Restorative Soundscapes

Dr Sarah Payne
Associate Professor of Health in the Built Environment
Heriot-Watt University
Presentation at Urban Sound Symposium, Gent, Belgium
3rd April 2019

The problem: Mental health

- Mental health issues and stress is rising
- Substantial economic cost on society
  - £105 billion in UK (UK Department of Health, 2011)
  - EUR 600 billion across 28 EU countries (OECD 2018)

Restorative environments help people recover from stressors and avoid some mental health problems
The need to (cognitively) restore

- **Attention Restoration Theory**  
- Working on a task involves Directed Attention
  - Involves effort
  - Inhibits distractions
  - Helps provide focus
- BUT it is susceptible to fatigue
  - Become distracted, focus on short term actions
  - Hinders problem solving, increases irritability

Dr S.R. Payne: Project DeStress

The need to (affectively) restore

- **Stress Recovery Theory**  
  Ulrich 1983, Ulrich et al., 1991
- Situations that challenge or threaten wellbeing => Stress
- Results in
  - negative emotions
  - reduced cognitive performance
  - coping responses
  ➢ utilises energy & can result in fatigue

Dr S.R. Payne: Project DeStress
Restorative environments

- Restorative Environment
  - Fascination - Involuntary Attention
  - Being Away
  - Compatibility
  - Extent

- Restorative Outcomes
  1. Recover (cognitively & affectively)
  2. Reflect
Dr S.R. Payne: Project DeStress

Which sounds are restorative? Which sounds disrupt restoration?

Natural sounds

- Bird sounds vary in **perceived restoration potential**
  - Greenfinch
  - Blue Tit
  - Quiet
  - Complex song
  - Familiar
  - X Magpie
  - X Gulls
  - X Loud
  - X Calls

Ratcliffe et al., 2016
Traffic sounds

Traffic related exposures affect perceived restorative quality of living environment which affects residential satisfaction

Von Lindern et al, 2016

Water sounds

Water as a masker of urban traffic

- Stream & waves are more preferable maskers (Jeon et al., 2010)
- Natural stream more relaxing than Fountain sounds > Waterfall (Galbrun & Ali, 2013)
- 0 to -3dB difference
- Temporal variation important
Restorative variation in urban soundscapes?

• 400 visitors to two urban parks in UK

<table>
<thead>
<tr>
<th>Background City</th>
<th>quiet</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>loud</th>
<th>N/A</th>
</tr>
</thead>
<tbody>
<tr>
<td>e.g. background traffic.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- Natural sounds
- Happy People sounds
- Sad and Angry people sounds
- Object sounds due to people in the park
- Sounds from the surrounding buildings
- Individual Vehicle or Aircraft
- Background City

Dr S.R. Payne: Project DeStress

<table>
<thead>
<tr>
<th>Soundscape Type</th>
<th>n</th>
<th>Sound types and their predominance level</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>177</td>
<td>Weak Natural and Happy People sounds</td>
</tr>
<tr>
<td>2</td>
<td>123</td>
<td>Strong Natural sounds with Happy People and weak People’s Object sounds</td>
</tr>
<tr>
<td>3</td>
<td>36</td>
<td>Strong Happy People sounds with Background City/Traffic and Natural sounds</td>
</tr>
<tr>
<td>4</td>
<td>24</td>
<td>Strong Buildings/Construction work with Background City/Traffic, and weak Natural and Happy People sounds</td>
</tr>
<tr>
<td>5</td>
<td>21</td>
<td>Strong Background City/Traffic and a cacophonous soundscape</td>
</tr>
</tbody>
</table>

**High perceived restorative qualities**

**Low perceived restorative qualities**

<table>
<thead>
<tr>
<th>Soundscape Type</th>
<th>n</th>
<th>Sound types and their predominance level</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>177</td>
<td>Weak Natural and Happy People sounds</td>
</tr>
<tr>
<td>2</td>
<td>123</td>
<td>Strong Natural sounds with Happy People and weak People’s Object sounds</td>
</tr>
<tr>
<td>3</td>
<td>36</td>
<td>Strong Happy People sounds with Background City/Traffic and Natural sounds</td>
</tr>
<tr>
<td>4</td>
<td>24</td>
<td>Strong Buildings/Construction work with Background City/Traffic, and weak Natural and Happy People sounds</td>
</tr>
<tr>
<td>5</td>
<td>21</td>
<td>Strong Background City/Traffic and a cacophonous soundscape</td>
</tr>
</tbody>
</table>

**Restoration**: 4.31 4.75 4.27 4.95 4.37 4.49 4.19

**Recovery**: 4.33 4.83 4.24 4.78 4.55 4.52 4.46

**Reflection**: 4.29 4.67 4.30 5.11 4.19 4.46 4.46

Field work in three urban places

- Urban garden, Urban park, Urban square
- *In situ* questionnaires – 159 people, 8 days
- Acoustic measurements at same time
- Ambisonic recordings at same time

Most frequently perceived sounds

<table>
<thead>
<tr>
<th>Garden</th>
<th>Park</th>
<th>Square</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nature 32%</td>
<td>Nature 37%</td>
<td>People’s vocal sounds 31%</td>
</tr>
<tr>
<td>People’s vocal sounds 19%</td>
<td>Vehicles &amp; Traffic 27%</td>
<td>Vehicles &amp; Traffic 20%</td>
</tr>
<tr>
<td>Vehicles &amp; Traffic 18%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Perceived Restoration

- **dB (A) level**
  - Coast: 49
  - Park: 58
  - Town Centre: 60

- **Perceived Quiet (7=Quietest)**
  - Coast: 6.2
  - Park: 5.5
  - Town Centre: 4.8

- **Perceived Restoration (7=most restored)**
  - Coast: 5.5
  - Park: 6.2
  - Town Centre: 5.8

Payne, S.R. (2019: under review - IJERPH)

Dr S.R. Payne: Project DeStress

---

Project DeStress

Designing and engineering Soundscapes to enable restorative environments for sustainable societies

Dr S.R. Payne: Project DeStress
Virtual Environment Simulator

- Experimentally assess impact of built and social environment on soundscape and restoration
- A tool for users to create virtual urban places - audio-visual simulations
- Uses field recordings & acoustic data
- Can manipulate built enviro. & social aspects
  - Building façade material
  - Ground surface material
  - Presence of water
  - Amount of vegetation
  - Amount of traffic
  - Amount of people

Project DeStress

Environment Simulator

Step 2 - Choose the main thing you want to change in this virtual place
Façade & surface changes

Urban Park Low
   (people, traffic & vegetation)

Thanks to Dr Neil Bruce
(RA on Project Destress)
Urban Park Medium
(people, traffic & vegetation)

Urban Park High
(people, traffic & vegetation)

Thanks to Dr Neil Bruce
(RA on Project Destress)
Restorative Soundscapes Summary

- **In general**, natural sounds important in creating restorative environments, urban traffic constrain restoration
- More research needed to show impact of designed soundscapes on restoration
- **Project DeStress Virtual Environment Simulator**
  - Tool to experimentally test relationship between restoration & soundscapes
  - Provide information to public on health benefits of high quality soundscapes
  - Raise planners awareness of implications of built environment decisions on impact on soundscapes & subsequent health impacts