

# A user-centered approach for evaluating and extending spatiotemporal crime analysis tools

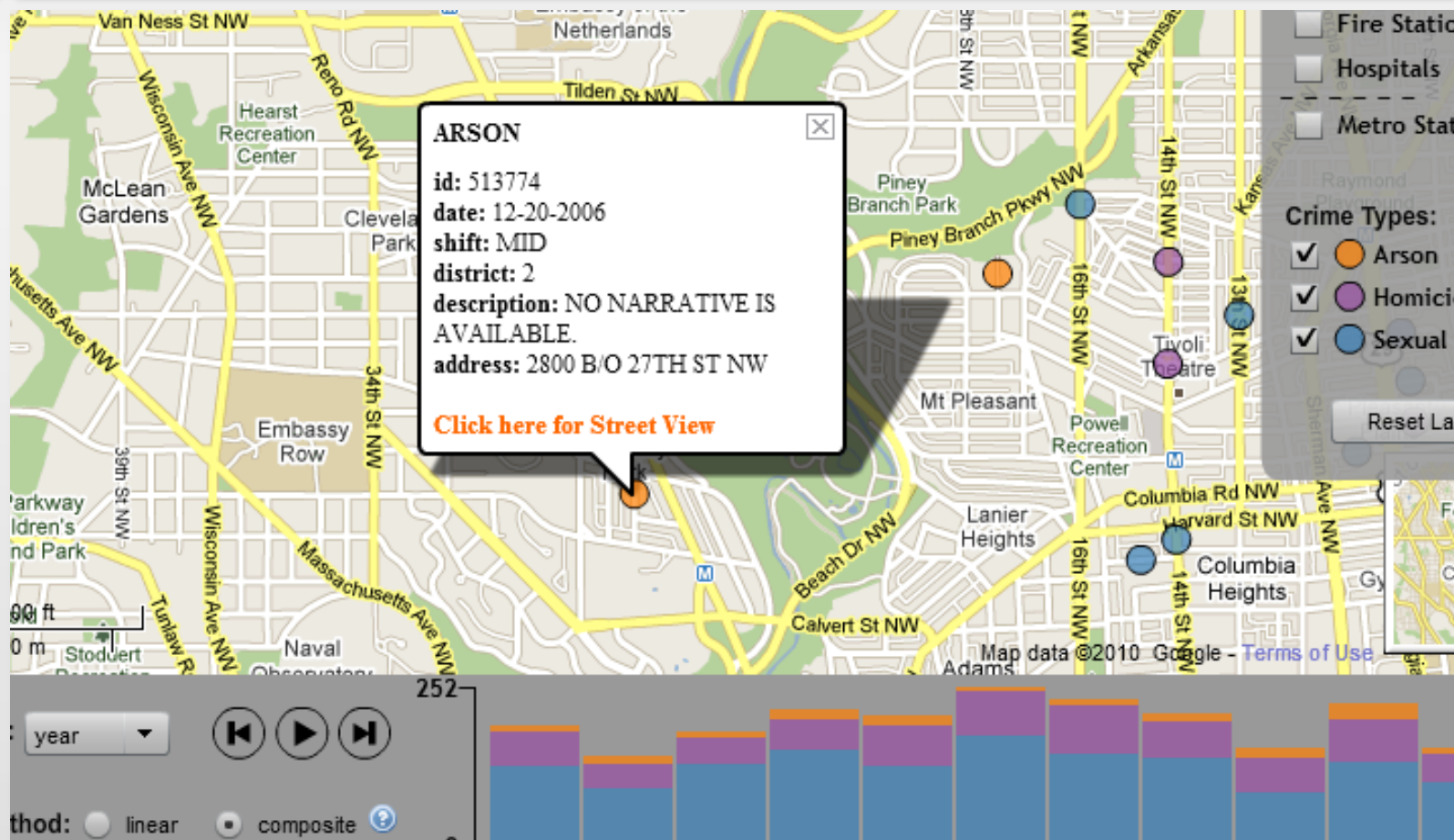
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# SPATIOTEMPORAL CRIME MAPPING

*"At present, the most under-researched area of spatial criminology is that of spatio-temporal crime patterns"*

**Ratcliffe (2009: 14)**  
*Crime Mapping: Spatial & Temporal Challenges*



<http://cartifact.com>

# SPATIOTEMPORAL VISUALIZATION

*"Spatio-temporal information can be effectively understood in **map animation** form, yet both training and tools are still too underdeveloped for mainstream use of animation within the policing domain "*

**Ratcliffe (2009: 17)**

*Crime Mapping: Spatial & Temporal Challenges*

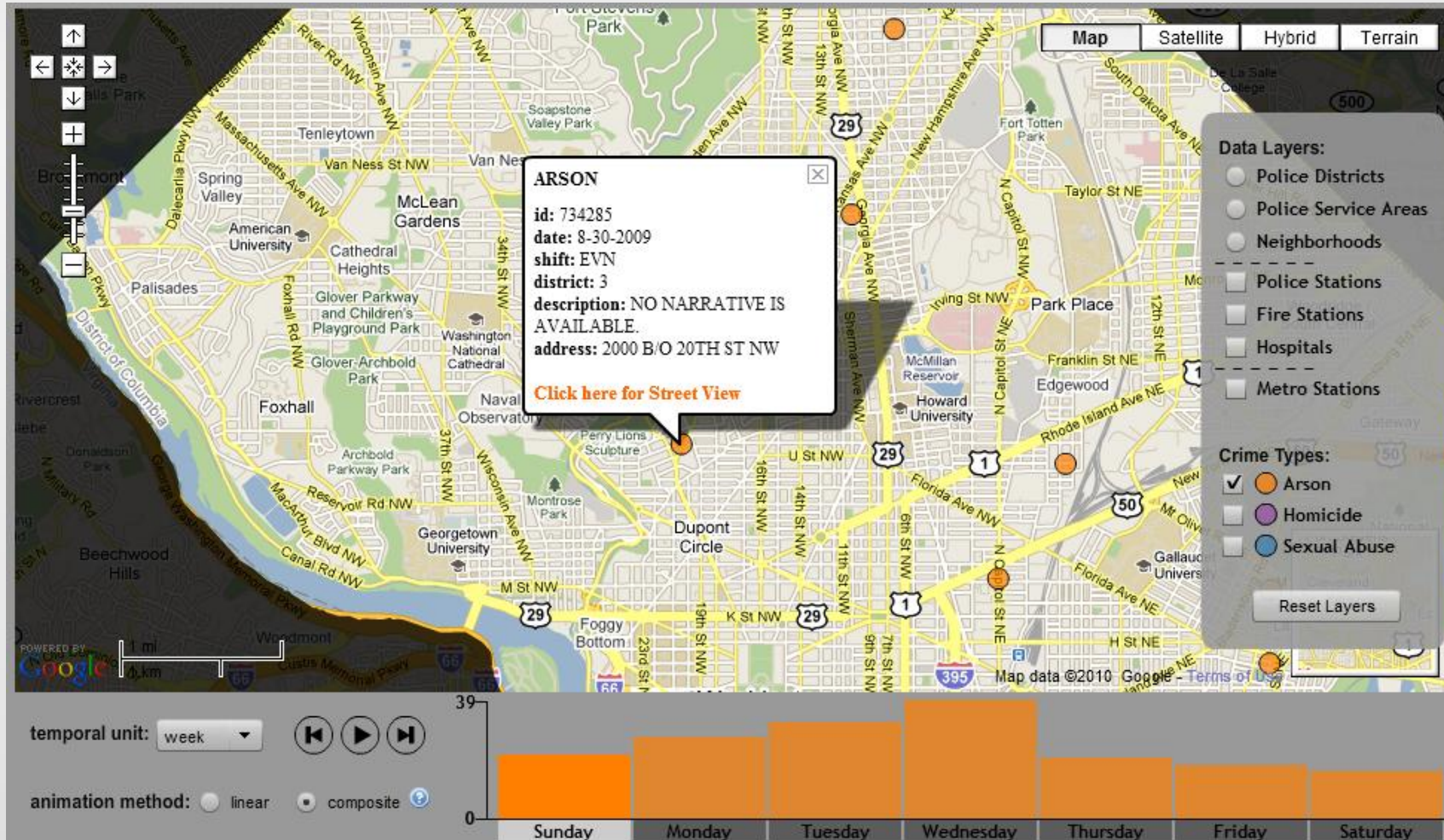


<http://cartifact.com>

# GeoVISTA CrimeViz Prototype

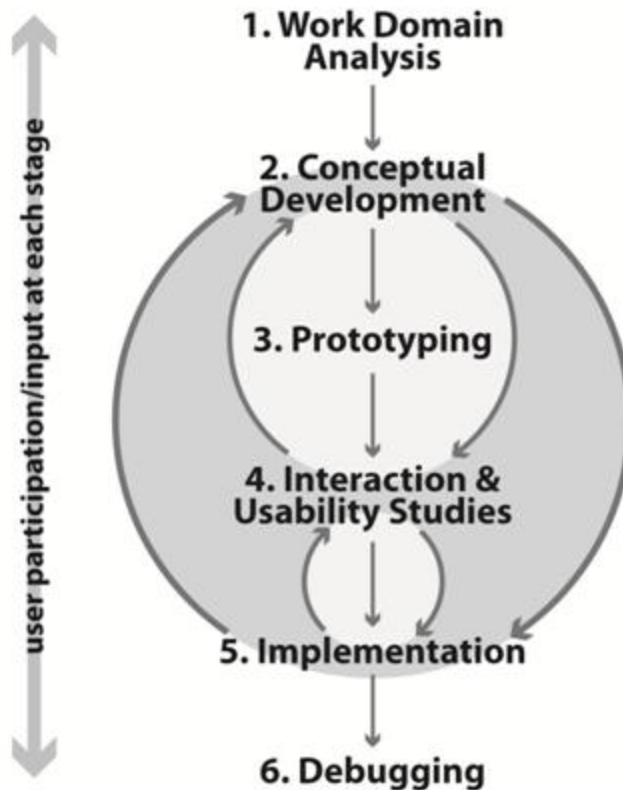
Roth & Ross (2009)

Extending the Google Maps API for Flash for Event Animation Mahsups



# USER-CENTERED DESIGN

interface design that includes numerous iterations of **end user evaluation** and subsequent interface revision to improve the usability and utility of the interface

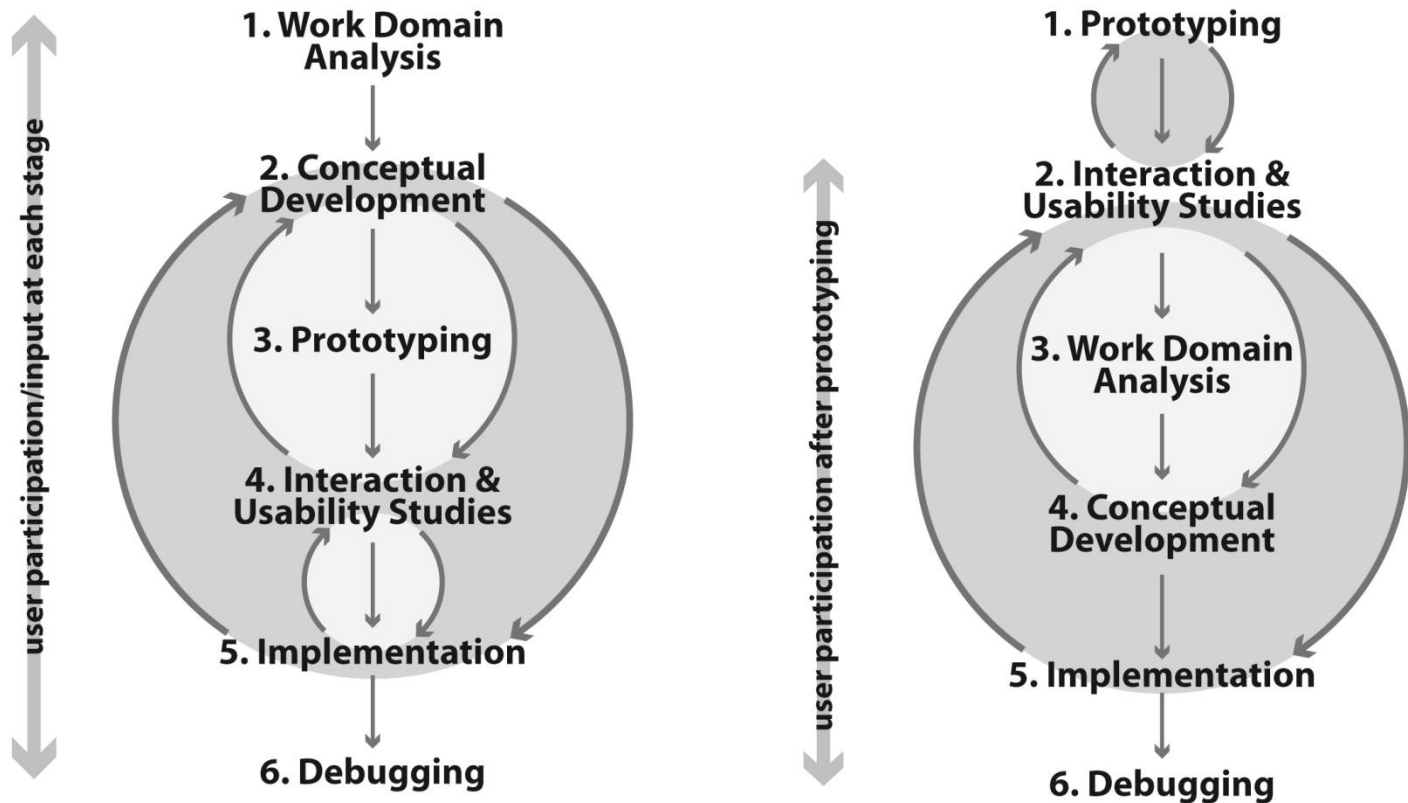


## User-Centered Design Workflow

**Robinson et al. (2005)**  
*Combining Usability Techniques to Design Geovisualization Tools for Epidemiology*

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# USER-CENTERED DESIGN APPROACH

## Pre-Alpha

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### **Think Aloud Study**

users are given a set of tasks and asked to verbalize what they are thinking as they complete them with the pre-alpha version

## Alpha

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### **Needs Assessment Study**

users are interviewed about their current use of spatio-temporal visualization tools in support of crime analysis

### **Follow-up Online Study**

users are asked to experiment with the alpha version and list the spatiotemporal analysis needs that are met and unmet by the tool

## Beta

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### **In-depth Case Study**

a beta version is deployed for a single user group for use 'in the wild' and designers/developers check-in incrementally about user problems/concerns

## Deployment

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# THINK ALOUD METHOD

**Discount methods:** Informal interface evaluation with end users in order to quickly identify usability/utility issues/concerns

**Nielsen (1993)**  
*Usability Engineering*

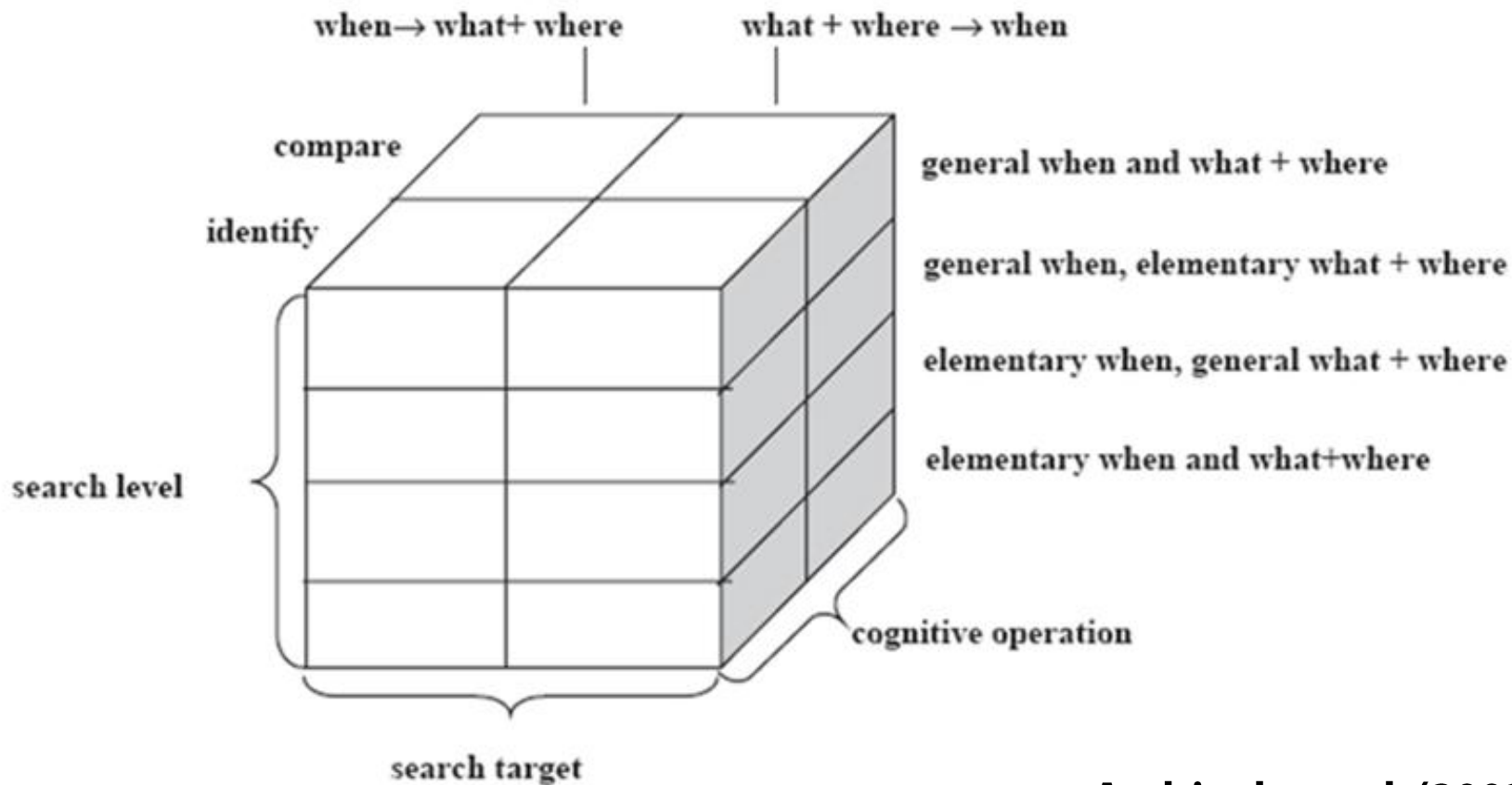
**Participants:** n=5, varying level of experience with spatiotemporal visualization

**Data Collection:** one administrator, two note takers recording critical incidents

## **Think Aloud Protocol (60 minutes):**

- Introduction (5 minutes)
- Opening (5 minutes)
- Tasks (35-40 minutes)
- Cognitive interview (10-15 minutes)

# SPATIOTEMPORAL TASK TAXONOMY



**Andrienko et al. (2003)**

*Exploratory Spatio-Temporal Visualization: An Analytical Review*

# BALANCED TASK SAMPLING

**Twelve** tasks total = ~3 minutes per task

## Identify

### *General*

1. What and Where --> When
2. When --> What and Where
3. Where and When --> What

### *Elementary*

1. What --> When and When
2. What and When --> Where
3. Where --> What and When

## Compare

### *General*

1. What --> When and When
2. What and When --> Where
3. Where --> What and When

### *Elementary*

1. What and Where --> When
2. When --> What and Where
3. Where and When --> What

# RESULTS

<b>Temporal Controls (WHEN) &amp; Histogram Issues</b>	<b>P1</b>	<b>P2</b>	<b>P3</b>	<b>P4</b>	<b>P5</b>	<b>#</b>
Ambiguity in the meaning of linear and composite aggregation	x	x	x	x	x	5
Add ability to select multiple histogram bars for persistent highlighting in the map	x	x	x	x	x	5
Lag in the animation and in histogram brushing when there are a small number of bins	x	x	x	x	x	5
Ambiguity in the meaning of temporal unit when composite is applied	x	x		x	x	4
Data filtering not reflected in the histogram tool tip		x	x		x	3
Add a clear division by year for the linear-month histogram	x		x			2
Add a scroll feature to the histogram so that the bins could be wider				x	x	2
Animations continued to play or stopped in unexpected ways when interacting with the histogram or map		x	x			2
Unclear labels on temporal legend	x				x	2
Unable to discriminate the different types of crime in the histogram without brushing				x		1
Add ability to customize the bin widths					x	1
Add a reset animation feature		x				1
Ambiguity in interpreting composite-month because of extra Jan and Feb from 2009		x				1

# RESULTS

<b>Spatial Controls (WHERE) &amp; Map Issues</b>	<b>P1</b>	<b>P2</b>	<b>P3</b>	<b>P4</b>	<b>P5</b>	<b>#</b>
Add a search feature by police record number	x	x	x	x	x	5
Add a search feature by address	x	x	x	x	x	5
Unable to discriminate the different areal boundary layers because they are the same color	x	x	x	x	x	5
Unable to retrieve information about districts (both IDs, population, and incidents) and POIs	x	x	x	x	x	5
Overlapping incident symbols / Too much data on the map / Add data aggregation option	x	x	x	x	x	5
Unable to discriminate the different types of crime without filtering/brushing them		x	x	x	x	4
Add scroll zooming using the mouse wheel	x	x			x	3
Add ability to zoom into a feature	x	x			x	3
Add a spatial extent reset feature		x	x	x		3
Add a measurement tool (linear) or distance query tool (circular from point)	x	x			x	3
Unable to discriminate the different Points of Interest		x		x	x	3
Add cluster analysis feature		x		x	x	3

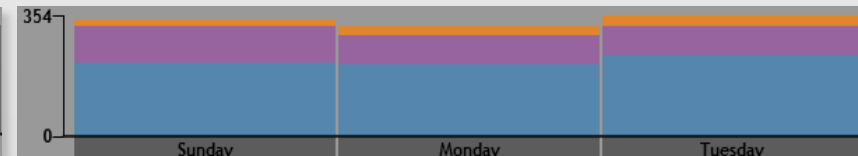
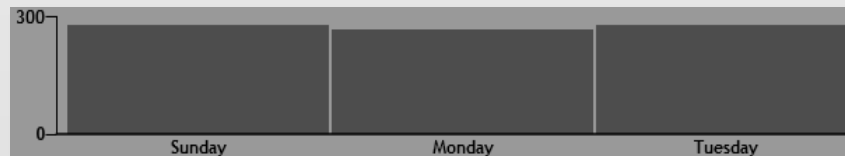
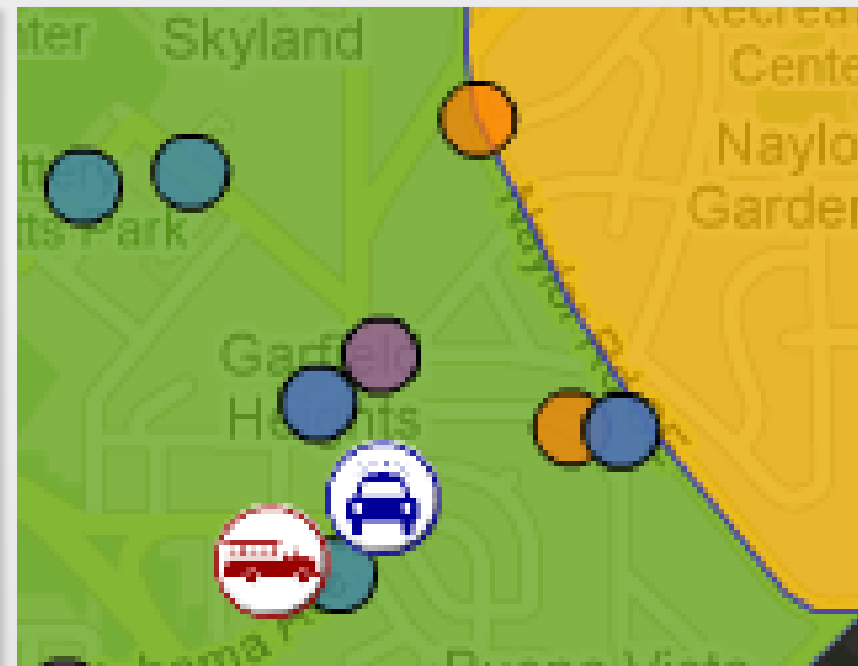
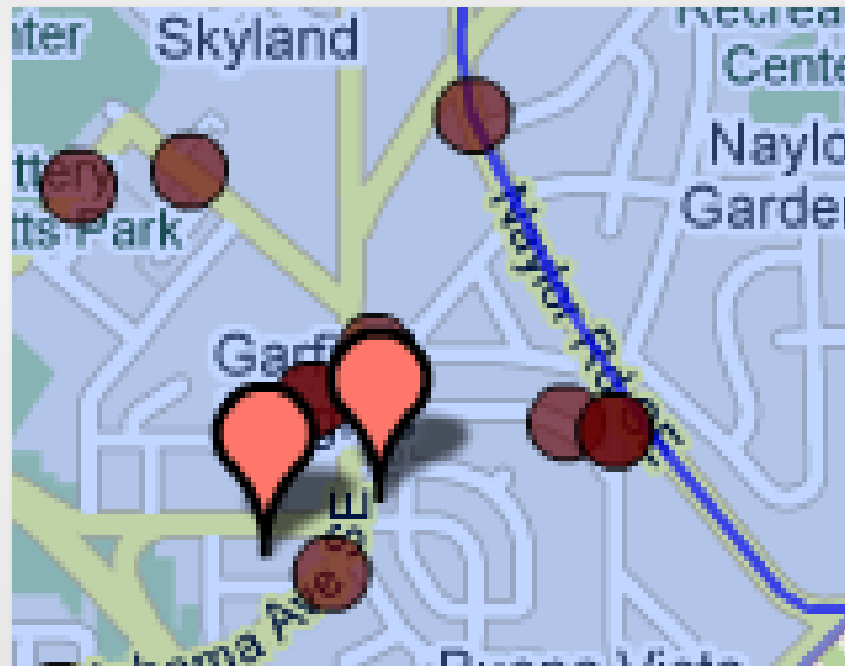
# RESULTS

<b>Spatial Controls (WHERE) &amp; Map Issues (cont'd)</b>	<b>P1</b>	<b>P2</b>	<b>P3</b>	<b>P4</b>	<b>P5</b>	<b>#</b>
Lag in panning and zooming when numerous points are shown	x					1
Add a search feature by Point of Interest					x	1
Add rubberband zoom using Shift+Drag		x				1
Unclear that Street View is available	x					1
Selection of 'fullscreen' instead of 'close' in Street View					x	1
Street View does not work in Internet Explorer					x	1
Information window should close when clicking outside of it		x				1
Information window should include the address		x				1
Add ability to show the case ID on mouse over of the point symbol					x	1
Add buffer feature				x		1

<b>Data Layers Panel (WHAT) &amp; Data Issues</b>	<b>P1</b>	<b>P2</b>	<b>P3</b>	<b>P4</b>	<b>P5</b>	<b>#</b>
Application breaks when viewing 'Bus Stops' data layer	x	x	x	x	x	5
Sexual abuse cases after 2006 not mapped	x	x	x	x	x	5
Loading screen does not provide feedback	x			x		2
Add a data layer with metro lines as well as stations			x			1
Data Layers panel overlaps the Google Maps inset	x					1
Add a layer reset feature			x			1
Crime layer check boxes low on the visual hierarchy				x		1
One misregistered data point		x				1

# DISCUSSION

## Recommendation #1: Identify Missing Functionality or Key Impediments to Use Through Early User Testing



# DISCUSSION

## Recommendation #2: Consider How to Best Support Each Expected Spatiotemporal Task

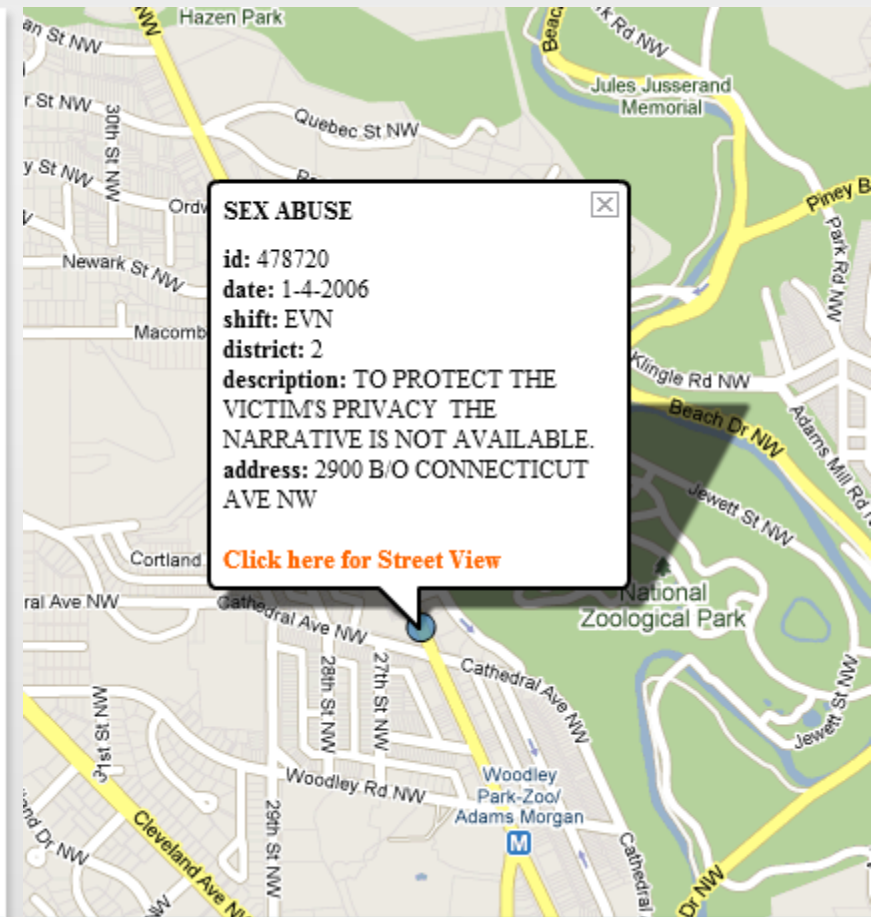
### Identify: Elementary

**4. What --> When and Where:** When and where did the sexual abuse described in report # 623801 occur?

**5. What and When --> Where:** How close is the nearest metro station to the August 2007 homicide described in report #100008683?

### Compare: Elementary

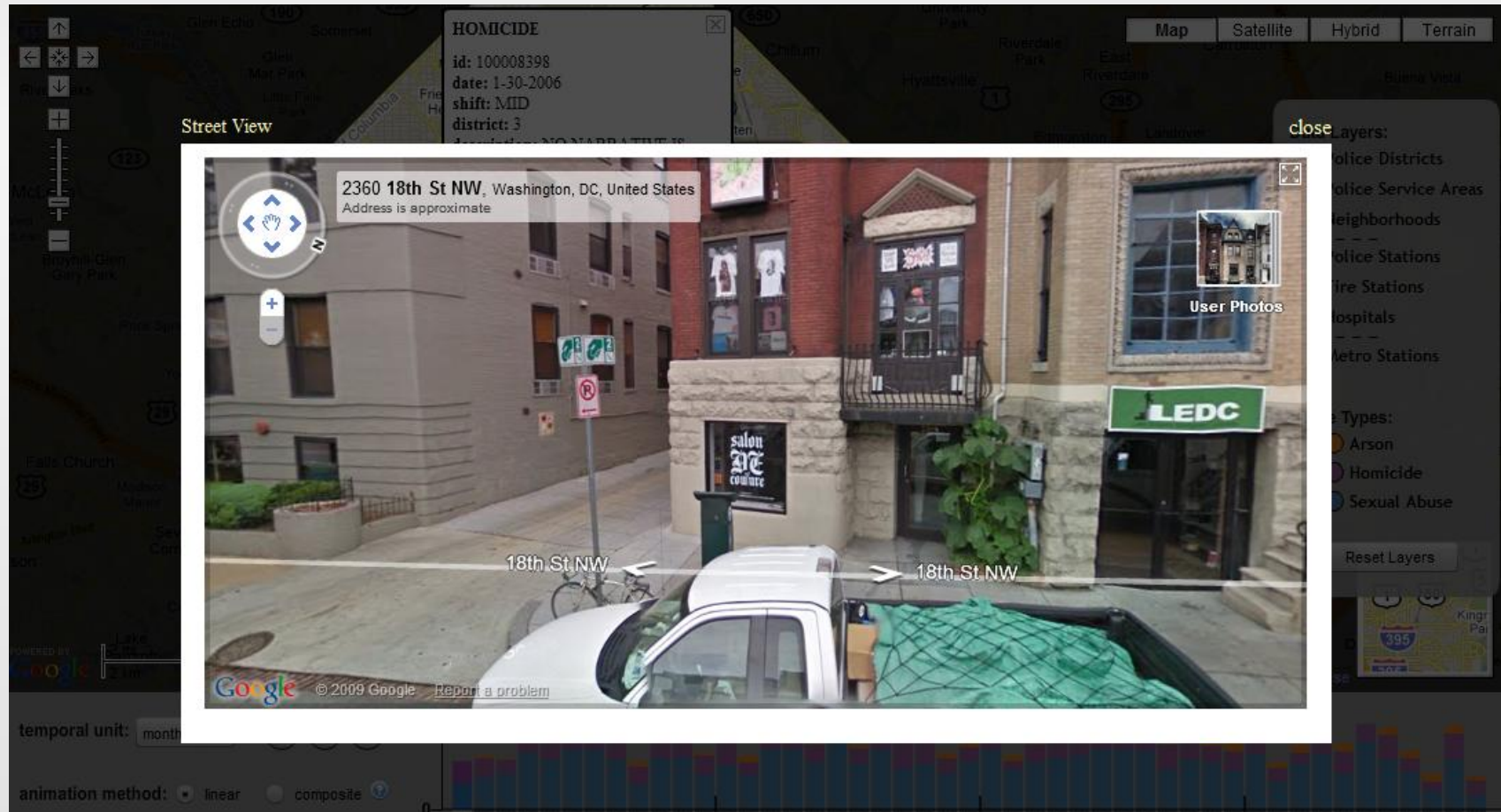
**12. Where and When --> What:** In January, 2006, which sexual abuse case took place near a playground: (a) the one near the corner of Florida Ave and 9th St, or (b) the one near the corner of New York Ave and N Capitol St?





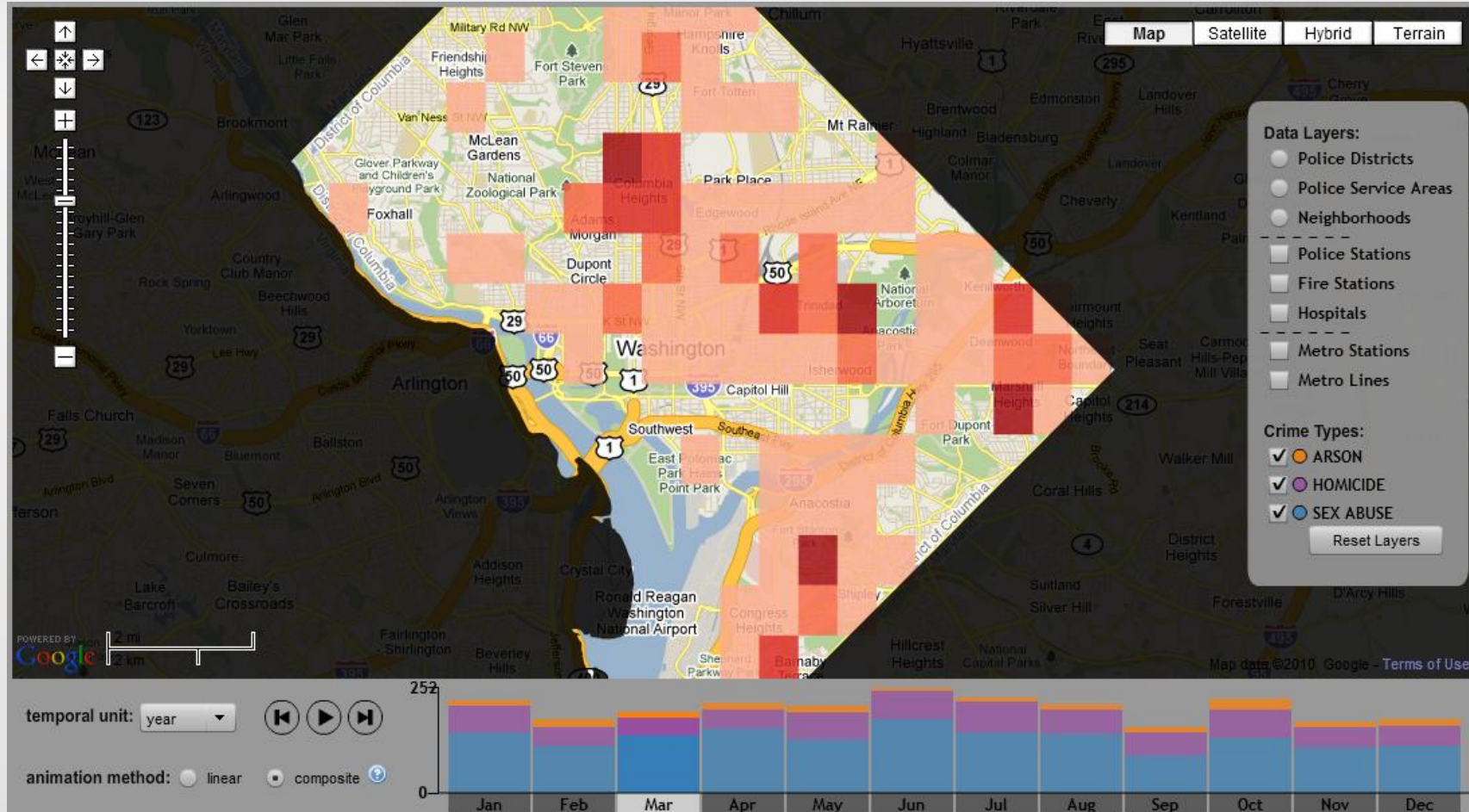
# DISCUSSION

## Recommendation #3: Where Possible, Follow Web Map Conventions



# DISCUSSION: VISUAL ANALYTICS

## Recommendation #4: Tools must scale to large, complex incident datasets



Learn more about the project & try out the alpha version at:  
<http://www.geovista.psu.edu/CrimeViz/>

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