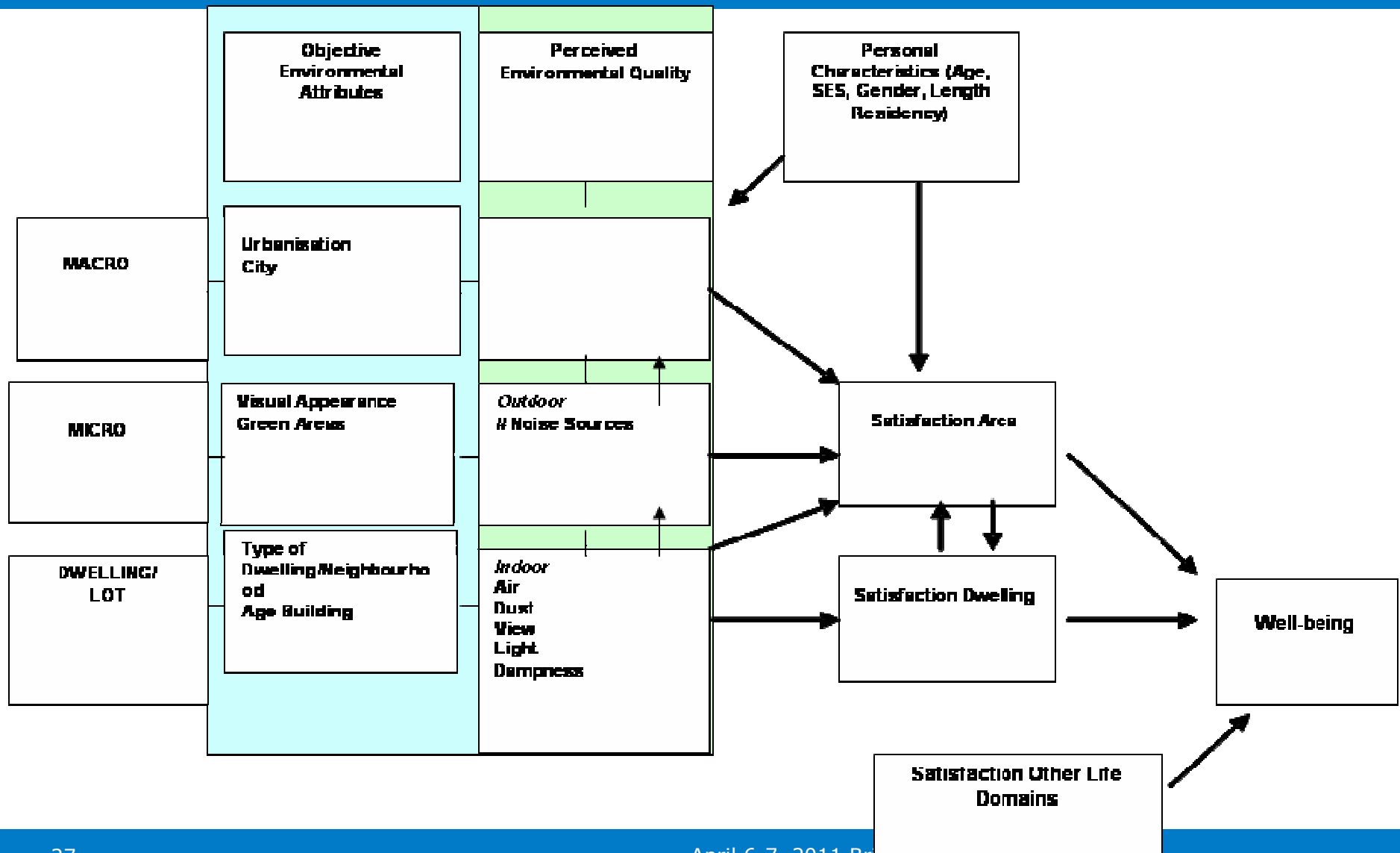
Schiphol outcomes: 2002 Before opening 5th runway

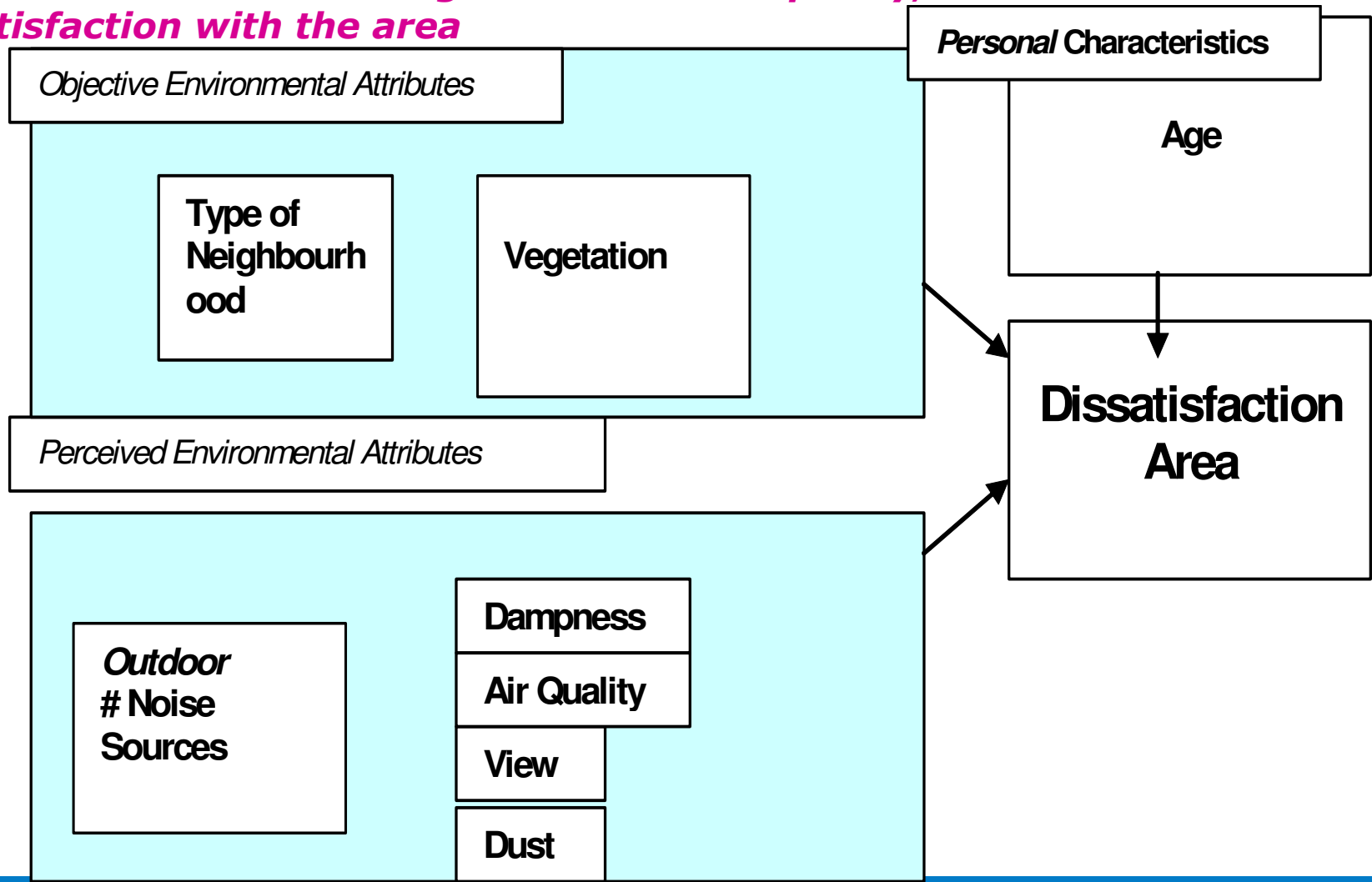| Outcome →	Perception acoustics qol	
	Sressfull	Restoring
	OR (95% CI)	OR (95% CI)
Severe annoyance Road traffic	2.6 (1.5-4.7)	.28 (.21-.4 0)
Vitality (Rand)	ns	1.39 (1.15-1.7)
GHQ	1.9 (1.5-2.5)	.74 (.69-.86)
Anxiety	.53 (.37-.76)	1.4 (1.1-1.7)
Depression	.46 (.32-.67)	1.4 (1.2-1.8)
Need for quiet	1.9 (1.3-2.7)	.46 (.37-.56)
Visit quiet	.68 (.54-.86)	1.3 (1.1 -1.5)
Dissatisfied access to quiet	2.9 (2.0.4.3)	.41 (.33-.50)

Schiphol outcomes: 2005 After opening 5th runway

| Outcome →	Perception acoustics qol	
	Sressfull	Restoring
	OR (95%Bthi)	OR (95%Bthi)
Severe annoyance Road traffic	2.6 (1.4-4.7)	.28 (.21-.40)
Vitality (Rand)	Ns	1.4 (1.2-1.7)
GHQ	1.9 (1.5-2.5)	.75 (.65-.87)
Anxiety	.53 (.37-.76)	1.4 (1.1-1.7)
Depression	.46 (.32-.66)	1.4 (1.2-1.8)
Need for quiet	2.3 (1.6-3.4)	.44 (.36-.54)
Nr Visits quiet area	ns	1.2 (1.0-1.4)
dissatisfied access to quiet	3.0 (2.1-4.3)	.51 (.42-.61)

Outcome model concerning environmental quality, dissatisfaction with the area

Personal Characteristics

Age

Objective Environmental Attributes

Type of Neighbourhood

Vegetation

Perceived Environmental Attributes

Dissatisfaction Area

Outdoor # Noise Sources

Dampness

Air Quality

View

Dust

Outcome model concerning environmental quality, dissatisfaction with the dwelling and unwell-being
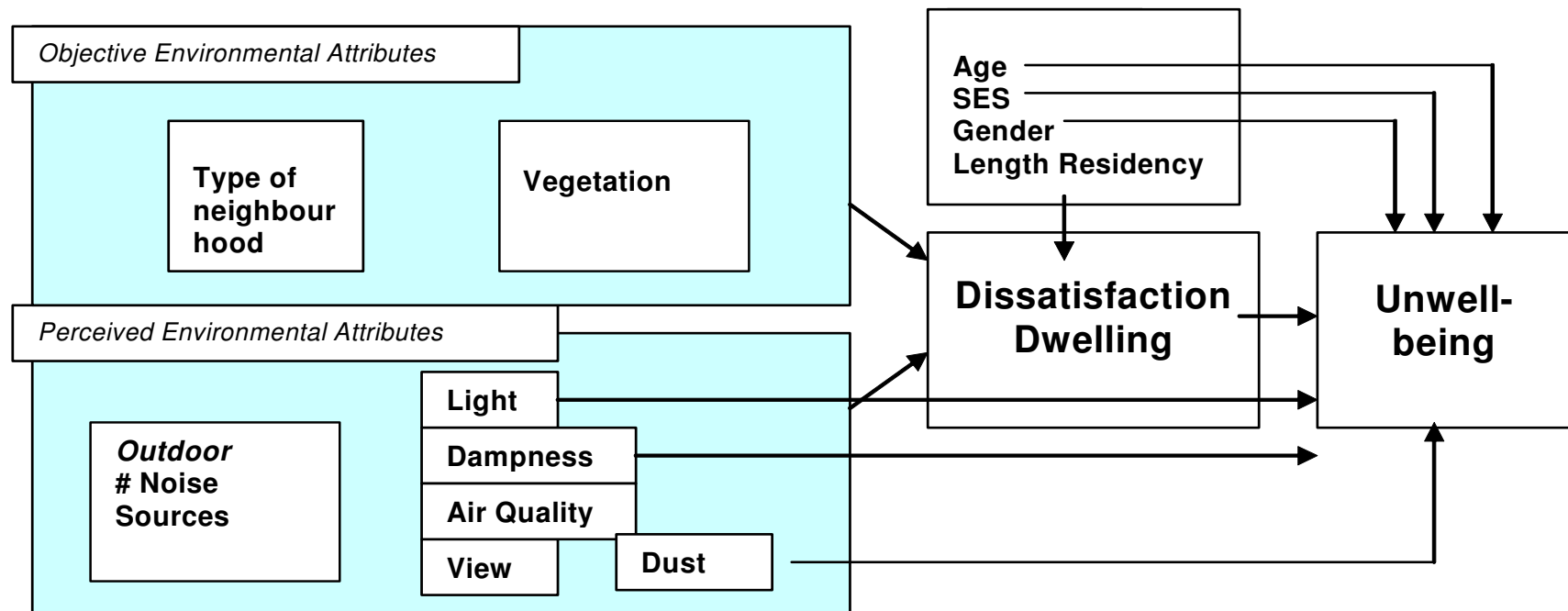
well-being

N=5535	Not adjusted for background characteristics	Adjusted for background characteristics[1]
	B (SE)	B (SE)
Intercept	24.42 (0.99)	26.77 (1.32)
Appearance	0.00 (0.01)	0.00 (0.01)
Vegetation	0.04 (0.01)***	0.03 (0.01)**
Number of traffic noise sourees	0.15 (0.25)	-0.09 (0.24)
Indoor climate: light	1.71 (0.54)*	1.46 (0.52)*
Indoor climate: view	0.26 (0.20)	0.11 (0.19)
Indoor climate: dampness	0.87 (0.18)***	0.62 (0.18)**
Indoor climate: air quality	0.45 (0 .26)	0.17 (0.26)
Indoor climate: dust	1.13 (0.47)	1.31 (0.45)*
Dissatisfaction with dwelling		0.12 (0.01)***

* $p < 0.01$, ** $p < 0.001$, *** $p < 0.0001$, [1] Adjusted for age of building, degree of urbanisation, type of neighbourhood, gender, age, length of residency, and SES
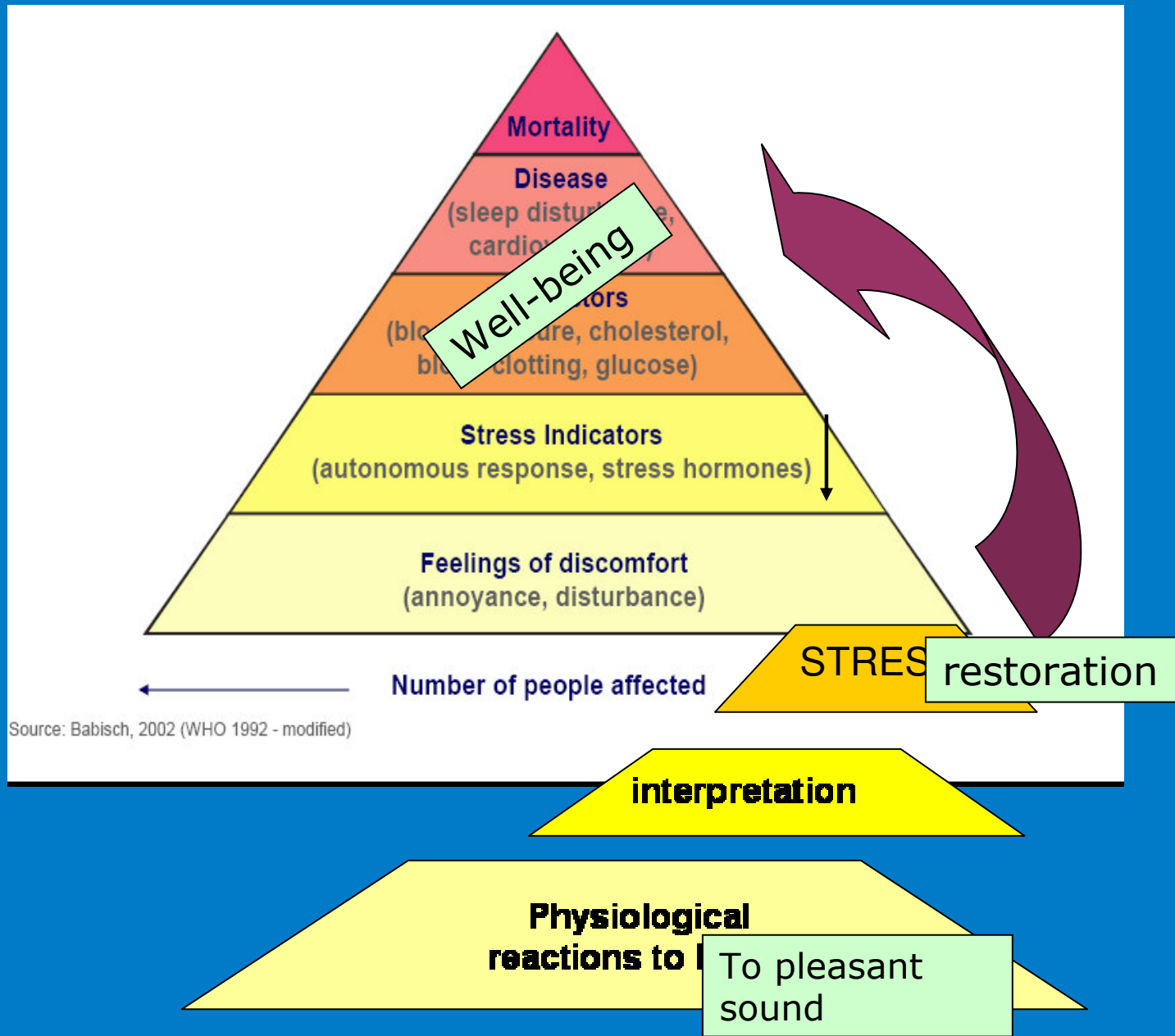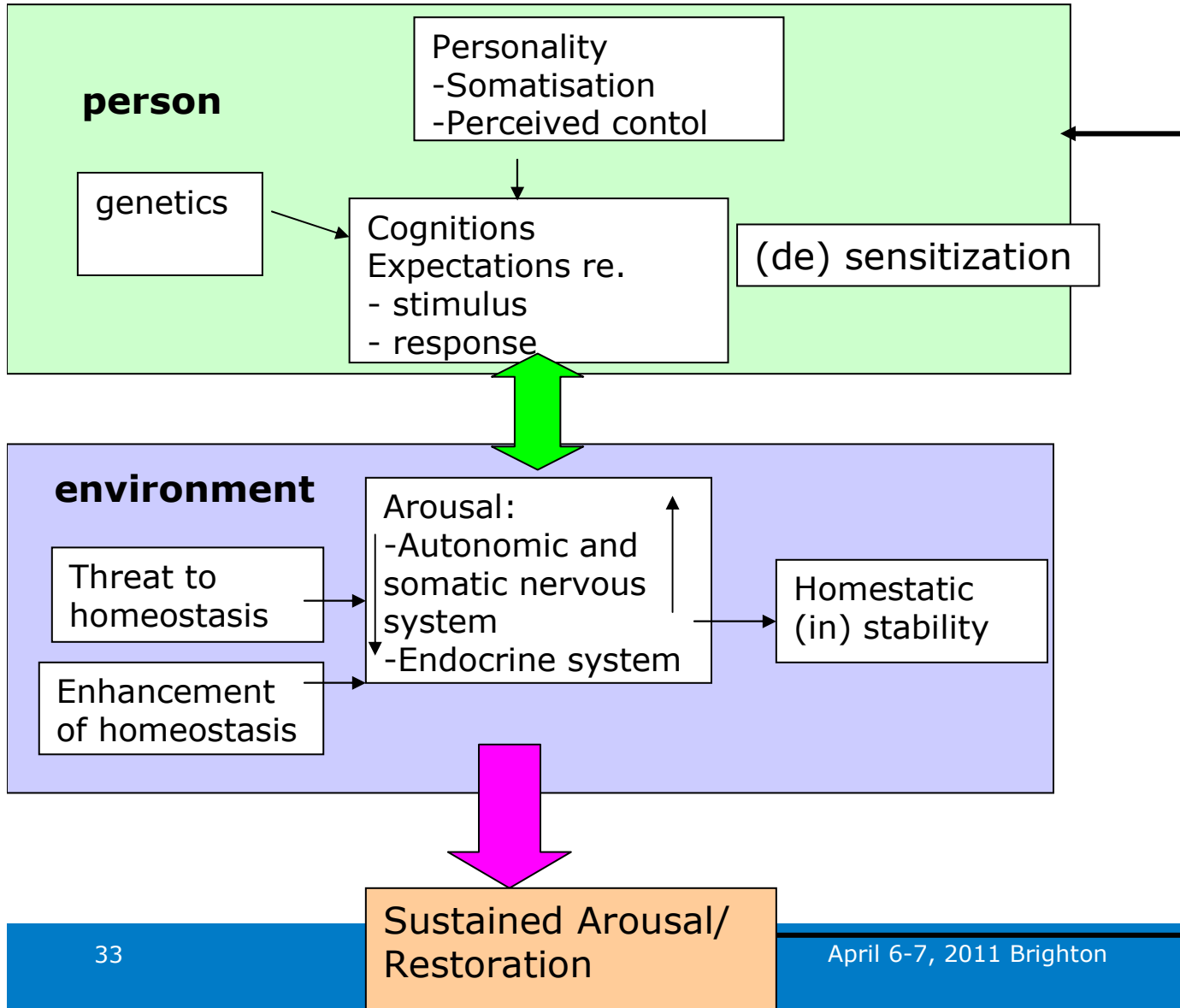
Future directions: Restoration

- More integral and contextual approach;
- More contextual studies into the positive and restorative effects of sounds

  - Link with health/wellbeing
  - Link with behaviour;
  - Link with physiological pocesses;
    › Relate characteristics of sound environment with physiological indicators of restoration:
      - Short term effects
      - Long term effects

  - Link with health/welbeing, behaviour and and restoration

TO BE DISCUSSED

Health/Wellbeing

Mortality

Disease
(sleep disturbance,
cardio...)

Well-being

...tors
(blo... ...re, cholesterol,
blo... clotting, glucose)

Stress Indicators
(autonomous response, stress hormones)

Feelings of discomfort
(annoyance, disturbance)

Number of people affected

Source: Babisch, 2002 (WHO 1992 - modified)

STRES...

restoration

interpretation

Physiological
reactions to ...

To pleasant
sound

person

Personality
-Somatisation
-Perceived contol

genetics

Cognitions
Expectations re.
- stimulus
- response

(de) sensitization

environment

Threat to
homeostasis

Enhancement
of homeostasis

Arousal:
-Autonomic and
somatic nervous
system
-Endocrine system

Homestatic
(in) stability

Sustained Arousal/
Restoration

context

POLICY AND PLANNING

Restoring Activities e.g Visiting a quiet place
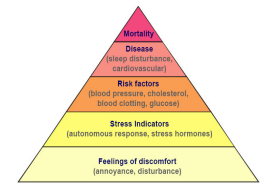
Environmental And Personal context

Acoustical Quality

Levels, Types and Distribution

Meanings **variety**

Inner response:
,
Emotion, Cognition, Behavior

Physiological Responses
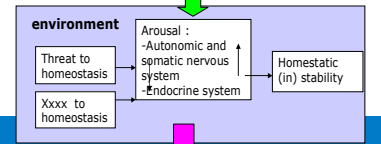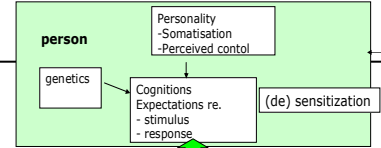
Social (behavioral) Effects)

Health

RESTORATION

Mortality
Disease
(sleep disturbance, cardiovascular)
Risk factors
(blood pressure, cholesterol, blood clotting, glucose)
Stress indicators
(autonomous response, stress hormones)
Feelings of discomfort
(annoyance, disturbance)

Number of people affected

Source: Babisch, 2002 (WHO 1992 - modified)

person

Personality
-Somatisation
-Perceived contol

genetics

Cognitions
Expectations re.
- stimulus
- response

(de) sensitization

environment

Threat to homeostasis

Xxxx to homeostasis

Arousal :
-Autonomic and somatic nervous system
-Endocrine system

Homestatic (in) stability

Sustained Arousal/ Restoration

Thank you for your attention!

Mechanisms I

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Source: NL Health Council 1999
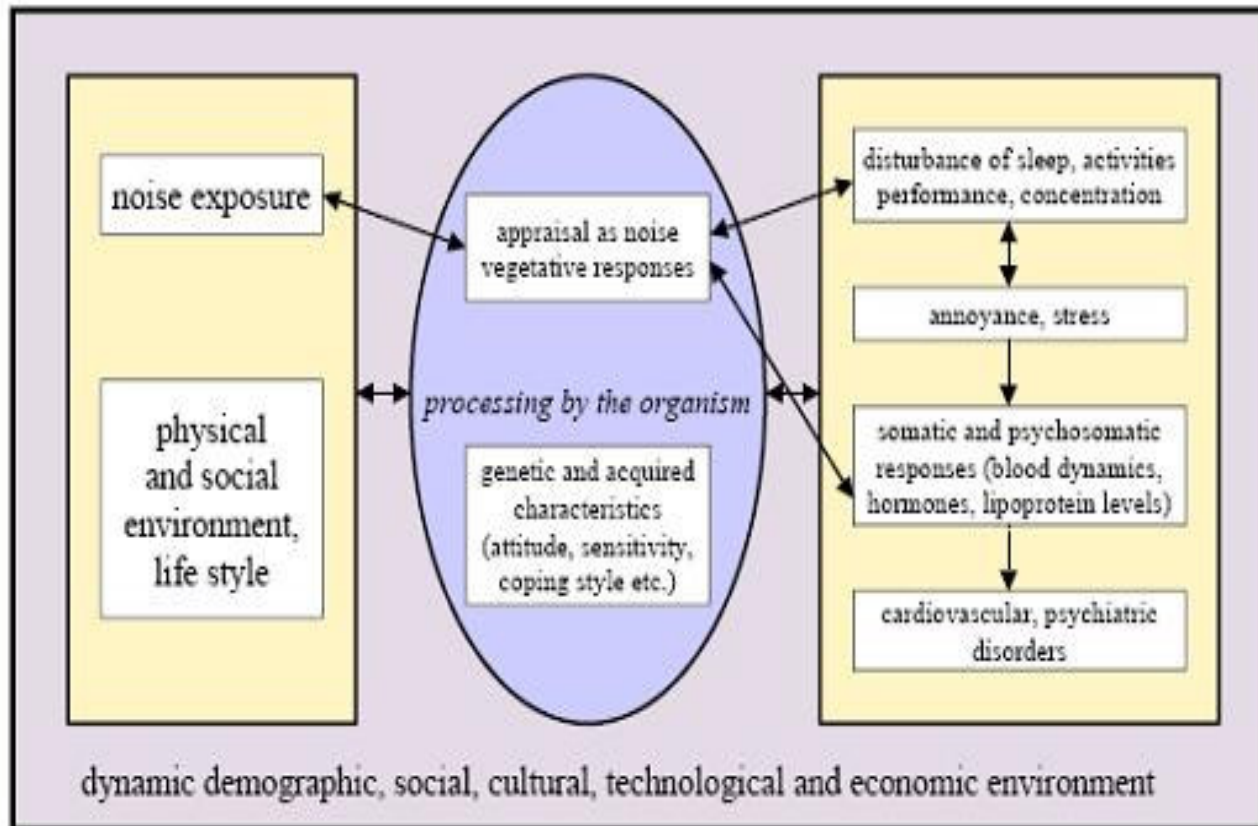
Figure 1: Coping Model (adapated from Lazarus, in Van Kamp, 1990)
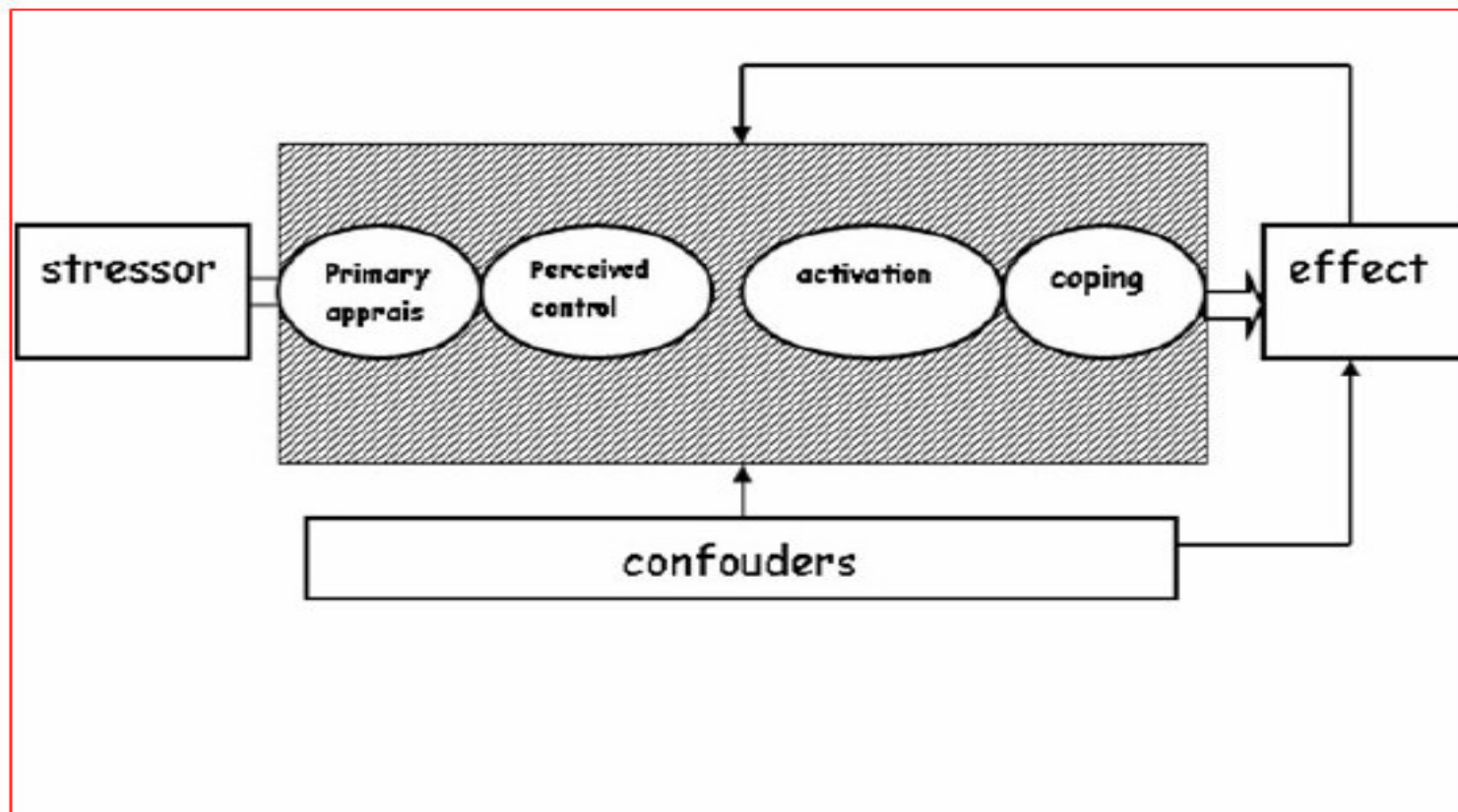
Noise and the Arousal Hypothesis

Coping

Noise

Physiological

hyper-reactivity

Illness

Appraisal

Barts and The London
School of Medicine and Dentistry
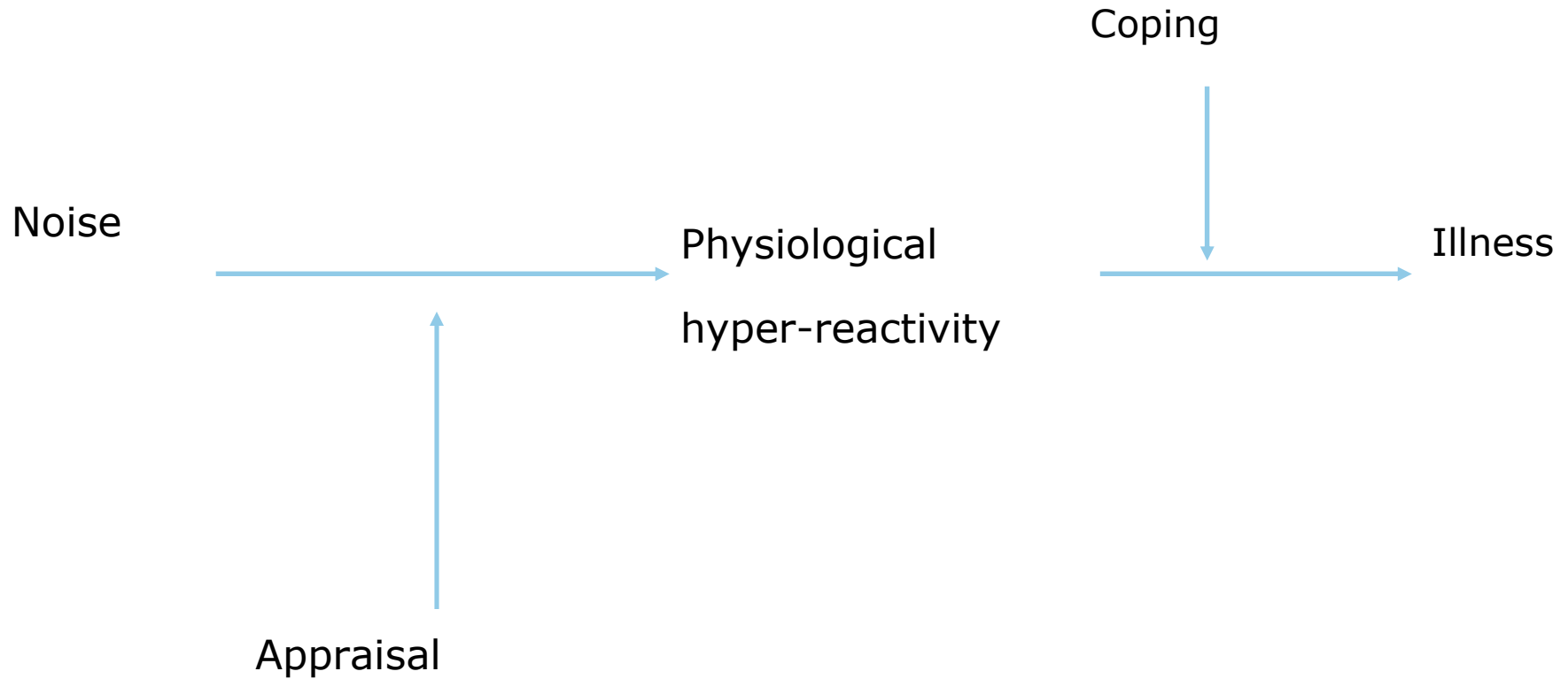
dwelling

N=5710	Not adjusted for background characteristics	Adjusted for background characteristics[1]
	B (SE)	B (SE)
Intercept	3.11 (1.29)	-3.38 (1.71)
Appearance	0.07 (0.01)***	0.03 (0.01)
Vegetation	0.04 (0.01)**	0.05 (0.01)***
Number of traffic noise sources	2.00 (0.33)***	1.50 (0.31)***
Indoor climate: light	2.71 (0.72)**	2.91 (0.69)***
Indoor climate: view	1.88 (0.26)***	1.75 (0.25)***
Indoor climate: dampness	1.55 (0.24)***	1.76 (0.24)***
Indoor climate: air quality	3.52 (0.34)***	3.05 (0.33)***
Indoor climate: dust	0.42 (0.62)	0.36 (0.59)

$* p < 0.01$, $** p < 0.001$, $*** p < 0.0001$, [1] Adjusted for age of building, degree of urbanisation, type of neighborhood, gender, age, length of residency, and SES

neighbourhood

N=1861	Not adjusted for background characteristics	Adjusted for background characteristics [1]
	B (SE)	B (SE)
Appearance	0.17 (0.02)***	0.16 (0.02)***
Vegetation	0.05 (0. 01)**	0.06 (0.01)***
Number of traffic noise sources	1.70 (0.42) ***	1.69 (0.43)***
Indoor climate: light	2.07 (0.86)	2.17 (0.86)
Indoor climate: view	2.88 (0.41)***	2.98 (0.41)***
Indoor climate: dampness	1.81 (0.29)***	1.60 (0.30)***
Indoor climat e: air quality	4.50 (0.43)***	4.47 (0.44)***
Indoor climate: dust	2.36 (0.79)*	2.51 (0.79)*
Feel safe in neighborhood:		
safe	0.69 (0.91)	0.69 (0.93)
relatively safe	-0.25 (1.08)	-0.15 (1.09)
unsafe	(ref)	(ref)

* $p < 0.01$, ** $p < 0.001$, *** $p < 0.0001$, [1] Adjusted for age of building, degree of urbanisation, type of neighborhood, gender, age, length of residency, and SES