A user-centered approach for designing and developing spatiotemporal crime analysis tools

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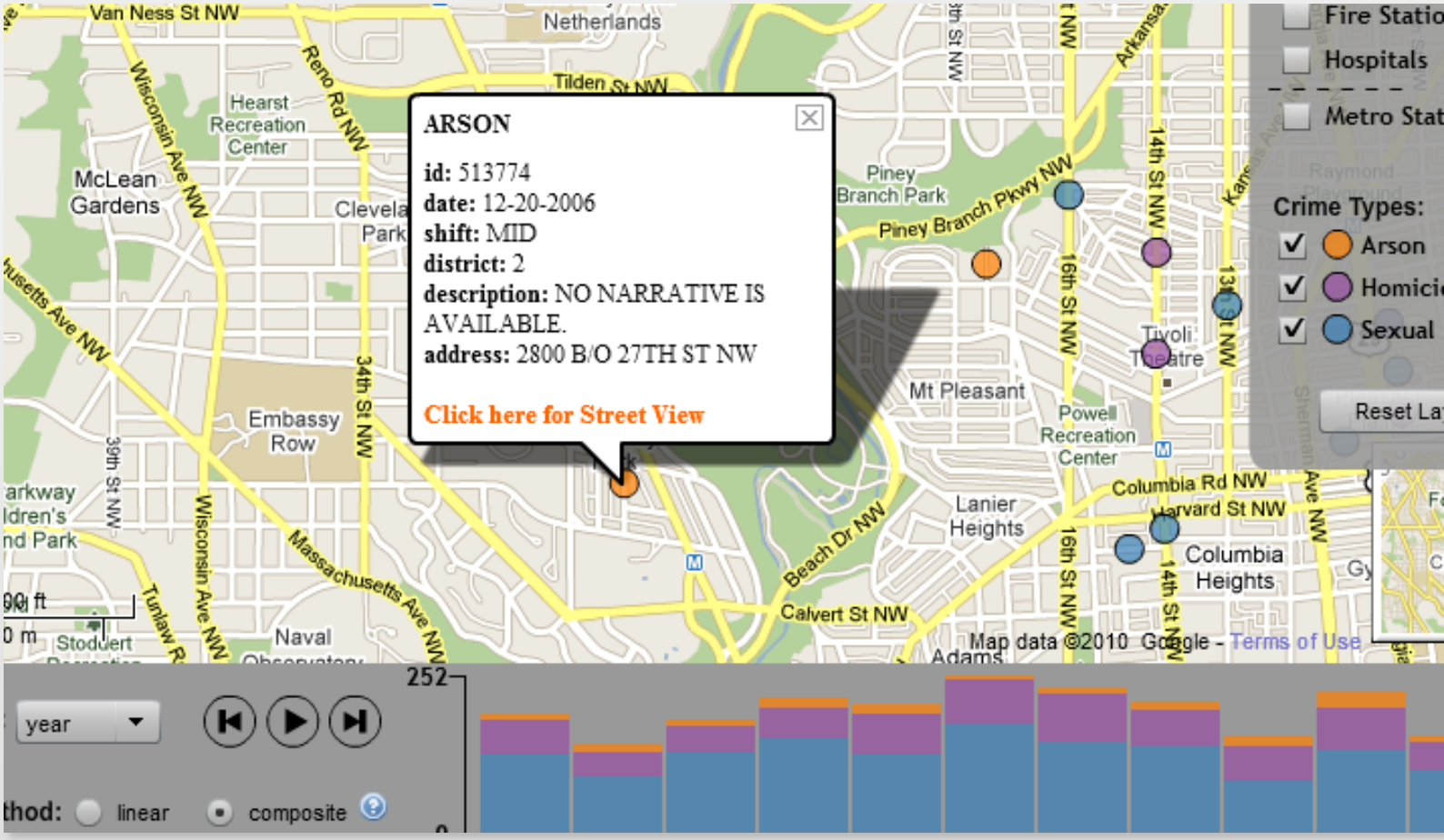


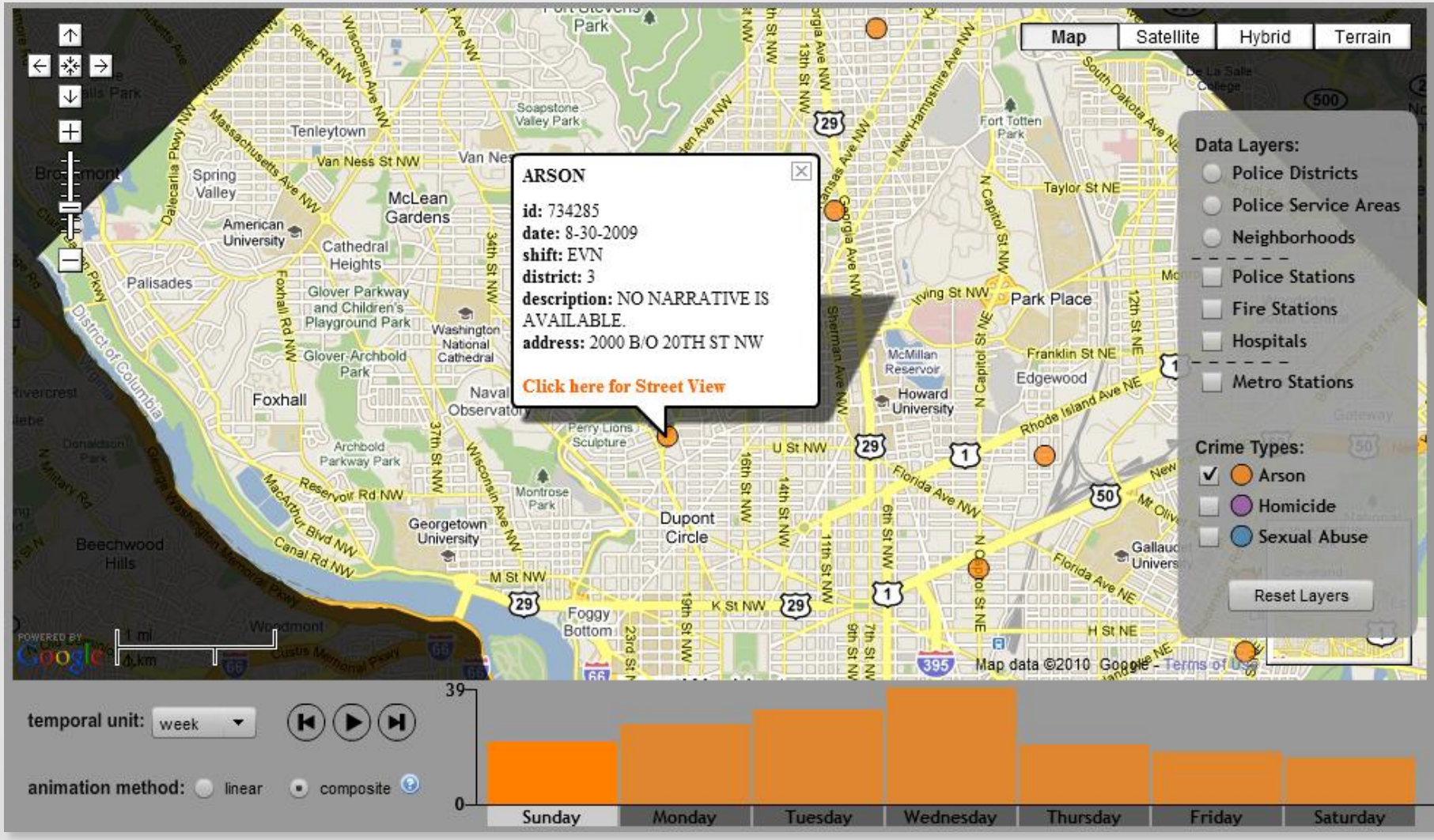
GIScience 2010
Zurich, Switzerland: 15 September 2010

GeoVISTA Center

GeoVISTA CrimeViz

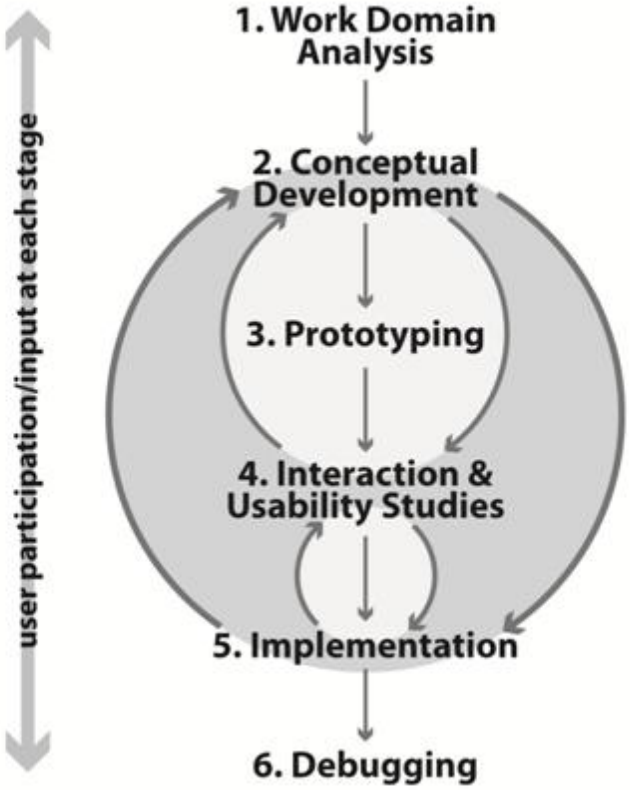
Roth & Ross (2009)

Extending the Google Maps API for Flash for Event Animation Mashups



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



UCD workflow for Geovisualization

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

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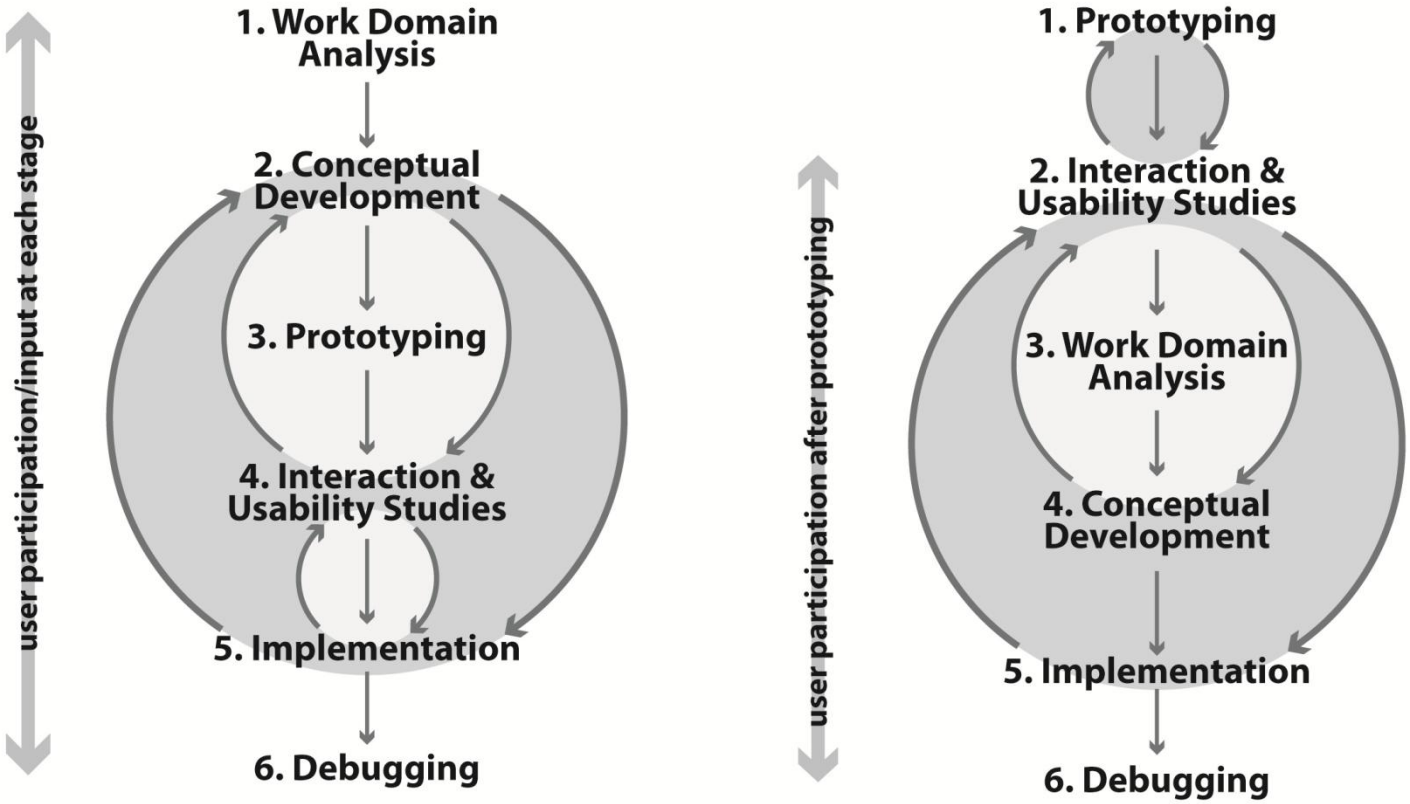

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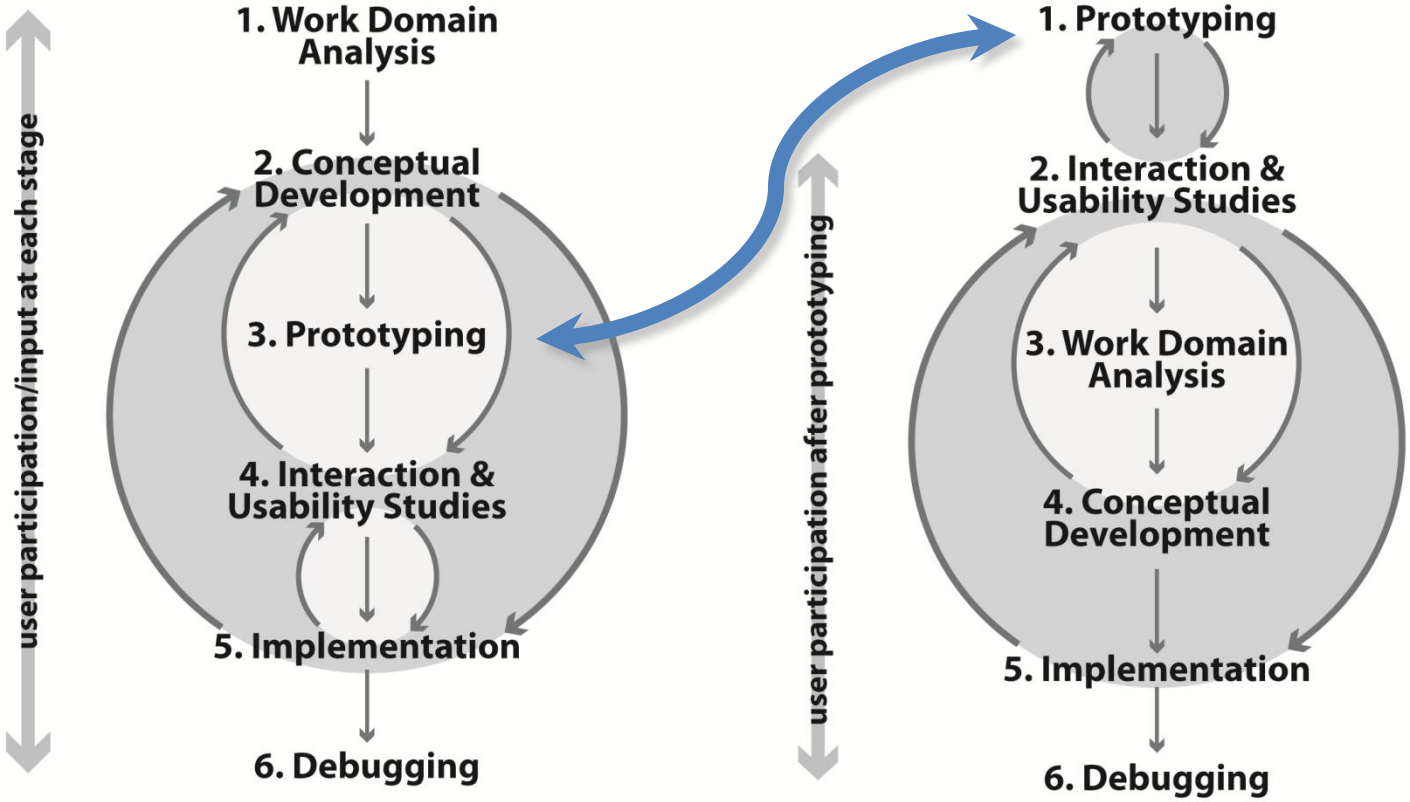

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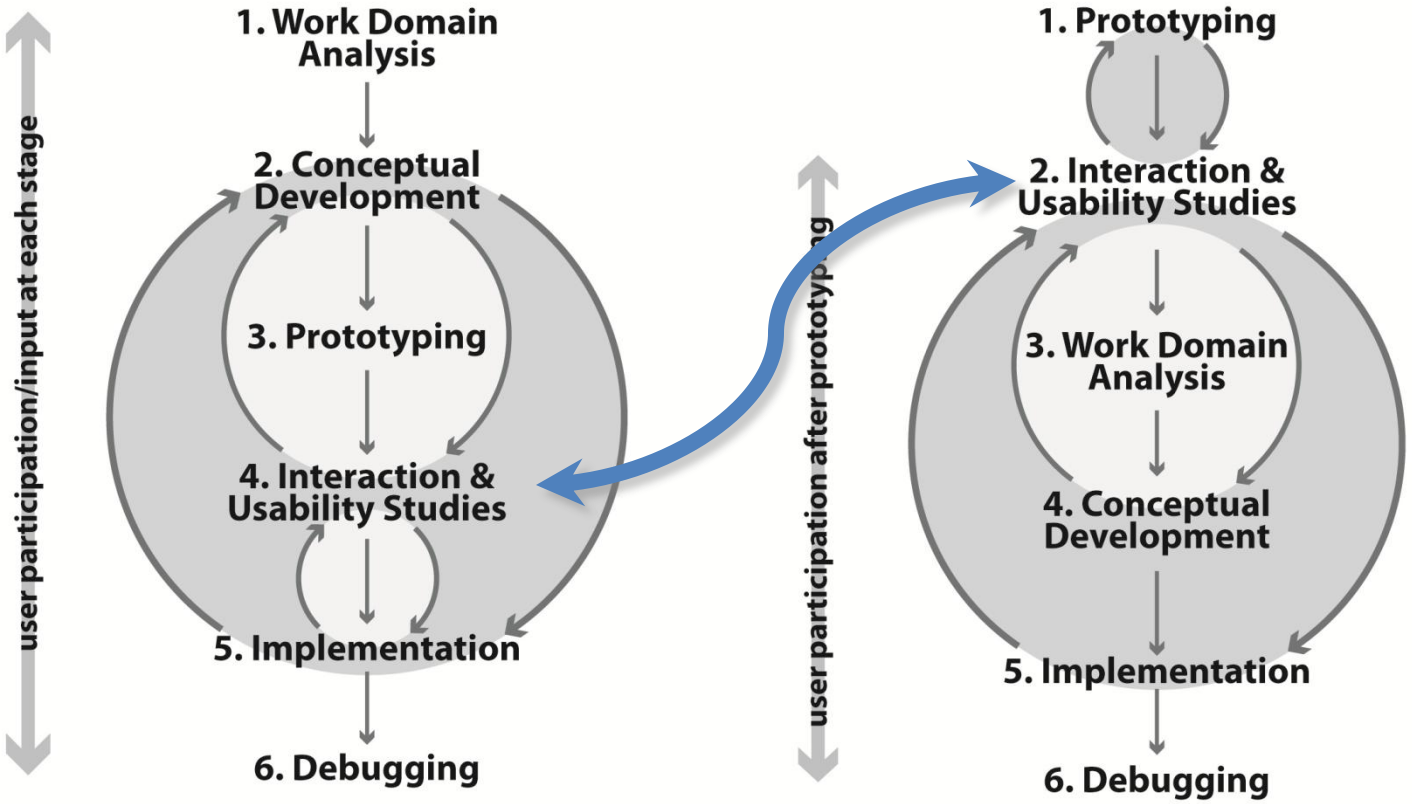

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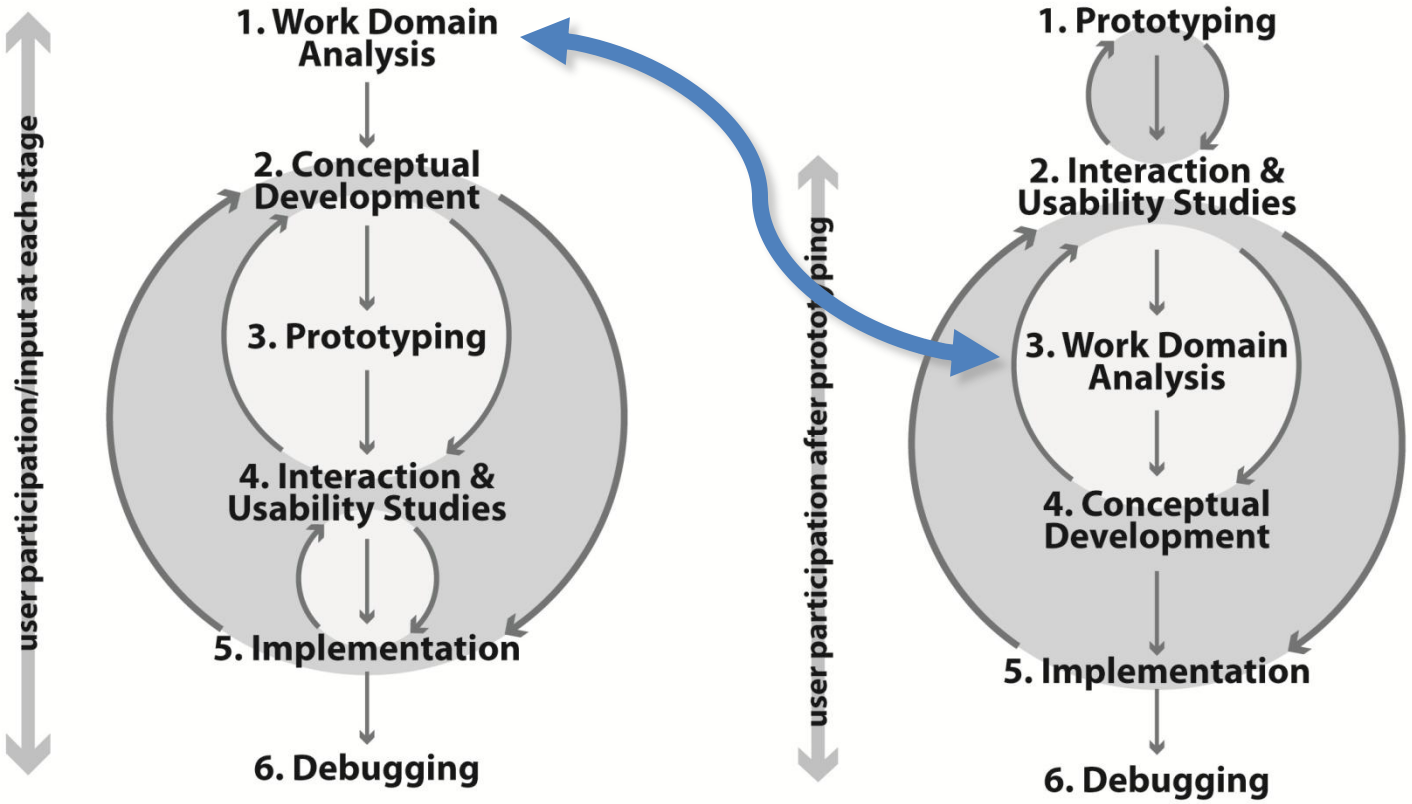

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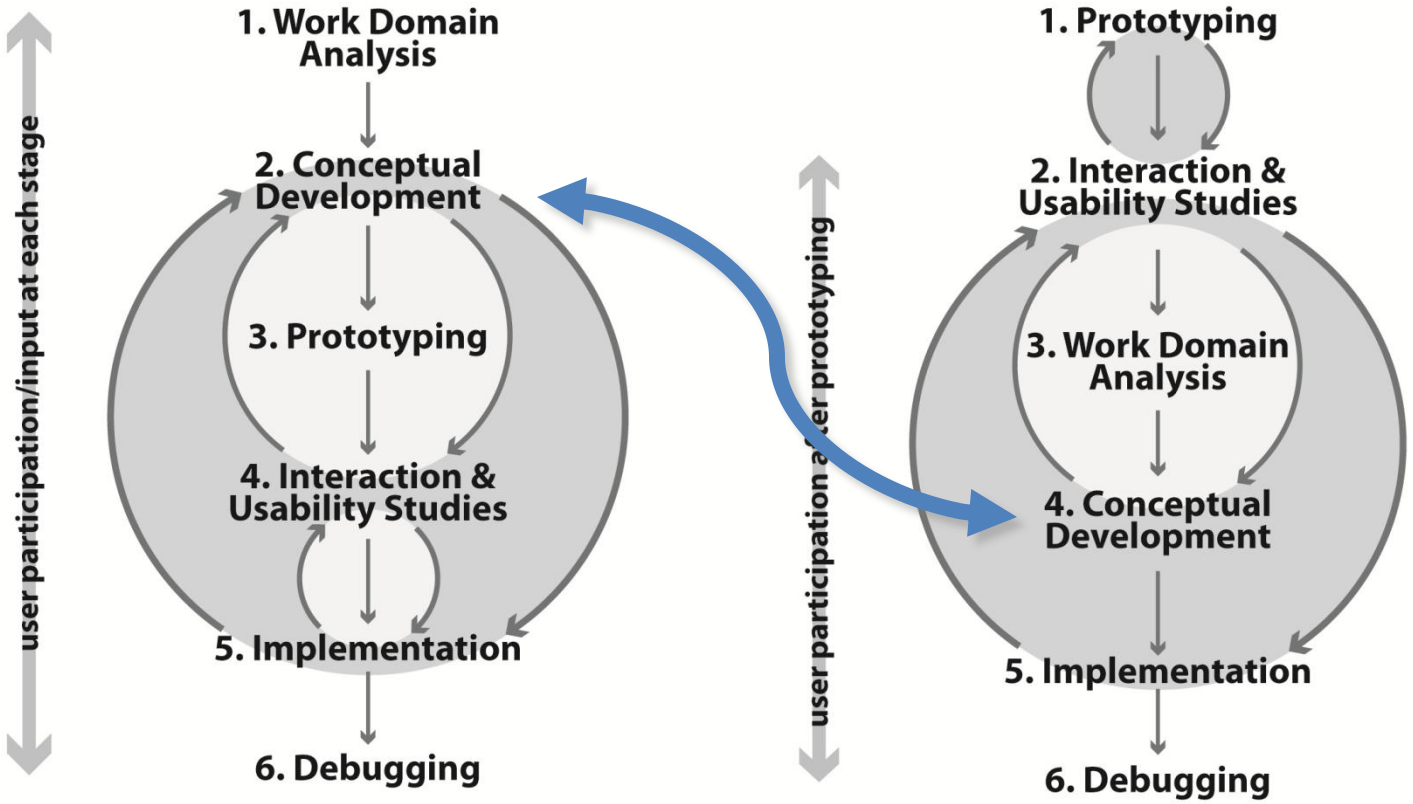

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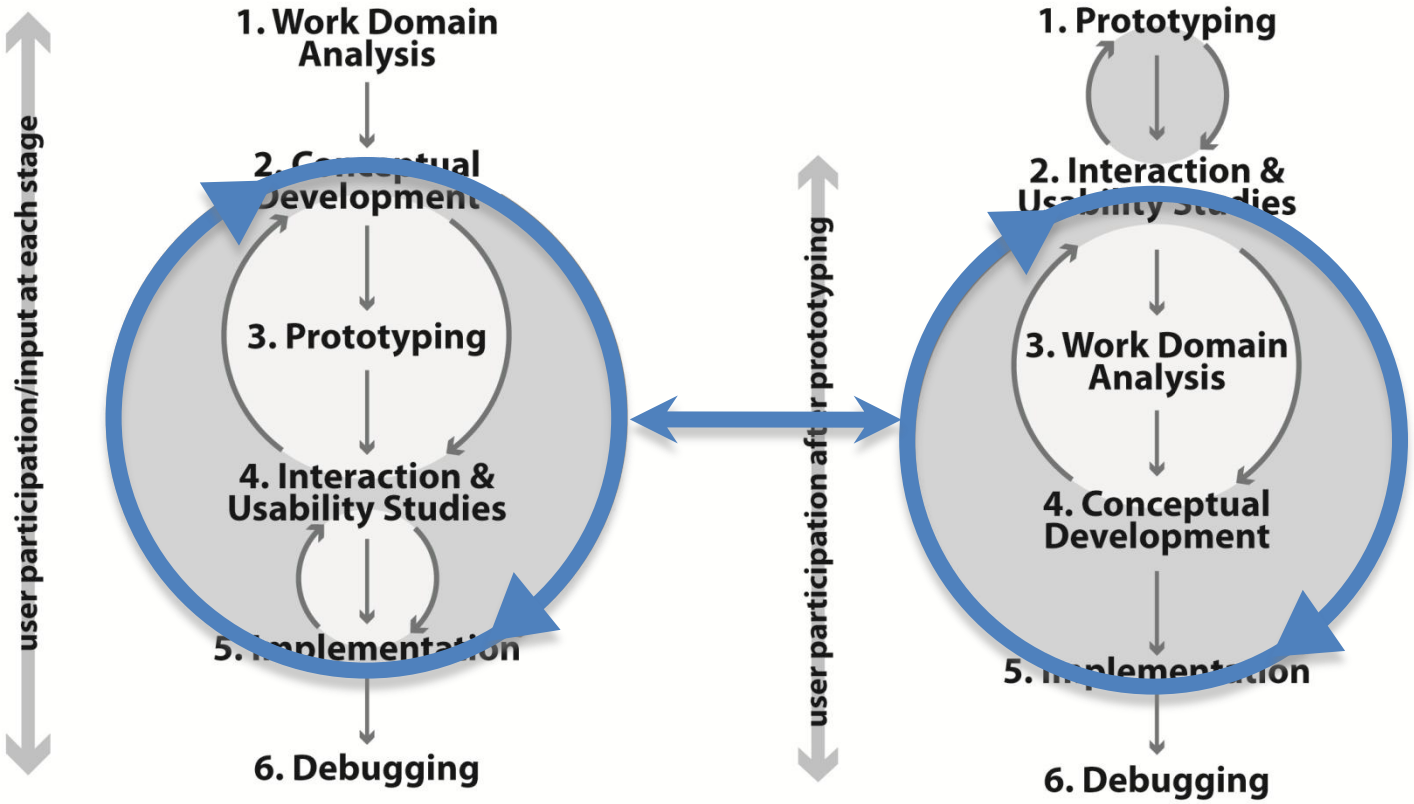

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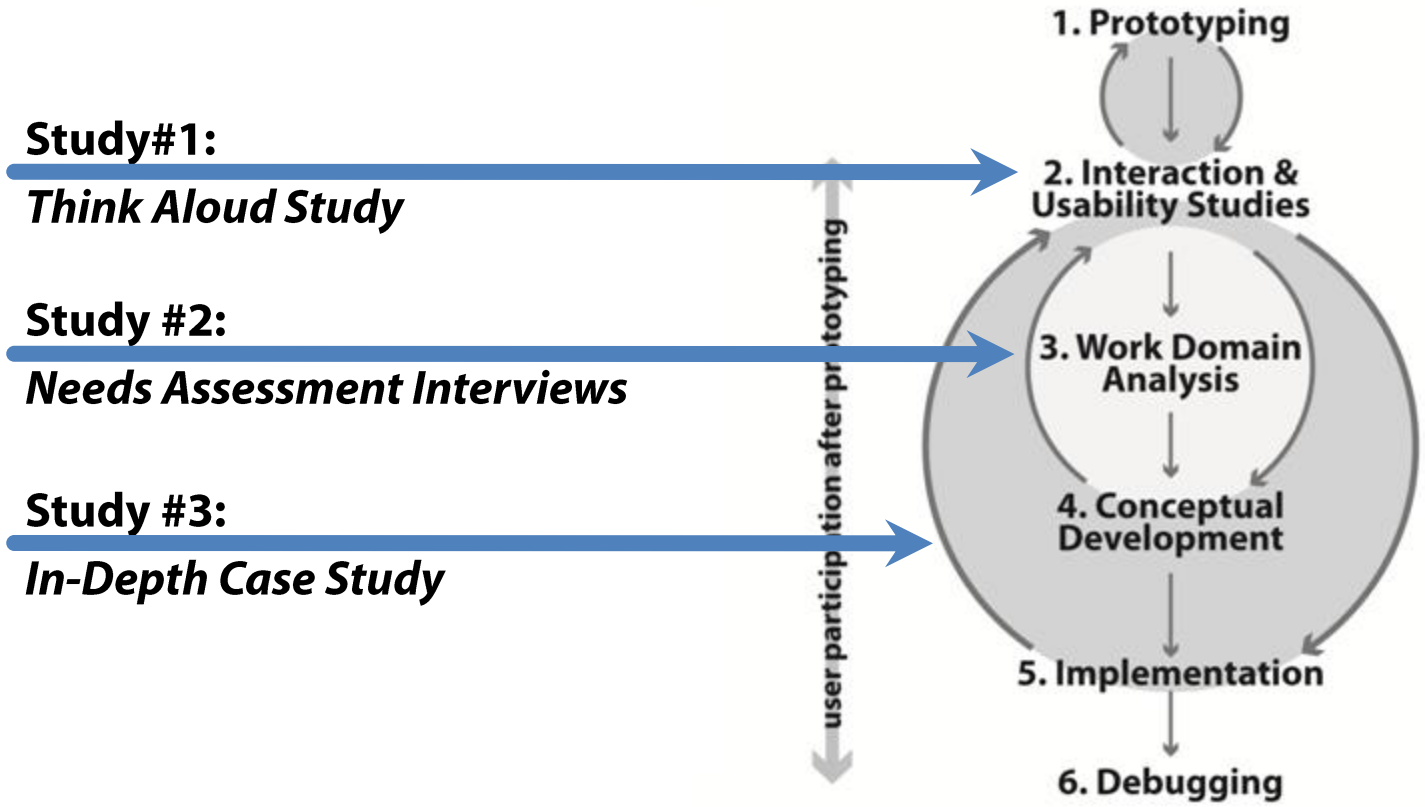


THINK ALOUD STUDY

users are asked to complete a set of benchmark tasks with an application and to describe verbally why they are doing what they are doing

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

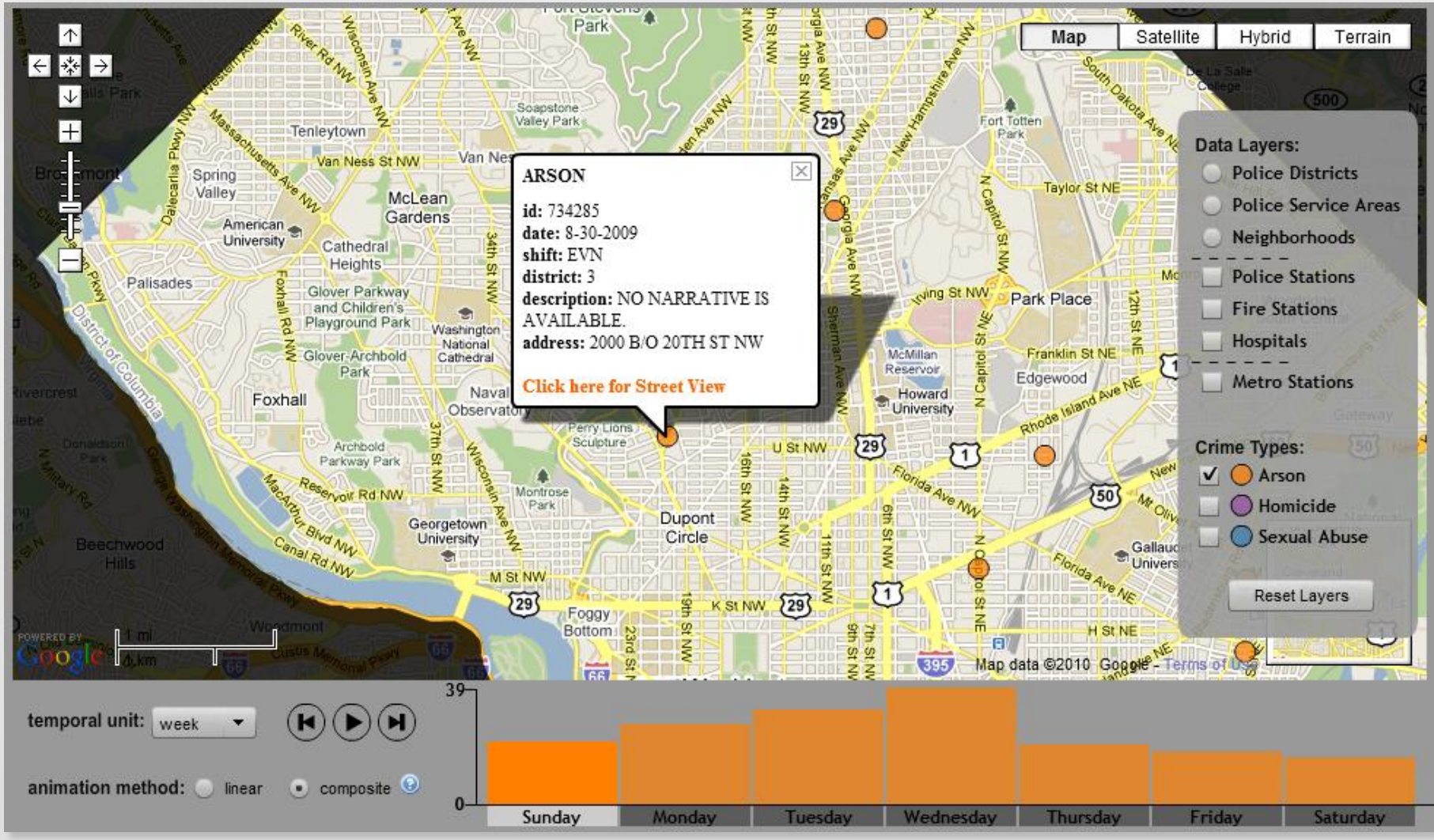
Data Collection: one administrator, two note takers recording critical incidents

Think Aloud Protocol (60 minutes):

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

DC CrimeViz

http://www.geovista.psu.edu/CrimeViz/



NEEDS ASSESSMENT INTERVIEWS

One-on-one interviews to assess the current crime analysis practice of law enforcement agencies, focusing on currently met and unmet needs

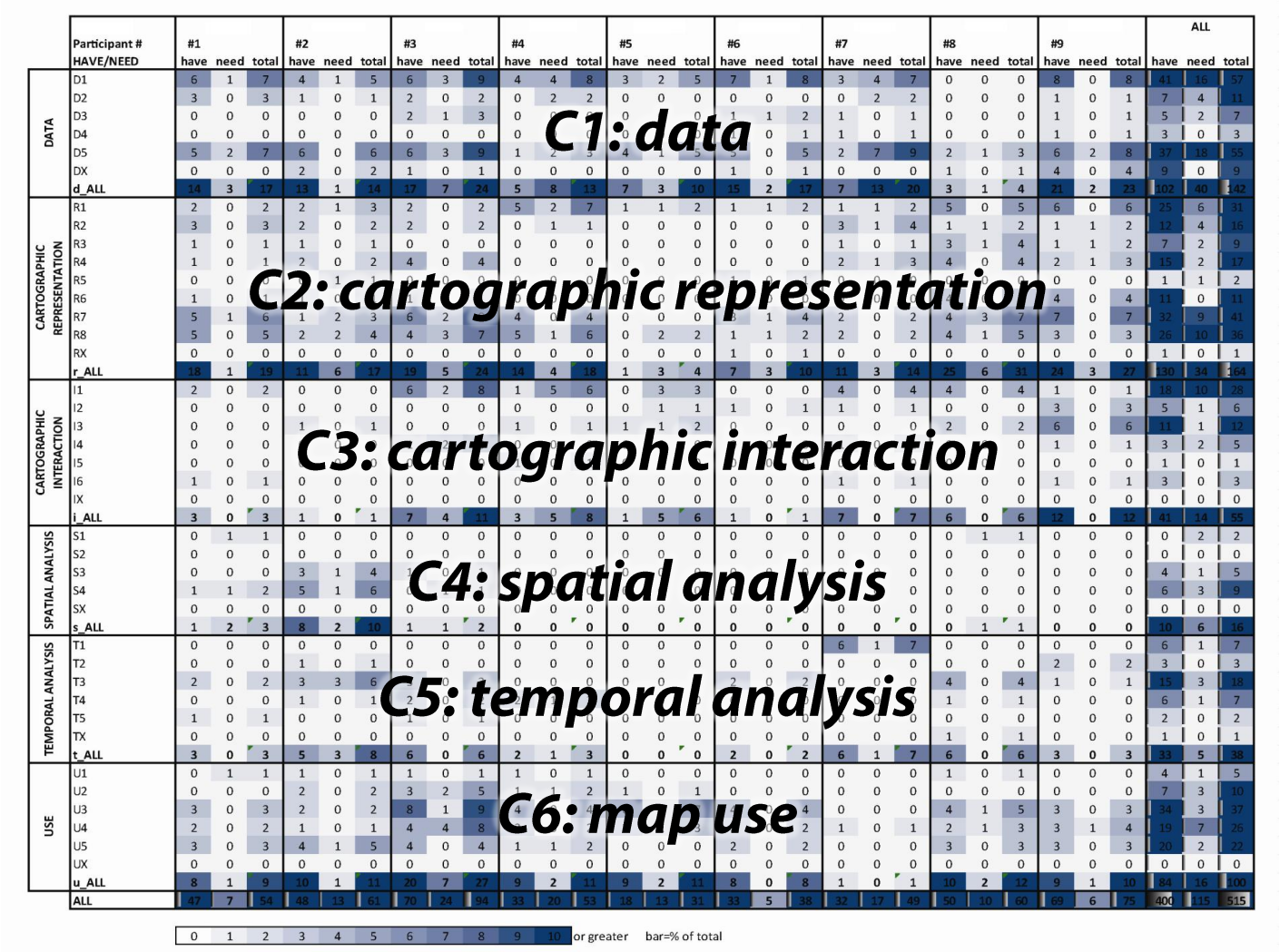
Participants: 9 analysts or decision-makers at 6 municipal and 1 federal agency

Data Collection: one interviewer, audio recorded for later transcription/codification

Think Aloud Protocol (60 minutes):

- Introduction & Background Survey (10 minutes)
- Data Information Characteristics (5 minutes planned)
- Mapping and Analysis Practices (20 minutes)
- Use (10 minutes)
- Follow-up survey about the CrimeViz prototype

QUALITATIVE DATA ANALYSIS



	Participant #	#1			#2			#3			#4			#5			#6			#7			#8			#9			ALL		
	HAVE/NEED	have	need	total	have	need	total	have	need	total	have	need	total	have	need	total	have	need	total	have	need	total	have	need	total	have	need	total	have	need	total
DATA	D1	6	1	7	4	1	5	6	3	9	4	4	8	3	2	5	7	1	8	3	4	7	0	0	0	8	0	8	41	16	57
	D2	3	0	3	1	0	1	2	0	2	0	2	2	0	0	0	0	0	0	0	2	2	0	0	0	1	0	1	7	4	11
	D3	0	0	0	0	0	0	2	1	3	0	0	0	0	0	0	1	1	2	1	0	1	0	0	0	1	0	1	5	2	7
	D4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	1	0	0	0	1	0	1	3	0	3
	D5	5	2	7	6	0	6	6	3	9	1	2	3	4	1	5	5	0	5	2	7	9	2	1	3	6	2	8	37	18	55
	DX	0	0	0	2	0	2	1	0	1	0	0	0	0	0	0	1	0	1	0	0	0	1	0	1	4	0	4	9	0	9
	d_ALL	**14**	**3**	**17**	**13**	**1**	**14**	**17**	**7**	**24**	**5**	**8**	**13**	**7**	**3**	**10**	**15**	**2**	**17**	**7**	**13**	**20**	**3**	**1**	**4**	**21**	**2**	**23**	102	40	142
CARTOGRAPHIC REPRESENTATION	R1	2	0	2	2	1	3	2	0	2	5	2	7	1	1	2	1	1	2	1	1	2	5	0	5	6	0	6	25	6	31
	R2	3	0	3	2	0	2	2	0	2	0	1	1	0	0	0	0	0	0	3	1	4	1	1	2	1	1	2	12	4	16
	R3	1	0	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	3	1	4	1	1	2	7	2	9
	R4	1	0	1	2	0	2	4	0	4	0	0	0	0	0	0	0	0	0	2	1	3	4	0	4	2	1	3	15	2	17
	R5	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	1	1	2
	R6	1	0	1	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	1	0	1	4	0	4	4	0	4	11	0	11
	R7	5	1	6	1	2	3	6	2	8	4	0	4	0	0	0	3	1	4	2	0	2	4	3	7	7	0	7	32	9	41
	R8	5	0	5	2	2	4	4	3	7	5	1	6	0	2	2	1	1	2	2	0	2	4	1	5	3	0	3	26	10	36
	RX	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	1	0	1
	r_ALL	**18**	**1**	**19**	**11**	**6**	**17**	**19**	**5**	**24**	**14**	**4**	**18**	**1**	**3**	**4**	**7**	**3**	**10**	**11**	**3**	**14**	**25**	**6**	**31**	**24**	**3**	**27**	130	34	164
CARTOGRAPHIC INTERACTION	I1	2	0	2	0	0	0	6	2	8	1	5	6	0	3	3	0	0	0	4	0	4	4	0	4	1	0	1	18	10	28
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	I3	0	0	0	1	0	1	0	0	0	1	0	1	1	1	2	0	0	0	0	0	0	2	0	2	6	0	6	11	1	12
	I4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	3	2	5
	I5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
	I6	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	1	0	1	3	0	3
	IX	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	i_ALL	**3**	**0**	**3**	**1**	**0**	**1**	**7**	**4**	**11**	**3**	**5**	**8**	**1**	**5**	**6**	**1**	**0**	**1**	**7**	**0**	**7**	**6**	**0**	**6**	**12**	**0**	**12**	41	14	55
SPATIAL ANALYSIS	S1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	2	2
	S2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	S3	0	0	0	3	1	4	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	1	5
	S4	1	1	2	5	1	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	3	9
	SX	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	s_ALL	**1**	**2**	**3**	**8**	**2**	**10**	**1**	**1**	**2**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**1**	**0**	**0**	**0**	10	6	16
TEMPORAL ANALYSIS	T1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	1	7	0	0	0	0	0	0	6	1	7
	T2	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	2	3	0	3
	T3	2	0	2	3	3	6	0	0	0	0	0	0	0	0	0	2	0	2	0	0	0	4	0	4	1	0	1	15	3	18
	T4	0	0	0	1	0	1	2	0	2	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	6	1	7
	T5	1	0	1	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	2
	TX	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	1	0	1
	t_ALL	**3**	**0**	**3**	**5**	**3**	**8**	**6**	**0**	**6**	**2**	**1**	**3**	**0**	**0**	**0**	**2**	**0**	**2**	**6**	**1**	**7**	**6**	**0**	**6**	**3**	**0**	**3**	33	5	38
USE	U1	0	1	1	1	0	1	1	0	1	1	0	1	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	4	1	5
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	ALL	47	7	54	48	13	61	70	24	94	33	20	53	18	13	31	33	5	38	32	17	49	50	10	60	69	6	75	0	0	0
		84	16	100	400	115	515																								

0 1 2 3 4 5 6 7 8 9 10 or greater bar=% of total

C1: data

C2: cartographic representation

C3: cartographic interaction

C4: spatial analysis

C5: temporal analysis

C6: map use

INTERVIEW STUDY: RESULTS

C1: data

- most datasets are maintained internally
- datasets are voluminous and multivariate
- geocoding varies, often not a requirement
- data quality hinges on reporting officer, often using paper forms
- use few external datasets, would like to use VGI but currently do not

C2: representation

- "push-pin" maps are most common
- "hot spot maps" generated for ecological analysis; preference for direct aggregation to a grid rather than a smoothing kernel
- choropleth maps specifically avoided
- time represented by coloring pins; composite small multiples common

C3: interaction

- overall limited, employed only by analysts
- mostly GIS desktop software; positive view towards web mapping services, although little use
- focusing/filtering most common operator; others used rarely
- several agencies employ interactive maps for their CompStat meetings

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C4: spatial analysis

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- reportedly due to lack of expertise across IT and lack of personnel in analysis units
- buffering most common analysis applied
- several instances of journey-to-crime analysis
- one reported use of spatial scan statistics (SaTScan & GeoDA)

C5: temp. analysis

- extreme variation across agencies
- most departments only generate time series info graphics for weekly reports
- two agencies regularly apply advanced analysis
- include aoristic analysis, predictive trend analysis, and spatiotemporal scan statistics with alerting

C6: map use

- most analysis is tactical, gaining a situational awareness of current patterns
- commonly look at past 7-30 days only
- only a subset of agencies have the personnel to conduct strategic analysis
- thus, tools must integrate into workflows and improve efficiency

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IN-DEPTH CASE STUDY

research and development collaboration with the Harrisburg (PA, USA) Police Department for the technology transition and evaluation of CrimeViz

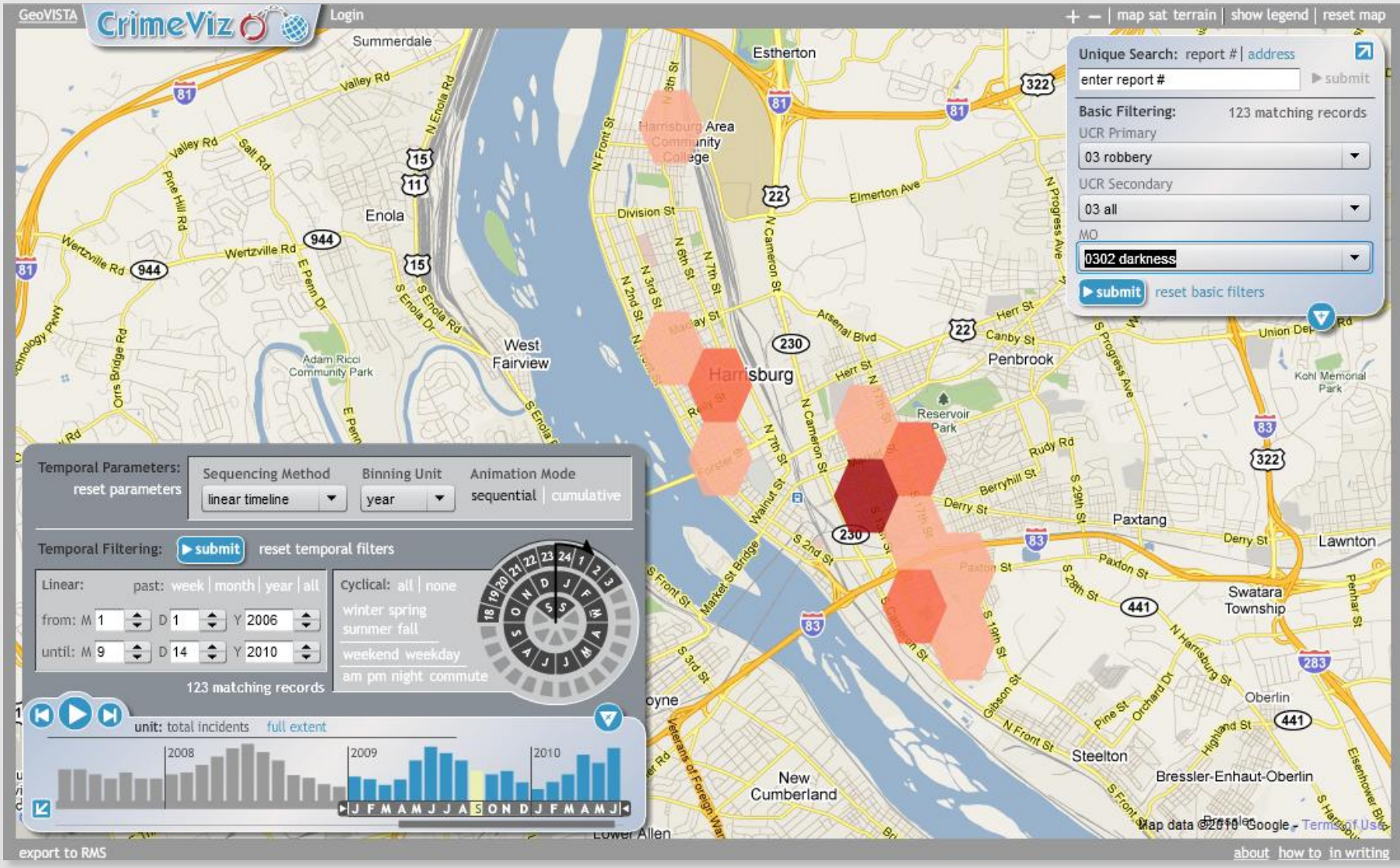
Harrisburg PD Participants:

- 3 captains
- 2 supervising officers (corporal level)
- 3 information technology personnel
- 2 network personnel

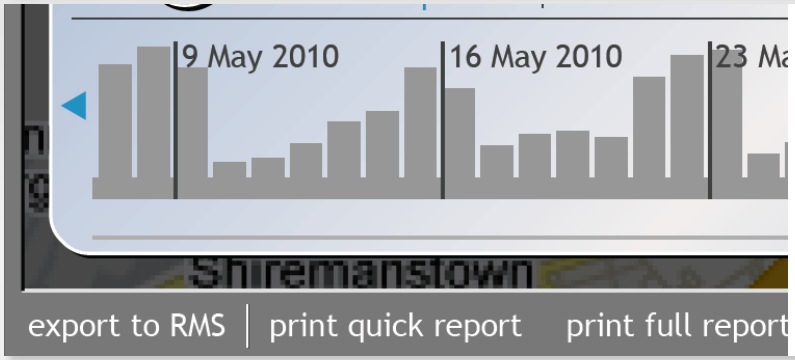
Data Collection:

- twice a month remote meetings that includes structured input on paper mockups and early prototypes
- participant observation (planned)
- interaction studies (planned)

REVISED CONCEPTUAL DESIGN

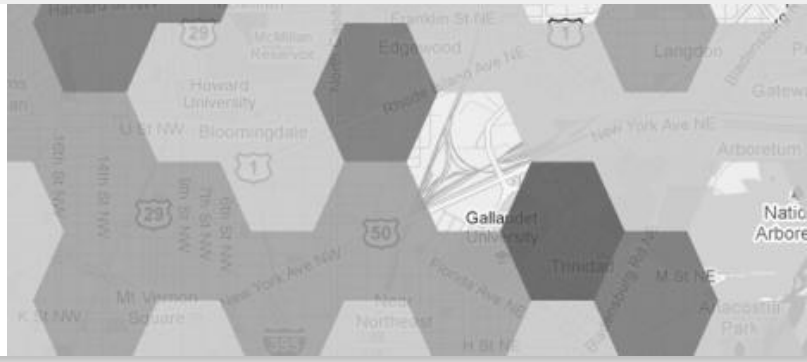


HARRISBURG CRIMEVIZ: FUTURE DIRECTIONS



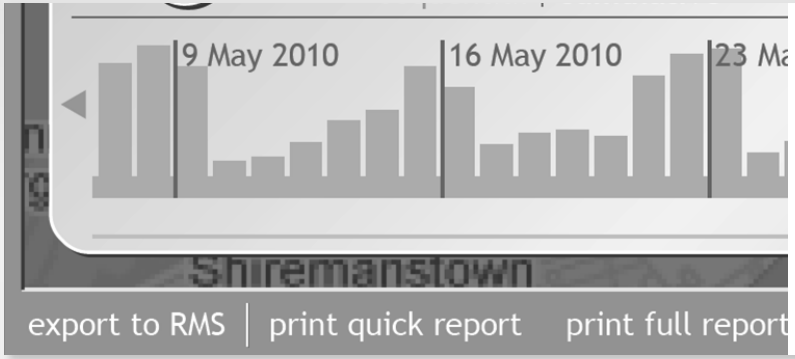
Export to RMS & Automated Report Generation

Integration of Statistical/Computational & Visual Methods



Levering External Data Sources (e.g., VGI) for Strategic Analysis

HARRISBURG CRIMEVIZ: FUTURE DIRECTIONS



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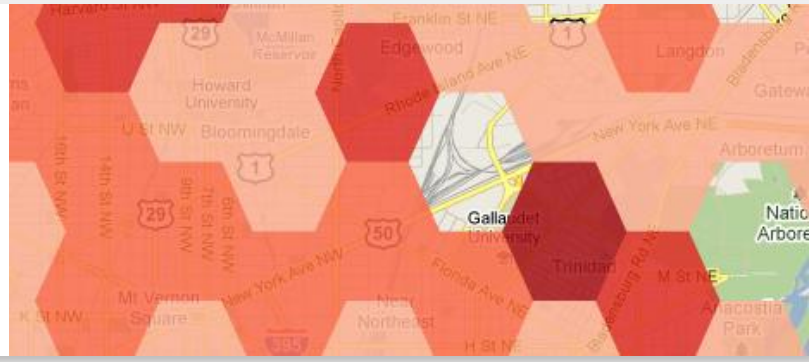

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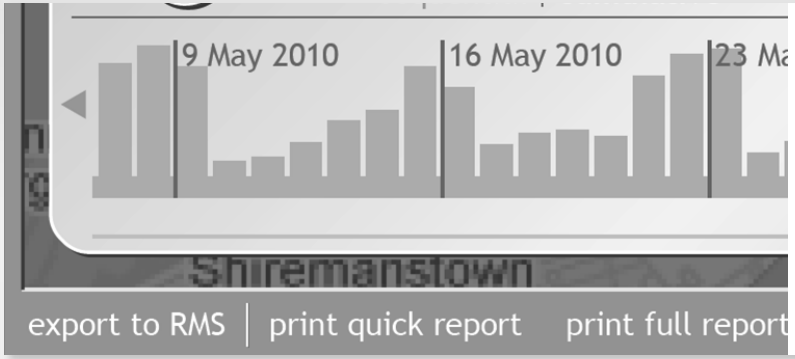

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Integration of Statistical/Computational & Visual Methods

Levering External Data Sources (e.g., VGI) for Strategic Analysis

Learn more about the project & try out the application at:

http://www.geovista.psu.edu/CrimeViz/

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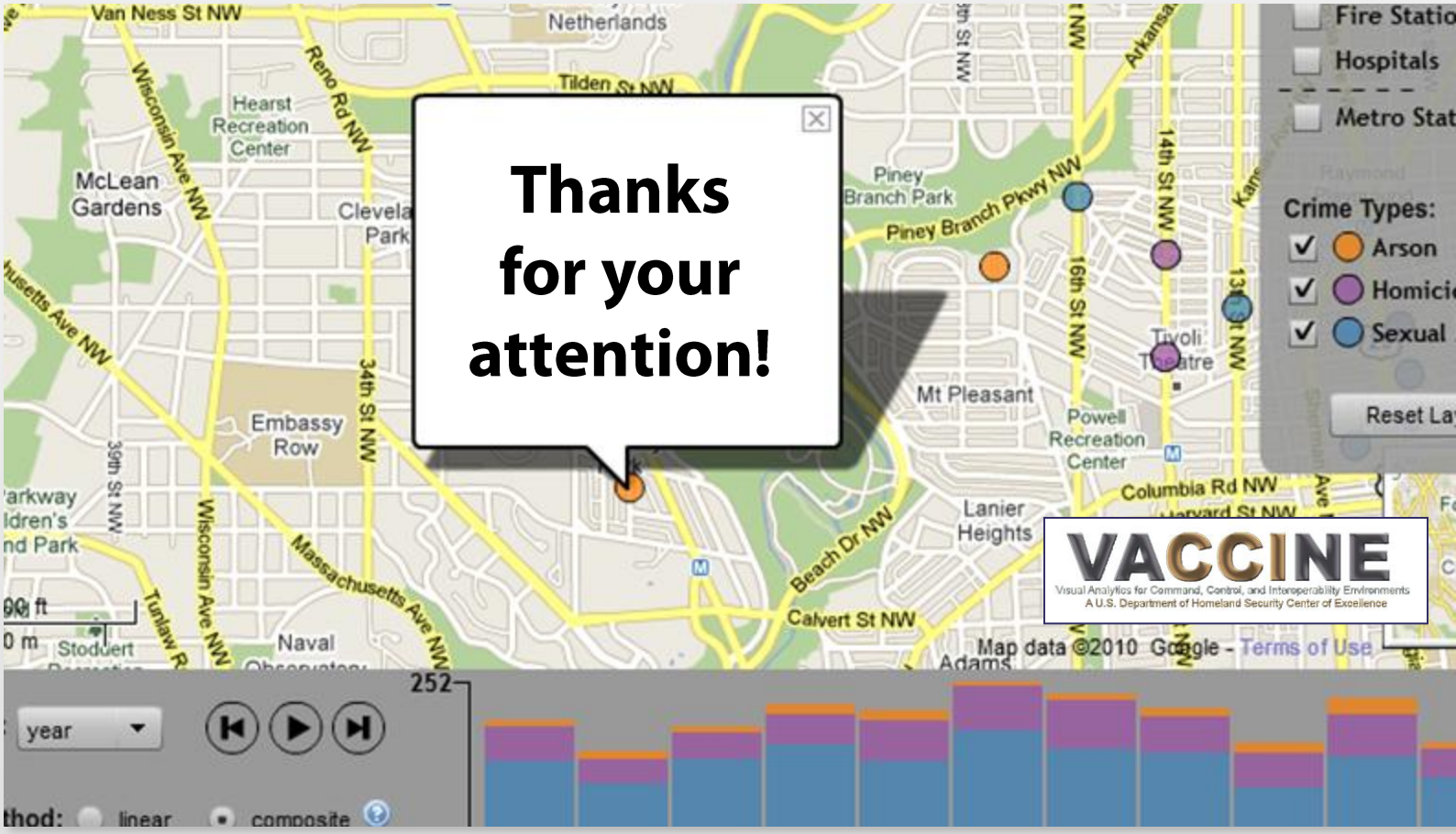

GIScience 2010
Zurich, Switzerland: 15 September 2010

GeoVISTA Center