Using Sound to Augment ‘the Image’

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The Power of the Image 2011
Using Sound to Augment ‘the Image’

- Using sound to represent uncertainty in spatial data
- Visual representation
- The need for alternatives
- Visual & sonic comparison
  - UKCP09 Data
  - Google Maps
- Results
- Conclusion

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![Map](image_url)
Spatial Data is usually shown Visually
But the ellipsis: Vision has Limits

- Limit on info shown visually
- Sometimes need to show all this information

Source: http://kbark.wordpress.com/2006/12/17/where-am-i/ (18/03/2009)
Future Climate Predictions

**Edinburgh**
$+1^\circ C \pm 0.2^\circ C$
$+0.8^\circ C$ to $+1.2^\circ C$

**Norwich**
$+2.5^\circ C \pm 5.2^\circ C$
$-2.7^\circ C$ to $+7.7^\circ C$

Jenkins, G. J., Perry, M. C. & Prior, M. J. (2008) Figure 2.63d

How do we show all of this info?

Use another sense
Use Another Sense

- Vision is visually saturated
- Haptic is expensive
- Smell & taste are difficult!
- Sound is easy & cheap
Sound Facts

• After vision, sound is next most powerful sense (Minghim, 1995; Fortin et al., 2007)

• Most people are capable of greater sonic differentiation that they utilise (Loomis et al., 1993; Klatzky & Golledge, 1995)
  • People can tell the difference between any 2 of 400,000 different sounds
  • People can remember up to 49 unique sounds Brewster (1994)

There should be some potential...

However, limited work and very limited testing
Previous Examples

- Often used for visual impaired
- Zhao (2006) Splits Screen into 9, Reads Aloud
- Fisher (1994) Uncertainty and Land Cover Classification
- MacVeigh & Jacobson (2007) Harbour, Sea and Land
- I’m looking at using sound and vision in combination
- Sound augmenting vision
- Method, UKCP09, Google Maps, Results

Visual Representation
Alternative Sense
Method

• Compare visual & sonic methods
• Used UKCP09 data

• Participants in small groups
  • Questionnaire
  • Google Maps API
  • Discussion session
UK Climate Projections 2009

- Future climate for UK up to 2080s
- Latest in the series
- First set to include uncertainty

- Uncertainty is useful
- But users have to change their workflow to make use of UKCP09
- How do we represent this?
Uncertainty in UKCP09

Edinburgh
+ 1°C ± 0.2°C
+0.8°C to +1.2°C

Norwich
+ 2.5°C ± 5.2°C
-2.7°C to +7.7°C

Jenkins, G. J., Perry, M. C. & Prior, M. J. (2008) Figure 2.63d
Methods

- Comparing visual and sonic methods of representing the uncertainty

- Showed users the data
  - visually and/or sonically

- Asked users to highlight specific areas where temperature and uncertainty over thresholds
How to compare?

- Online evaluation
- Web based mapping
  - Show UKCP09 data
  - Collect responses
- Google Maps
  - Familiar to most users
  - Good API docs & support
- How?
  - Lots of tutorials
  - Took about 6 months
These maps show both the 50th Percentile values and the Range values using colour.

Please highlight on the right-hand map the locations where the 50th Percentile values are greater than approx 28°C and where the Range values are greater than approx 6.5°C.

Remember: highlight the locations where both values exceed the specified limits.

Remove Last Point
Clear Highlight
Continue
These maps show both the 50th Percentile values and the Range values using colour and sound.

Please highlight on the right-hand map the locations where the **50th Percentile** values are greater than approx. 21.5°C and where the **Range** values are greater than approx. 4.5°C.

Remove Last Point
Clear Highlight

Continue

Sound is not muted.
This map shows the 50th Percentile values using colour and the Range values using sound.

Please highlight the locations where the 50th Percentile values are greater than approx. 21.5°C and where the Range values are greater than approx. 4.5°C.

Remove Last Point
Clear Highlight
Continue
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Results

- Calculated Phi value: +1.0 to -1.0
- Great variation within results
- Awareness of data set is important
- Using sound to reinforce vision increases scores (p = 0.005) for most
- Using sound for different variable helps some but not others
- Subject knowledge & repeated use appear to help

The graph shows a scatter plot with multiple lines connecting various points on the x and y axes. The x-axis labels include 'Map1 Phi', 'Map2 Phi', 'Map3 Phi', and 'Map4 Phi'. The y-axis ranges from 0.2 to 1.0. The lines are color-coded, with each line representing different data sets or conditions. The visual representation helps in understanding the variation and relationships between the different maps and their Phi values.
Results

• Learning Style may have an impact
  • Visual or aural
  • Slight trend for visual
  • Currently unclear based on these results

• Could be very useful to colour blind users
  • But not the focus of this research

• Lots of views on the sound
  • Not all consistent!
Overall

*Using sound to represent uncertainty in spatial data*

- Compared different methodologies
  - Vision, sound and both
- Using Uncertainty in UKCP09
- Sound can be useful
- Awareness of the data is important
- Reinforcing vision with sound helps