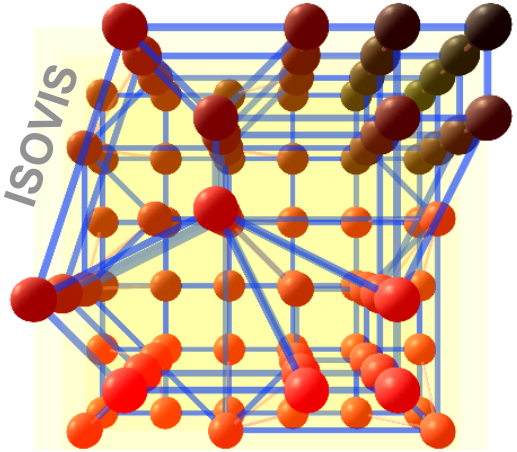

Detecting Insight and Emotion in Visualization Applications with a Commercial EEG Headset

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Content

- Motivation
- Emotiv EPOC
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- Pilot Study
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  - ManyEyes Visualizations
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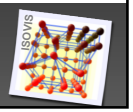


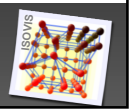
Motivation

- Insight, Aha! moment, epiphany…
  - Isaac Newton - a moment of clarity when he observed an apple falling from a tree ➔ theory of gravity
  - Friedrich August Kekule von Stradonitz - the ring-like structure of benzene

Motivation

- Insight in psychology, cognitive neuroscience…
- "The purpose of visualization is insight, not pictures" - Ben Shneiderman (1999)

- Why? Use insight to evaluate and compare visualization techniques
- How? Defining insight objectively, measuring the number of insights
- Indirect detection of insight through emotions
  - Correlation between emotions and insight?



Motivation

Infosquito, Futurama TV series

Emotiv EPOC Headset

Study

Image blurred by request

- detect facial expressions and emotional states
- considered emotions: engagement, excitement, satisfaction and frustration
- validation and measuring emotions in spot-the-difference tasks and computer games

Pilot Study

Image blurred by request

- Six participants
- Four tasks:
  - 2 visual insight problems and 2 information visualizations
- The difference:
  - single solution-single insight; multiple insights possible

Pilot Study

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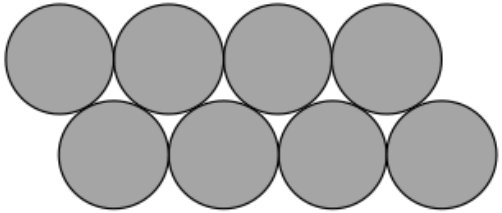
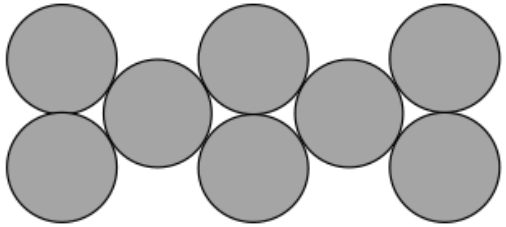
- Comparing the moment of insight with the emotional states prior and during the discovery

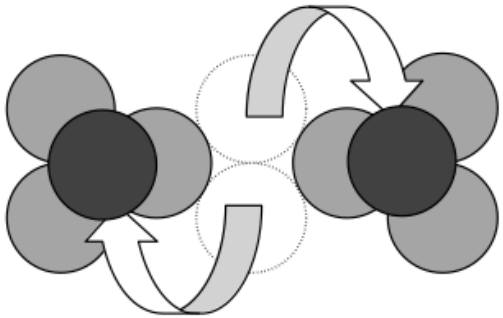
  ➔ frustration - 2 min before, excitement - 10 sec before

- Insights confirmation – verbal and post-task questionnaire

Visual Insight Problems

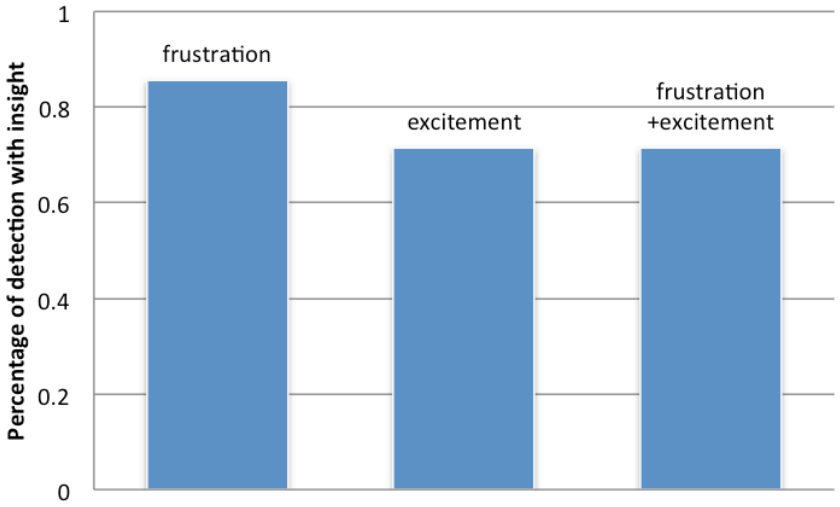


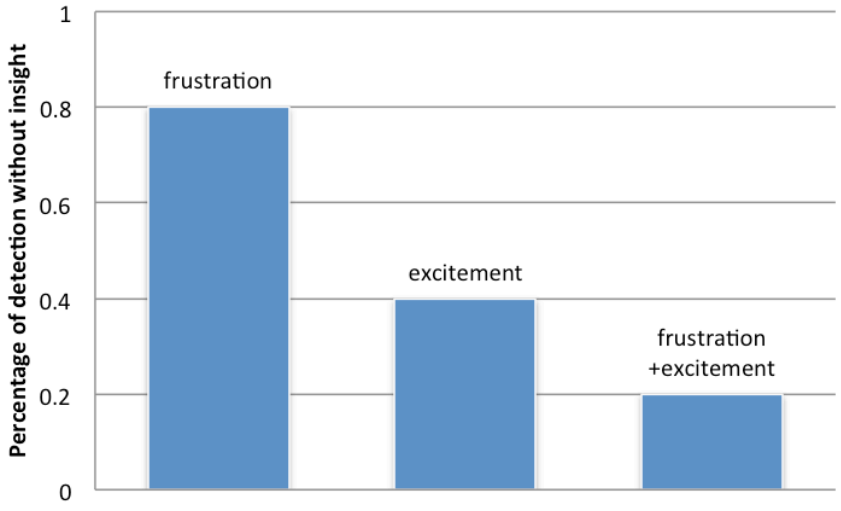




- Eight Coin Problem and Matchstick Arithmetic
- 12 possible insights - 7 solutions

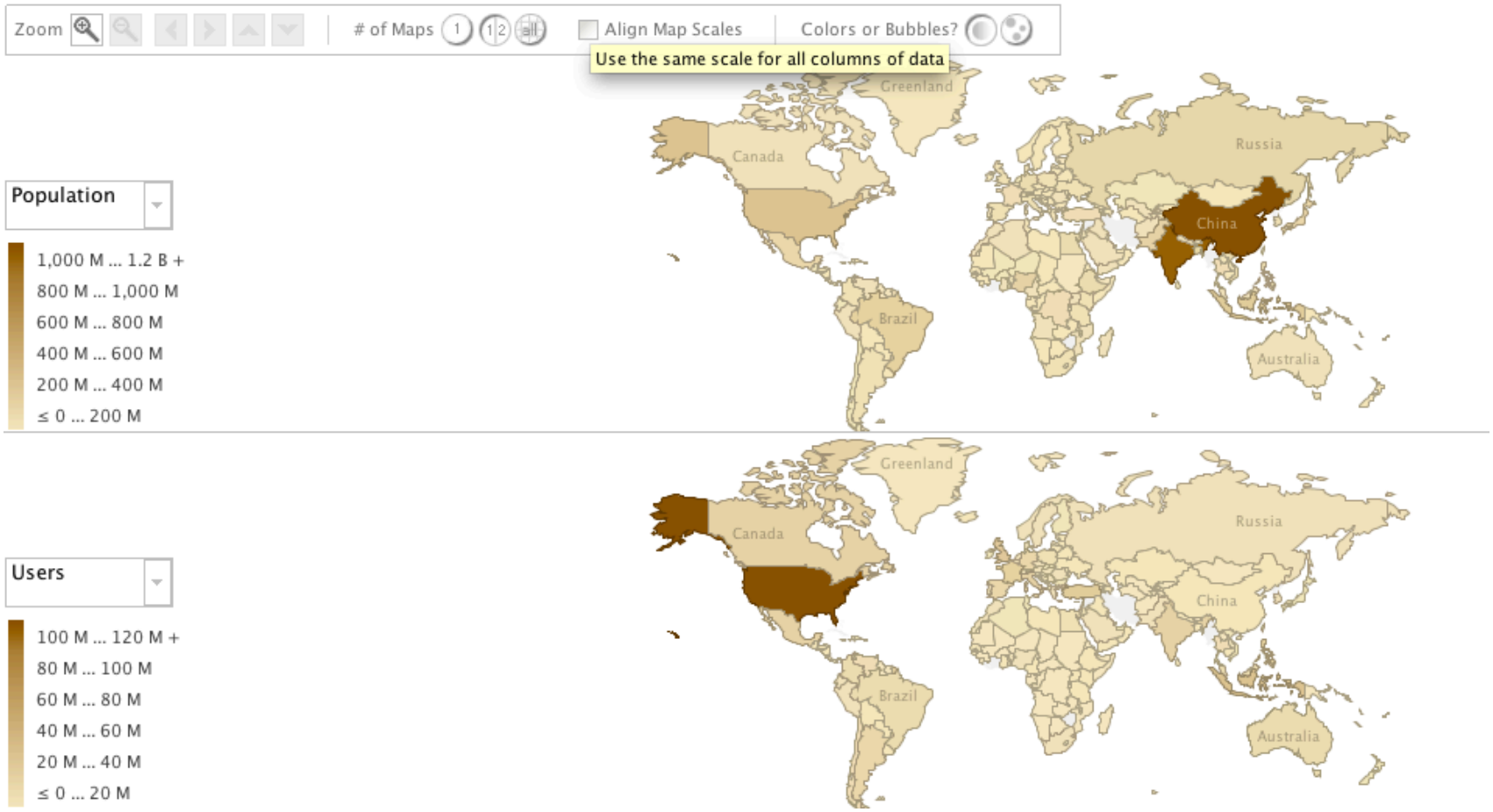
Visual Insight Problems



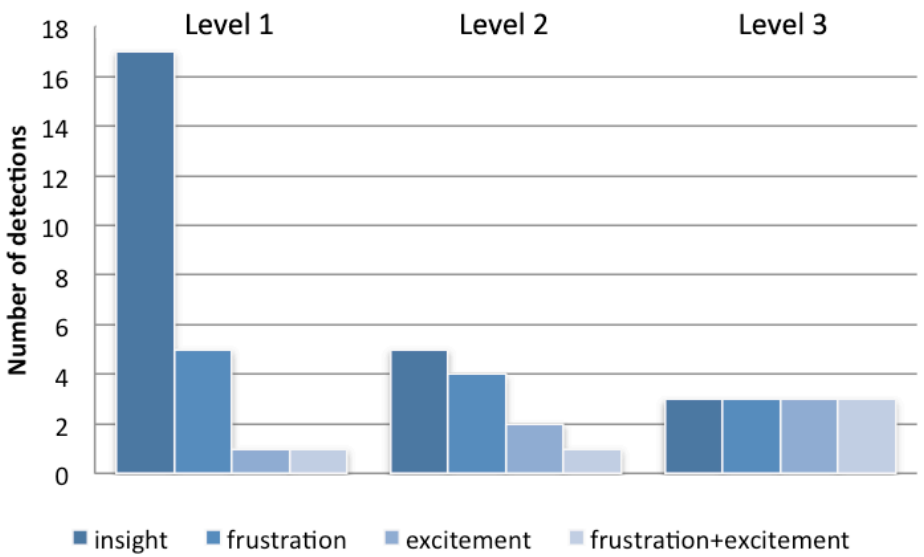


- Correlation
  - 29% error for detection of insight
  - 20% for false detection of insight
- Post-task questionnaire – to confirm insight

ManyEyes Visualizations



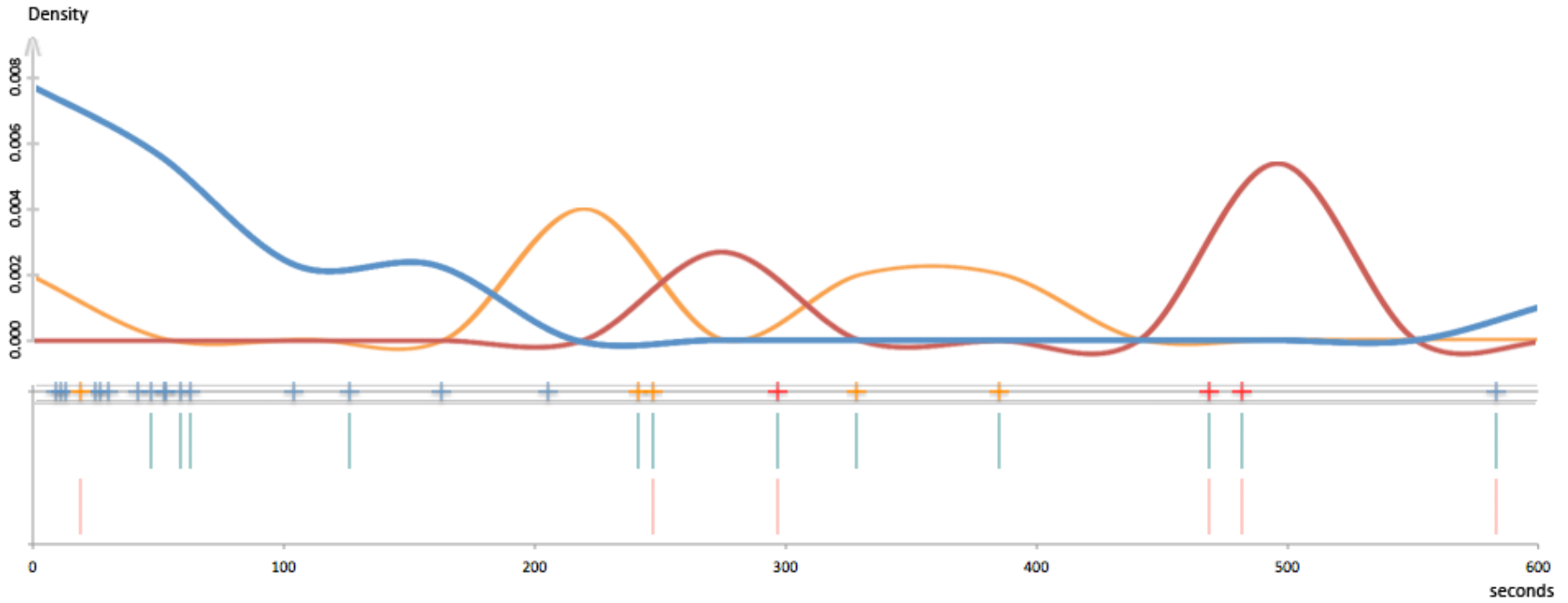
ManyEyes Visualizations



- 2 visualizations
  - data about global demographics and social media
  - stacked graph and cartographic visualization

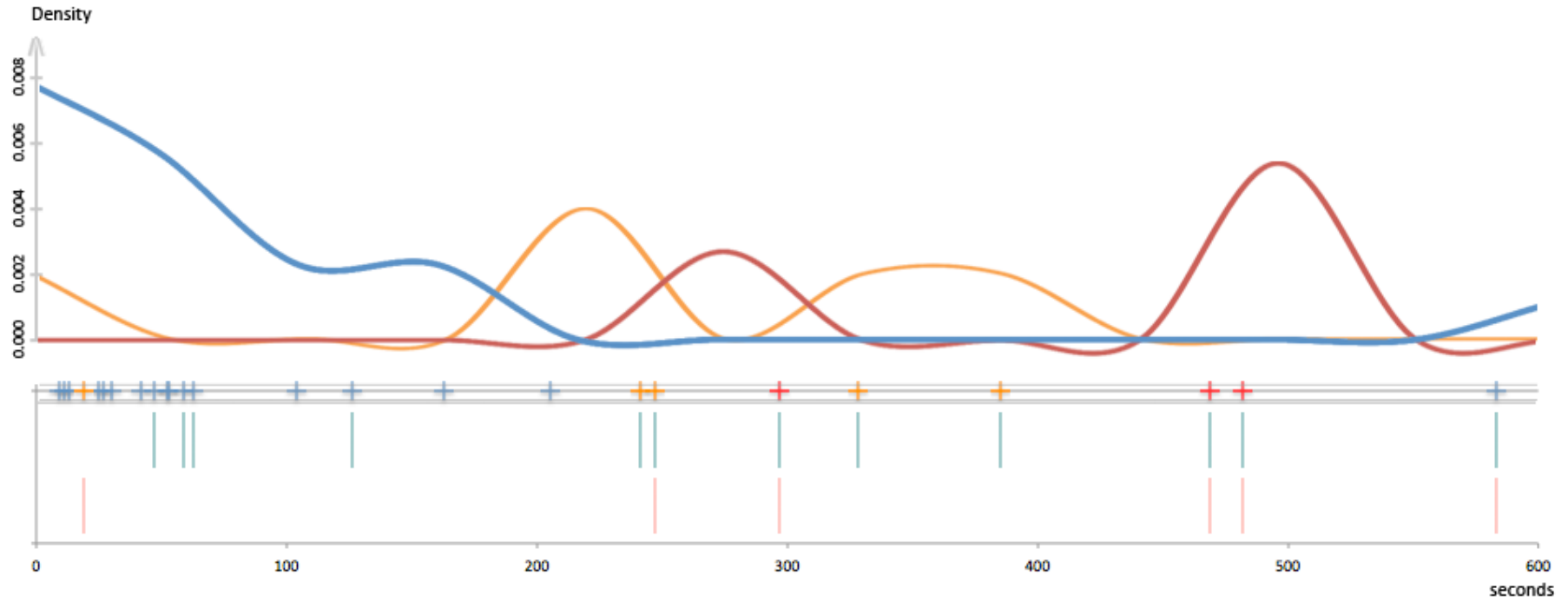
- Depth of insights:
  - trivial insights that include direct observations of one data type
  - combination of multiple data types or insights about a process
  - new hypotheses about the underlying information

ManyEyes Visualizations



- Time – key factor
- Deep insights are more likely to generate emotions (f+e)

ManyEyes Visualizations



- Questionnaire
  - low complexity and was "easy to find" – keyword *unexpected*

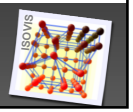
Future Work

- New EEG-based tests for evaluating and comparing different visualization techniques

  + relative value of the insight to the person

- Data tagging and binding based on the interactions the user executed shortly prior and during the moment of insight

- Direct detection of insight



Conclusions

- Insights in visual tasks have the potential of generating emotional responses
- EEG measurements are capable of detecting these emotional states
- Most accurate detection of insight:
  - presence of frustration / effort / deadlock
  - importance to the user – through complexity, domain, direction
  - thinking time

Thank you.

Questions?

Comments?

Suggestions?