Public Health England

Protecting and improving the nation's health

Valuing impacts of environmental noise

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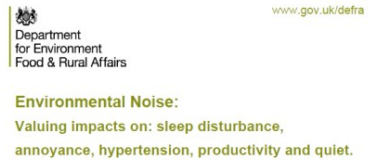
Deriving environmental values

- Revealed preference (e.g. hedonic pricing, travel cost method)
- Hypothetical questioning (e.g. contingent valuation method, stated preference (trade-off) approach)
- Dose response / impact pathway approach
- Mitigation cost
- …

Note: timeline represents publication dates


Department for Environment Food & Rural Affairs

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Environmental Noise:
Valuing impacts on: sleep disturbance, annoyance, hypertension, productivity and quiet.

November 2014

A report informed by: the Interdepartmental Group on Costs and Benefits Noise Subject Group

valuation of transport-related noise in Birmingham
Bateman *et al.* 2004

IGCBN
1st report 2008

IGCBN
2nd report 2010

Transport Analysis Guidance TAG Unit 3.3.2
2003

dose response relationships review
Berry & Flindell 2009

hypertension review
Berry 2014

ITS / TSG review
Nellthorp *et al.* 2005

revised TAG Unit 3.3.2

noise-related hypertension
Harding *et al.* 2011

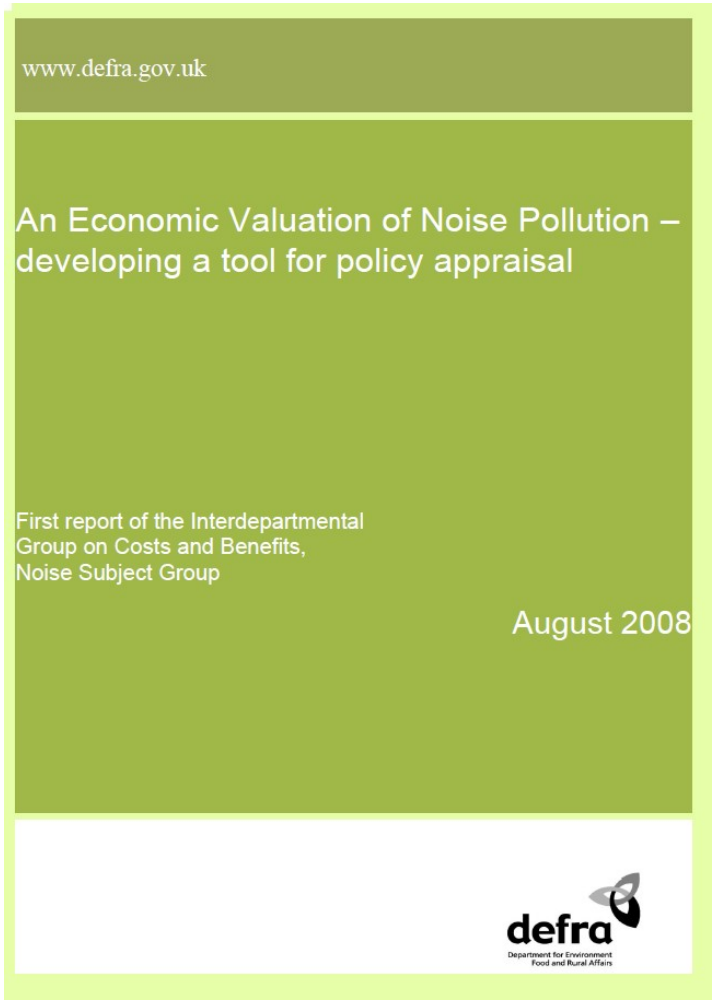
productivity impacts of noise
Muirhead *et al.* 2011

economic value quiet areas
URS Scott Wilson 2011

WTP / Hedonic Pricing approach

- Results from study on property prices in Birmingham generalised to national averages for TAG appraisal
- Several issues identified:
  - valuations for noise from road vs rail vs air traffic
  - valuations may capture effect of other environmental factors (air pollution, severance, pedestrian risk and safety, vibration, visual intrusion,…)
  - choice of lower noise threshold (55dBA vs 45dBA)
  - influential variables – annoyance, noise sensitivity, personal noise exposure, income, socio-economic and area effects, time of day, household tenure, …
  - residential vs non-residential | urban vs rural context
  - generalisation of study results – using household income vs property price | national averages vs local values

Nellthorp, Bristow, Mackie (2005)
Nellthorp, Bristow, Day (2007)



documents available from https://www.gov.uk/guidance/noise-pollution-economic-analysis

1st IGCB(N) report – 2008

Identified four broad groups of impact:

- Health impacts, this includes the most severe health effects such as changes in cardiovascular mortality;
- Effect on amenity, which reflect people's "conscious annoyance from noise exposure";
- Productivity, which relates to areas such as reduced work quality through tiredness or noise acting as a distraction; and
- Environmental, where noise levels may impact on the functioning of the ecosystems, such as through birds breeding patterns."

1st IGCBN report (2008)

"Based on the existing evidence, initial estimates of the cost of noise pollution suggest that it is currently imposing a cost in excess of £7 billion per annum. This estimate is made up of ***between £3 - £5 billion in annoyance costs, adverse health cost of around £2 - £3 billion and productivity losses of another £2 billion****. Therefore, even where best practice is being observed this means monetised impacts could be around half their true value."*

- Decision to prioritise work on estimating dose response functions between noise exposure and a range of health outcomes.

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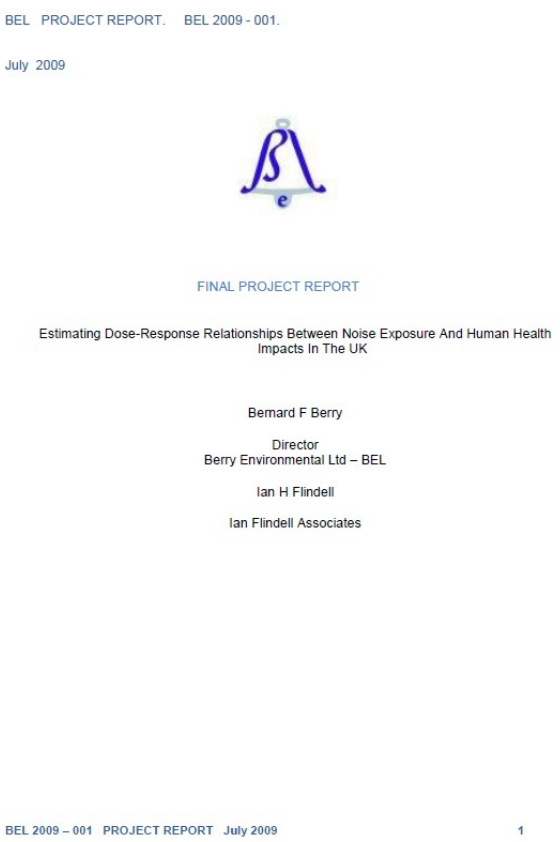
An Economic V
developing a to

First report of the Interd
Group on Costs and Be
Noise Subject Group



BEL PROJECT REPORT. BEL 2009 - 001.

July 2009

FINAL PROJECT REPORT

Estimating Dose-Response Relationships Between Noise Exposure And Human Health Impacts In The UK

Bernard F Berry

Director
Berry Environmental Ltd – BEL

Ian H Flindell

Ian Flindell Associates

documents available from https://www.gov.uk/guidance/noise-pollution-economic-analysis

Berry & Flindell 2009

- the work carried out by Babisch and van Kempen et al. deemed to provide the most robust assessments to date of the increased prevalence of acute myocardial infarction and other cardiovascular effects
- links between noise and transient sleep disturbance well developed, statistically-robust data and dose-response relationships, BUT
  - no consensus on any single dose-response relationship which could be used to inform cost benefit analysis
  - no quantitative link between acute or transient sleep disturbance caused by noise and any long term adverse health effects.
  - estimation of self-reported sleep disturbance is possible using dose-response relationships in 2004 EU position paper.
- strong evidence was found to link noise and hypertension, however evidence was not seen to be advanced enough to support fully quantitative assessment.

documents available from https://www.gov.uk/guidance/noise-pollution-economic-analysis

2nd IGCBN report (2010)

- Monetary valuation of noise-induced acute myocardial infarction (AMI) using the 2006 Babisch dose-response function.
- Indicative *quantification* of hypertension and sleep disturbance impacts
- Continued use of the Department for Transport's WebTAG monetary values for amenity impacts of noise.
- Prioritising and monitoring policy-oriented research in areas where impacts are believed to be significant, (i.e. hypertension and sleep disturbance impacts).

documents available from https://www.gov.uk/guidance/noise-pollution-economic-analysis

3rd IGCBN report (2014)

- Summarises current understanding of the links between environmental noise and various effects including sleep disturbance, annoyance, hypertension and related diseases.
- Includes some commentary on productivity and the value of quiet areas
- Presents recommended methods to assess these impacts to support policy, programmes and project appraisal.
- concerned solely with environmental noise from transport

3rd IGCBN report – recommendations

1. Monetise (self-reported) sleep disturbance
2. Monetise annoyance using a DALYs approach
   - reduce risk of double counting (e.g. sleep disturbance, quiet areas)
   - a more consistent approach with other impacts
   - robust evidence to treat road, rail, air separately
3. For changes to environmental noise levels, consider the impacts on hypertension—and consequently on dementia and stroke, and monetise where proportionate. Continue monetising AMI impacts.
4. Prioritise further research into productivity impacts of noise
5. Value impacts on quiet areas, where sufficient evidence is available

3rd IGCBN report – two approaches

- **Marginal values –** intended for use where noise is not expected to be a significant factor in decision making

- **Detailed analysis –** should be considered where noise is central to the decision. Guidance provides key data such as the best available exposure response functions, but depending upon the significance of the issue "*it may however be necessary to undertake a bespoke review of the latest available evidence to supplement this information*".

Uncertainties / limitations

- Disability weights for annoyance, (self-reported) sleep disturbance
- Impacts below 45dBA L_{den} / L_{night}
- “Change effect”
- Monetary value of one QALY/DALY (£30-80k)
- Statistical average response
- The influence of personal characteristics and context

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QUANTIFYING THE LINKS BETWEEN ENVIRONMENTAL NOISE RELATED HYPERTENSION AND HEALTH EFFECTS

MSU/2011/07

Lead Author: **Anne-Helen Harding**
Contributing Authors: **Gillian Frost, Howard Mason**
Aki Tsuchiya, Nick Warren

Transport Research Laboratory
Creating the future of transport

TRL

CLIENT PROJECT REPORT CPR1080

Estimating the productivity impacts of noise

P A Morgan, L Morris and M Muirhead

Prepared for:	Defra, Air and Local Environment - Natural Er
Project Ref:	NO 0233

Quality approved:

M Muirhead (Project Manager)

M J Ainge (Technical Referee)

URS Scott Wilson

The Economic Value of Quiet Areas
Final Report

March 2011

Prepared for

defra

documents available from randd.defra.gov.uk

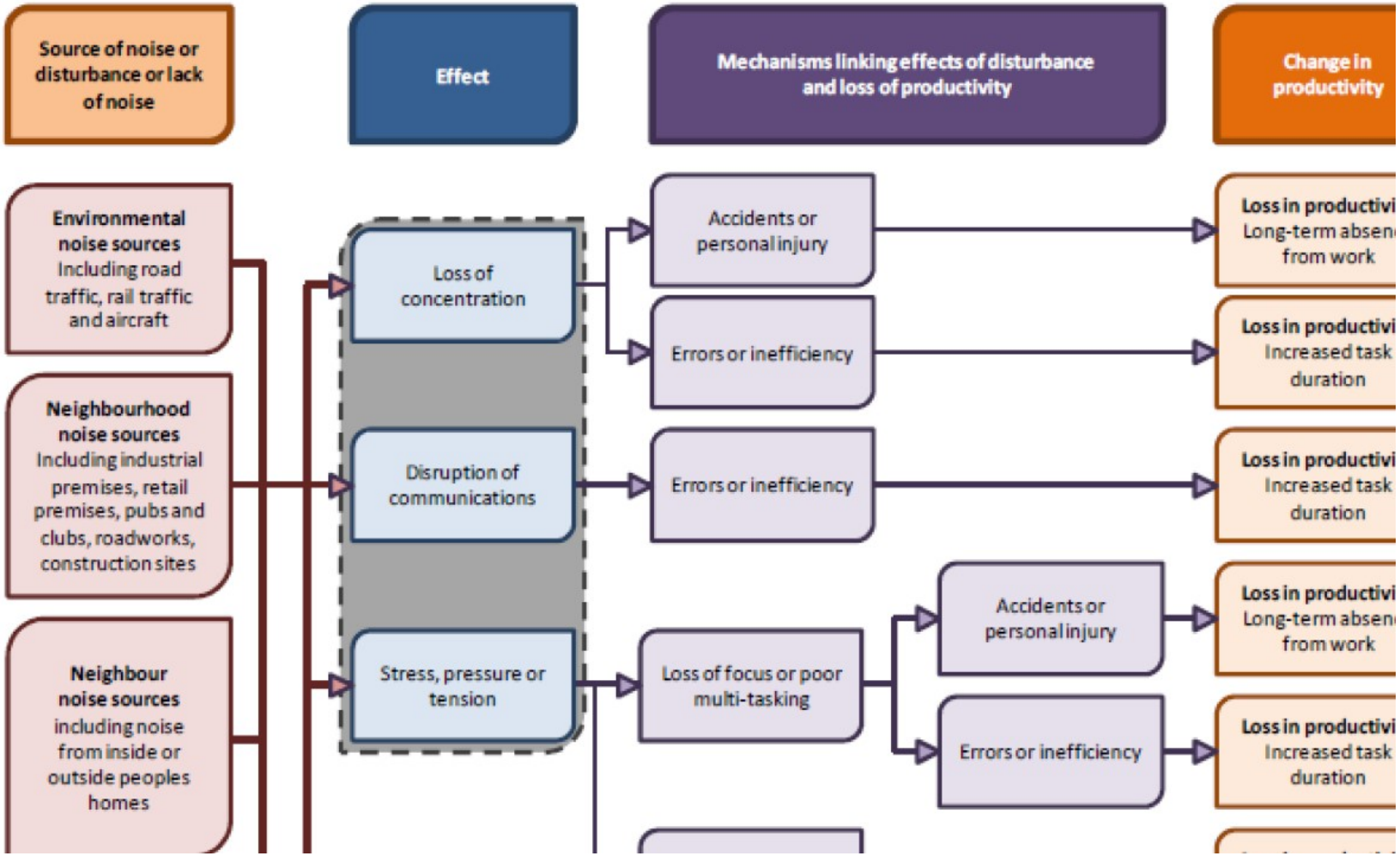
Noise-induced hypertension

- Two-stage approach:
  - estimate expected incidents of hypertension (function of noise exposure, odds ratios for noise-induced hypertension, prevailing risk of hypertension in the affected area)
  - value the expected incidents of hypertension by quantifying and valuing consequential changes in incidents of dementia and stroke
- Does not include worsened impacts in those with pre-existing conditions
- Health values only reflect the cost to the individuals affected

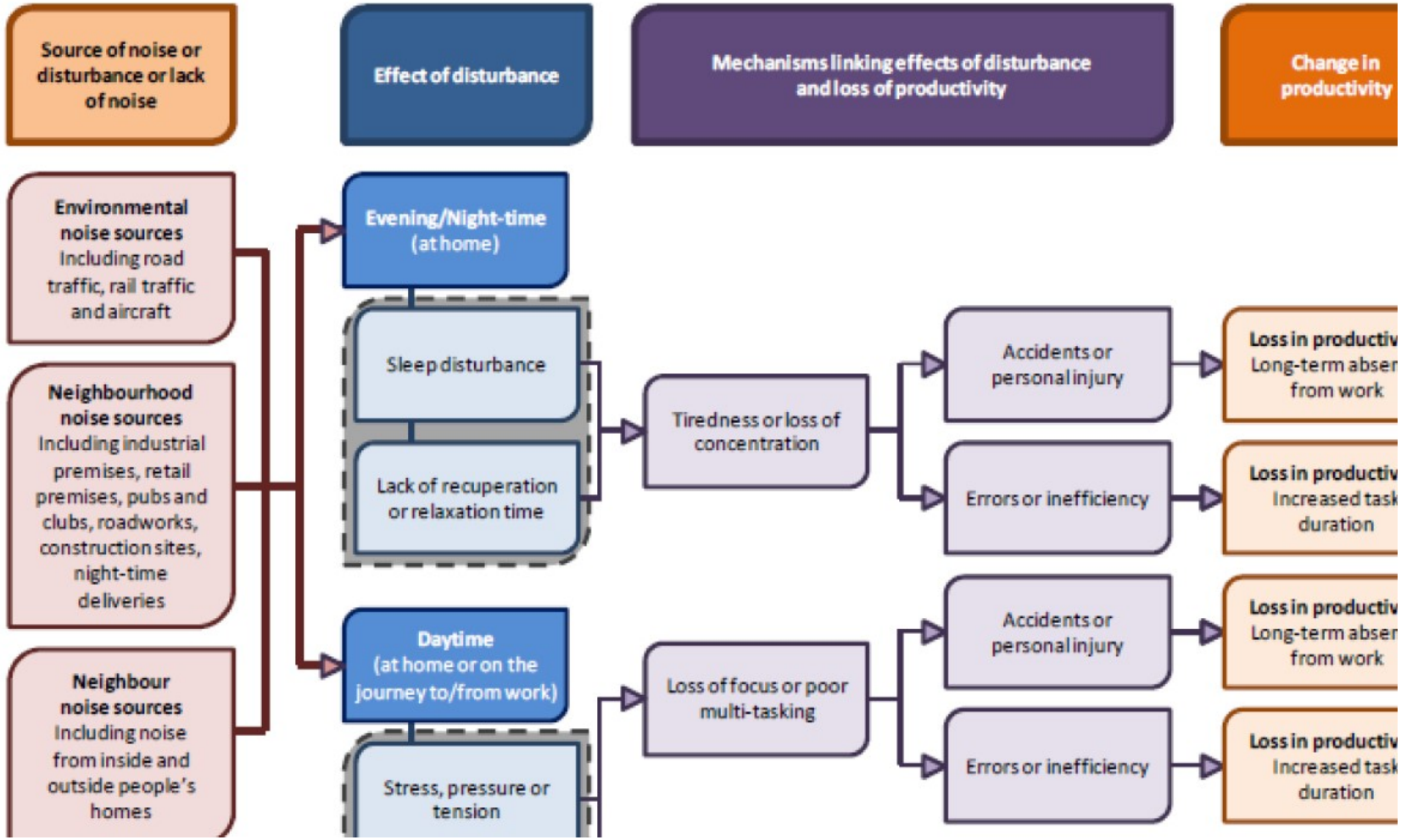
Productivity

- Research investigated the potential pathways through which noise could affect productivity.
- Potential pathways:
  - noise experienced during working hours,
  - noise experienced outside of working hours;
  - noise impacts on academic performance linked to later-in-life productivity
- Indicative estimates for the productivity costs to England from sleep disturbance attributable to environmental noise ~ £2-4billion per annum.

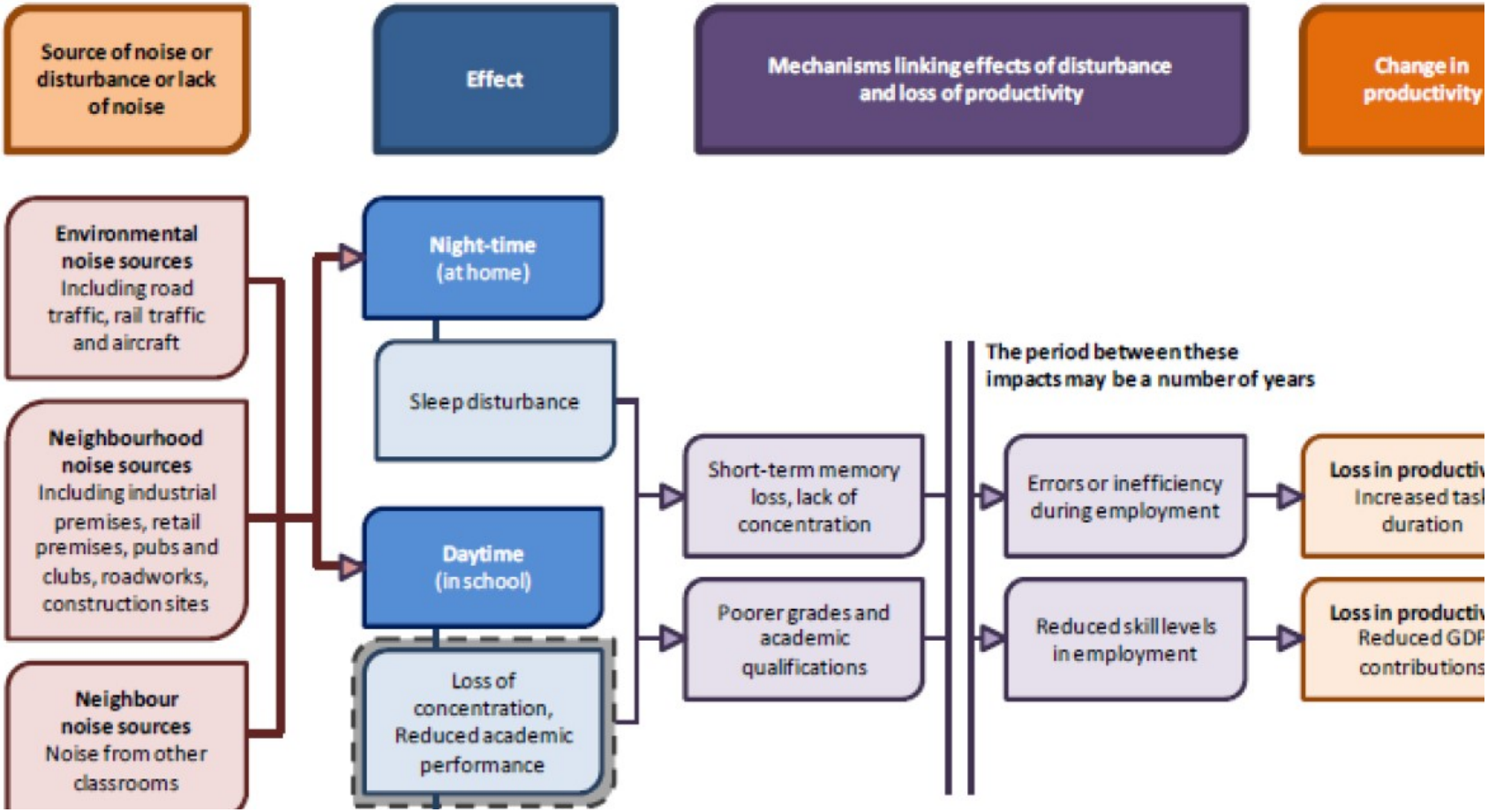
Productivity – noise during working hours



Productivity – noise outside working hours



Productivity – academic performance



Economic value of quiet areas

- Defining quiet and quiet areas
  - quantitative methods, subjective methods, sound quality, potential use
- Benefits of quiet and quiet areas
  - improved creativity, problem solving, mental health, concentration and undisturbed sleep.
- Value of Open Spaces – survey in 3 green urban spaces
  - deriving a noise-sensitive demand curve for urban open spaces.
- A conceptual approach to valuing quiet and quiet areas
  - total use value for visits to quiet areas in England estimated between £19 million and £1.4 billion per year.