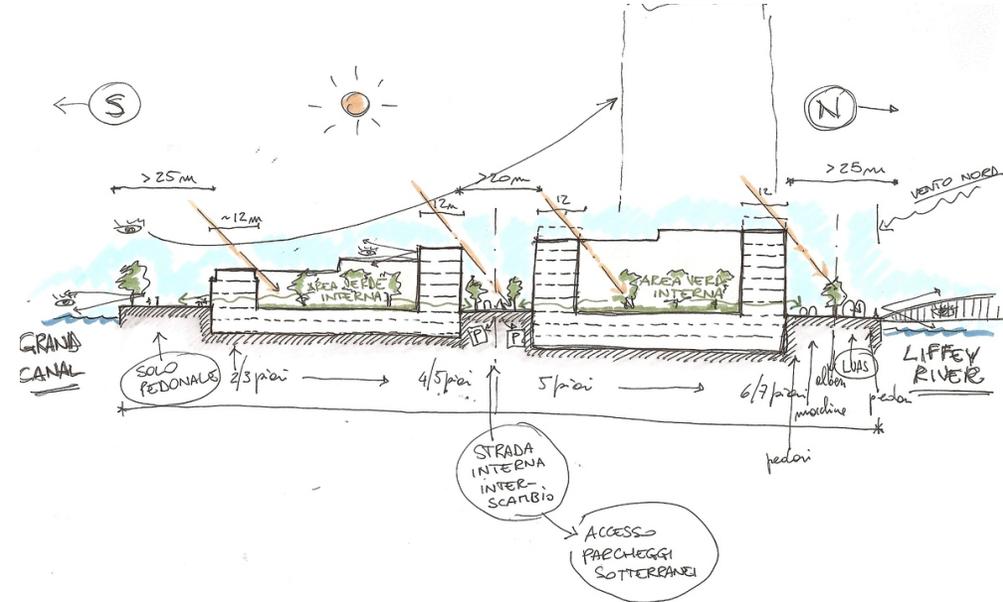


Vis-A-Ware: Integrating Spatial and Non-Spatial Visualization for Visibility-Aware Urban Planning.

Thomas Ortner, Johannes Sorger, Harald Steinlechner, Gerd Hesina, Harald Piringer, Eduard Groller.

IEEE TVCG 23(2):1139-1151 2017



Matthew Chun

High Level Overview

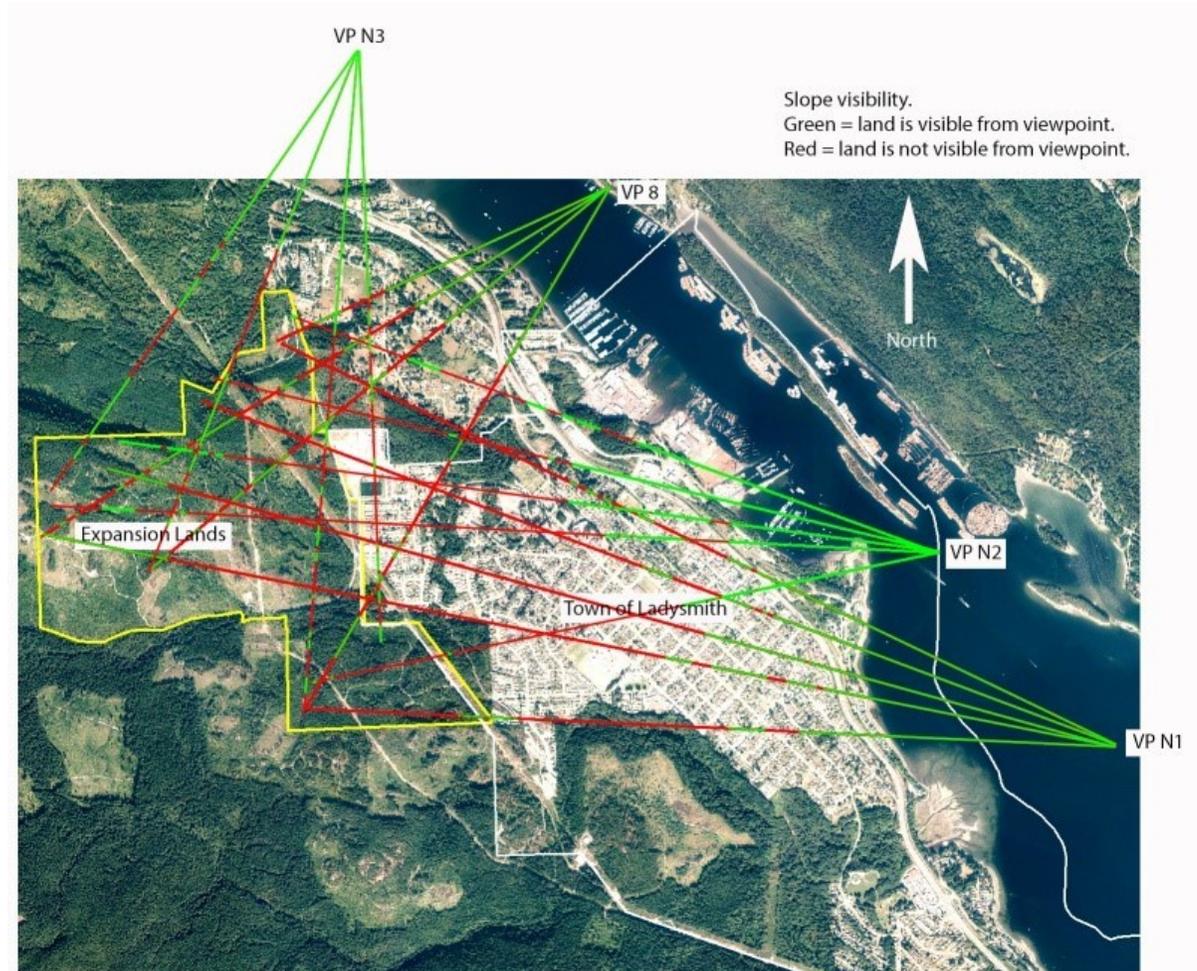
- Urban planning
 - What is the visual impact of new buildings on city scape?
 - How will it look from multiple different perspectives?
 - How can we easily compare different buildings beyond subjective perception?

High Level Overview

- Urban planning
 - What is the visual impact of new buildings on city scape?
 - How will it look from multiple different perspectives?
 - How can we easily compare different buildings beyond subjective perception?
- Vis-A-Ware
 - Qualitative and quantitative evaluation, ranking, and comparison on the different types of “visibility” of candidate buildings from various viewpoints
 - Links together a 3D spatial urban view with non-spatial data for more context

Domain Practice

- Experts create visibility and landmark occlusion maps



Domain Practice

- Photo montages that overlay real images with virtual candidate buildings



Before



After

Domain Practice

- 3D rendering from a few viewpoints
- Haptic models



Task Analysis

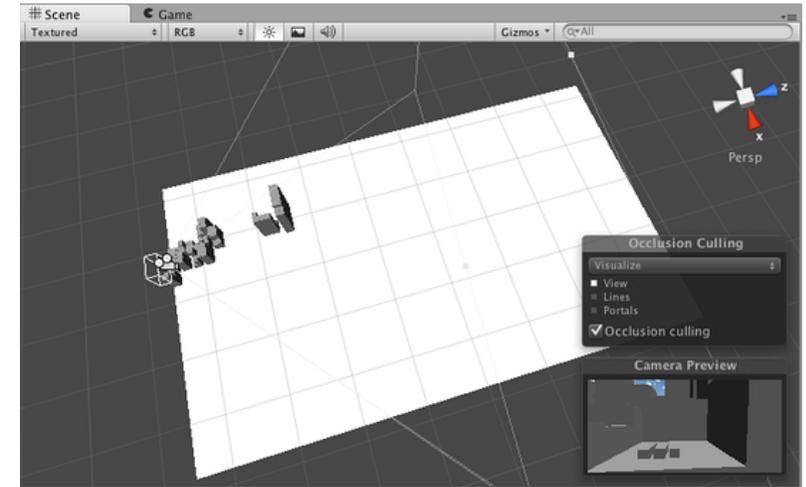
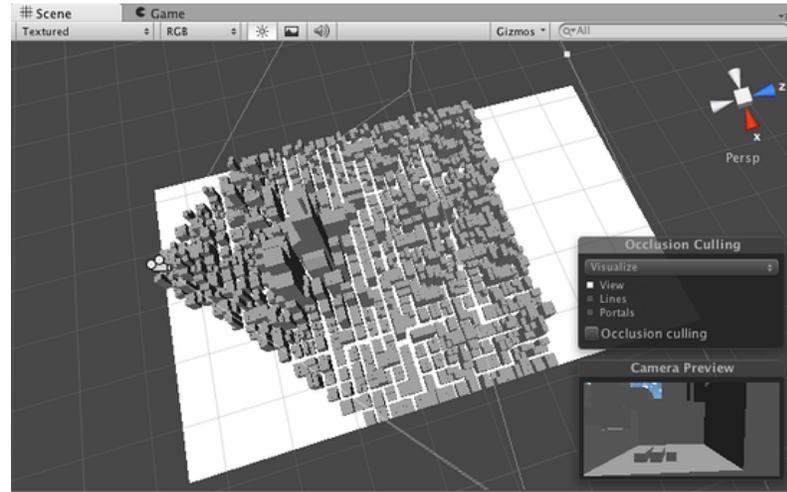
- With a combination of above techniques, compare candidate buildings with respect to visual impact (Current Practices)
 - Qualitative -> Potential subjective bias
 - Can only compare a few viewpoints at a time

Task Analysis

- With a combination of above techniques, compare candidate buildings with respect to visual impact (Current Practices)
 - Qualitative -> Potential subjective bias
 - Can only compare a few viewpoints at a time
- Can we also compare candidate buildings in a more holistic manner? (Suggested New Practice)
 - Quantitative -> More specificity in details (eg. How occluded)
 - More comparisons possible -> Multiple viewpoints
- Is it possible to combine the current and new approaches?

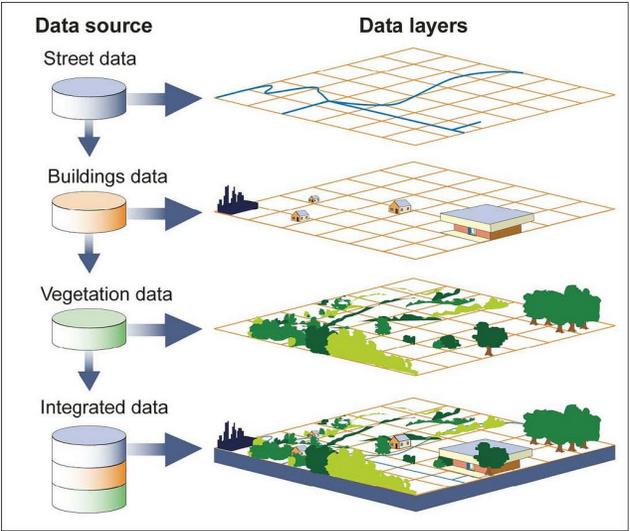
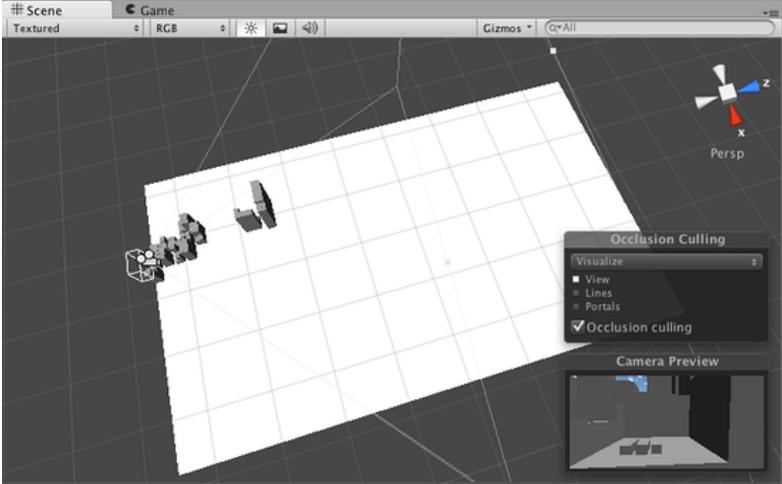
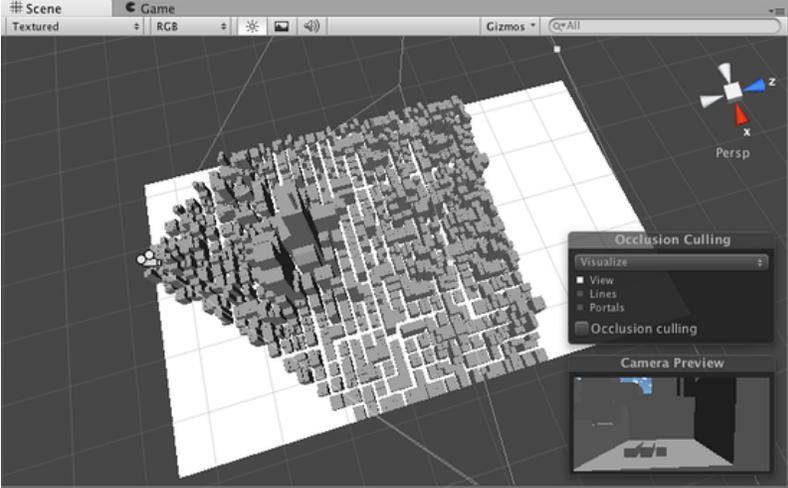
Related Work

- Occlusion culling



Related Work

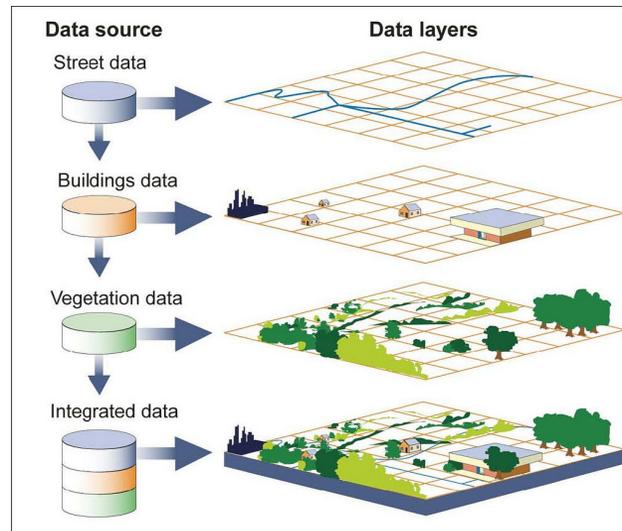
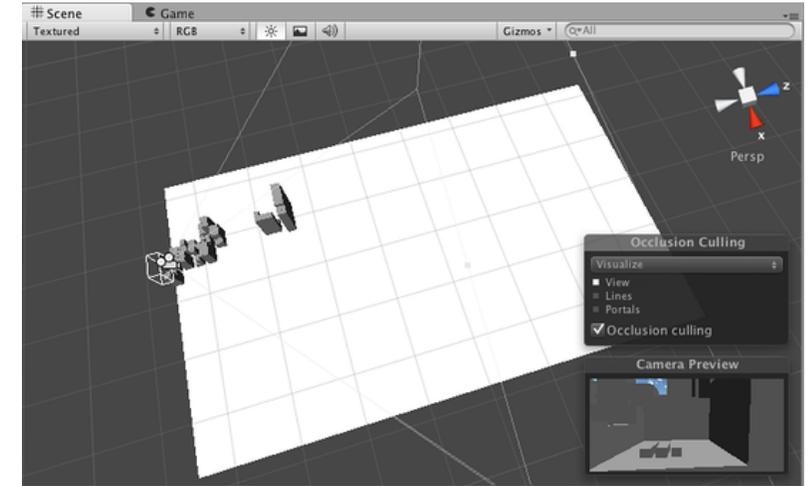
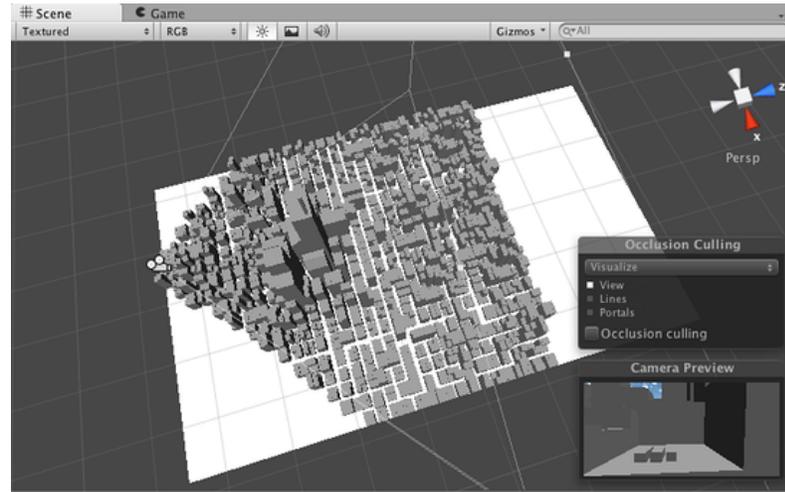
- Occlusion culling
- Geographic Info System (GIS)



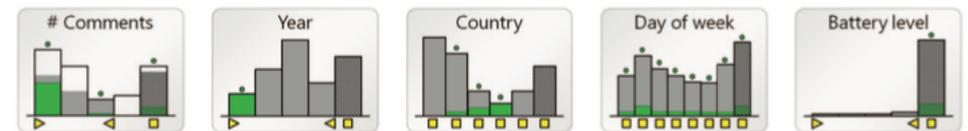
Source: GAO.

Related Work

- Occlusion culling
- Geographic Info System (GIS)
- Multiple Criteria Decision Analysis (MCDA)
- Coordinated Multiple Views (CMV)



Source: GAO.



Design Goals

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- G6: Incorporating exploration and visualization metaphors users are familiar with from existing tools

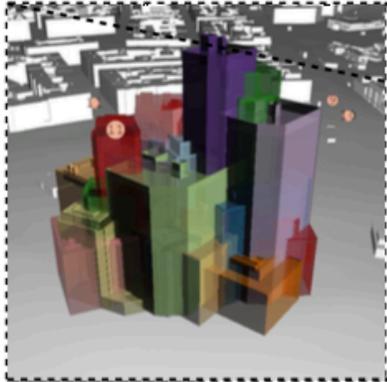
Video

- <https://vimeo.com/183311609>

Vis-A-Ware

Spatial

Non-spatial

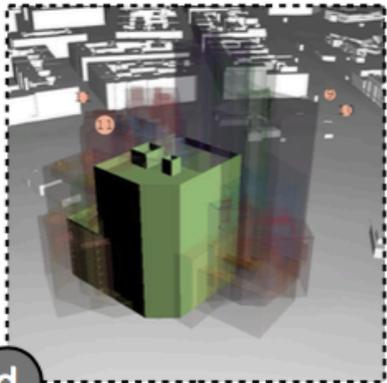


ViewPoint Major					
Id	Cat	Landmark	Visibility	Openess	SkyFactor
LoS	>>>	[Bar]	[Bar]	[Bar]	[Bar]
Street	>>>	[Bar]	[Bar]	[Bar]	[Bar]
vp100	●	[Bar]	[Bar]	[Bar]	[Bar]
vp99	●	[Bar]	[Bar]	[Bar]	[Bar]
vp98	●	[Bar]	[Bar]	[Bar]	[Bar]
vp96	●	[Bar]	[Bar]	[Bar]	[Bar]
vp8	●	[Bar]	[Bar]	[Bar]	[Bar]
vp87	●	[Bar]	[Bar]	[Bar]	[Bar]
vp10	●	[Bar]	[Bar]	[Bar]	[Bar]
vp86	●	[Bar]	[Bar]	[Bar]	[Bar]
vp74	●	[Bar]	[Bar]	[Bar]	[Bar]
vp64	●	[Bar]	[Bar]	[Bar]	[Bar]
vp65	●	[Bar]	[Bar]	[Bar]	[Bar]

Metrics - Cols

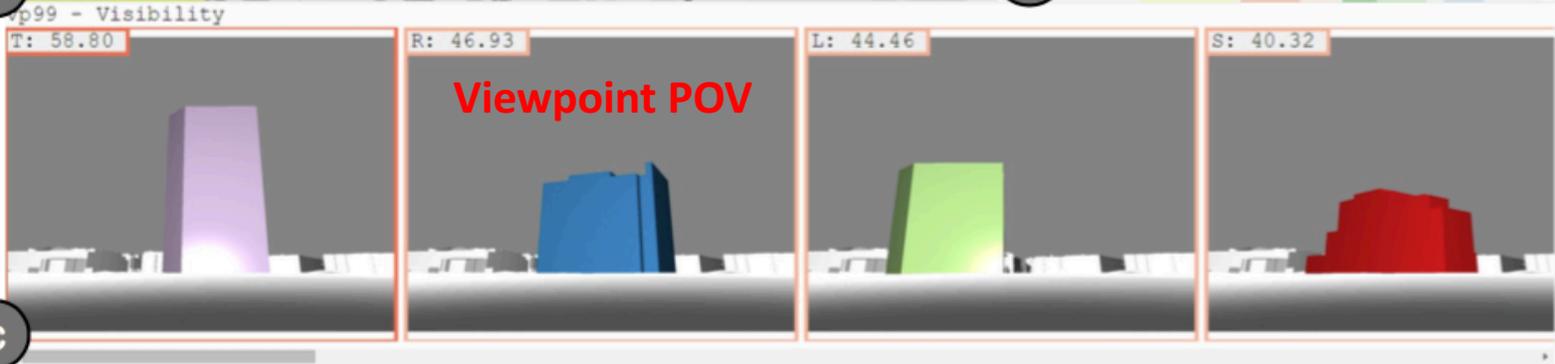
Viewpoints /Candidates - Rows

Visual Impact - Cell



a

b



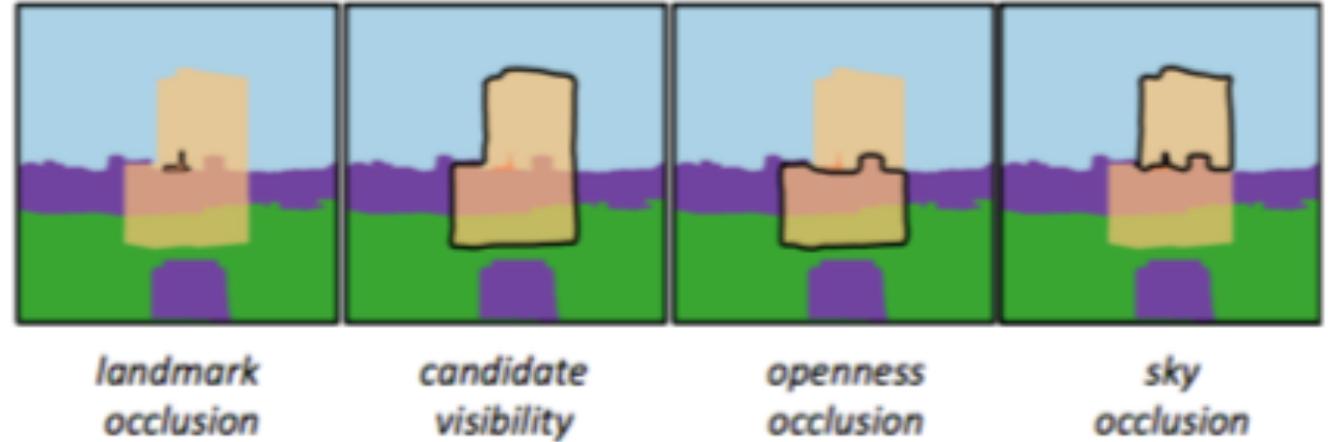
c

d

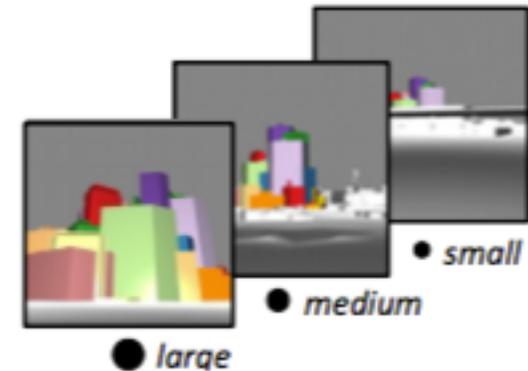
System Overview – Visual Impact Metrics (VIM)

- Coded by “false colour” -> colour that stands out in a scene
 - Landmarks are red
 - Sky is blue
 - Openness is green
 - Candidate building is orange

© Different Visual Impact Metrics (VIMs):



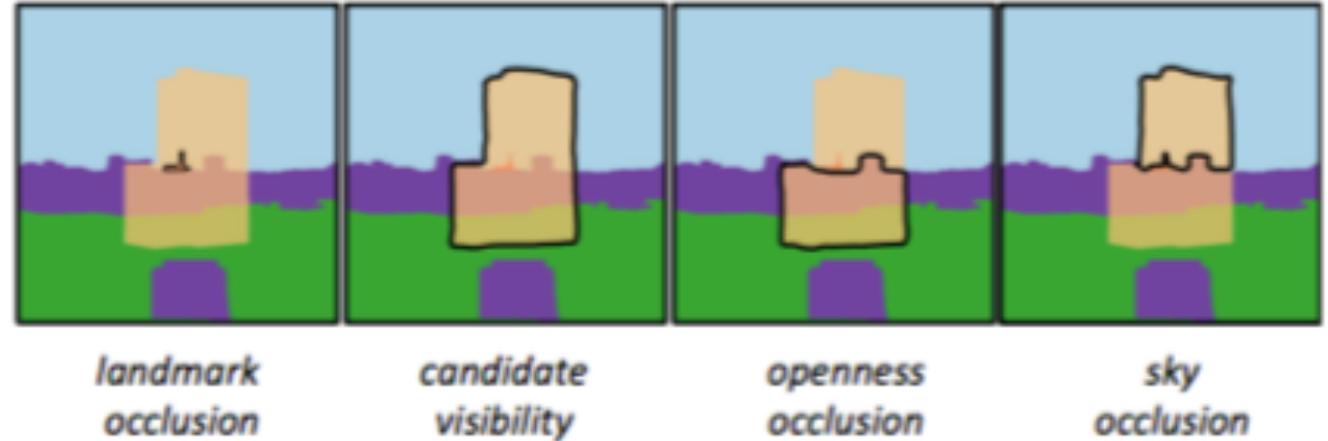
© Viewpoint Coverage:



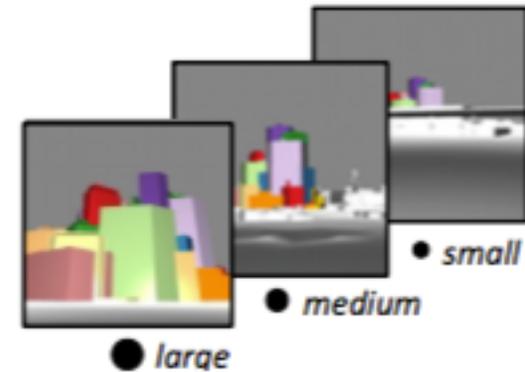
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- To get a number, normalized on a ratio
 - # of pixels of VIM of interest/# of candidate pixels
 - Bin categories
 - Low, medium, high, very high
- How relevant is particular viewpoint?
 - all candidate pixels/total number of image pixels
 - Bin categories
 - Small, medium, high

© Different Visual Impact Metrics (VIMs):

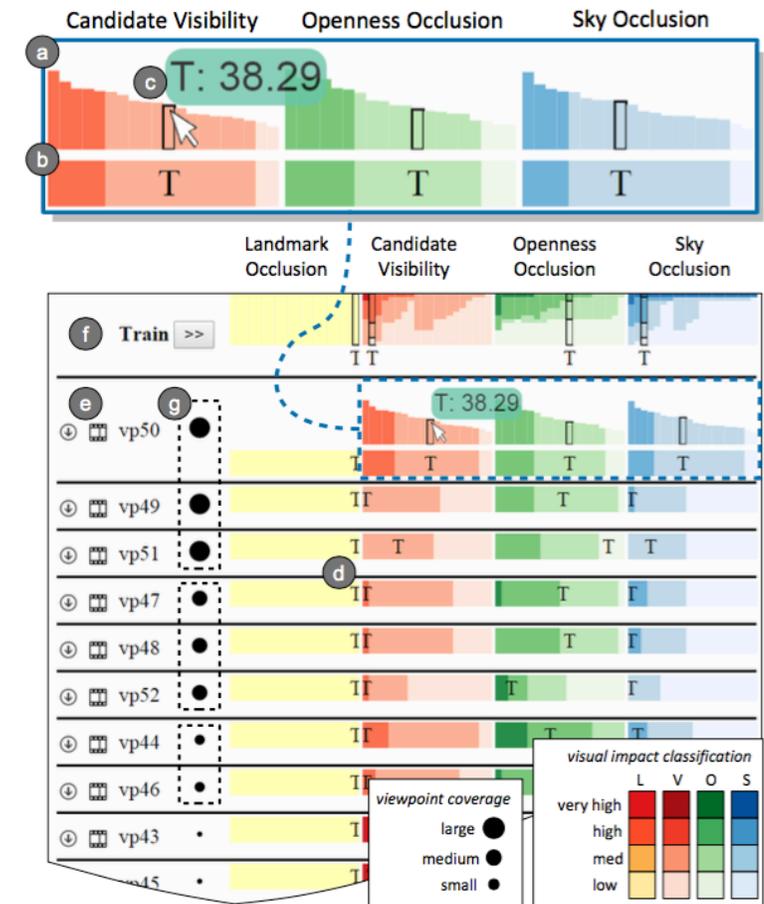
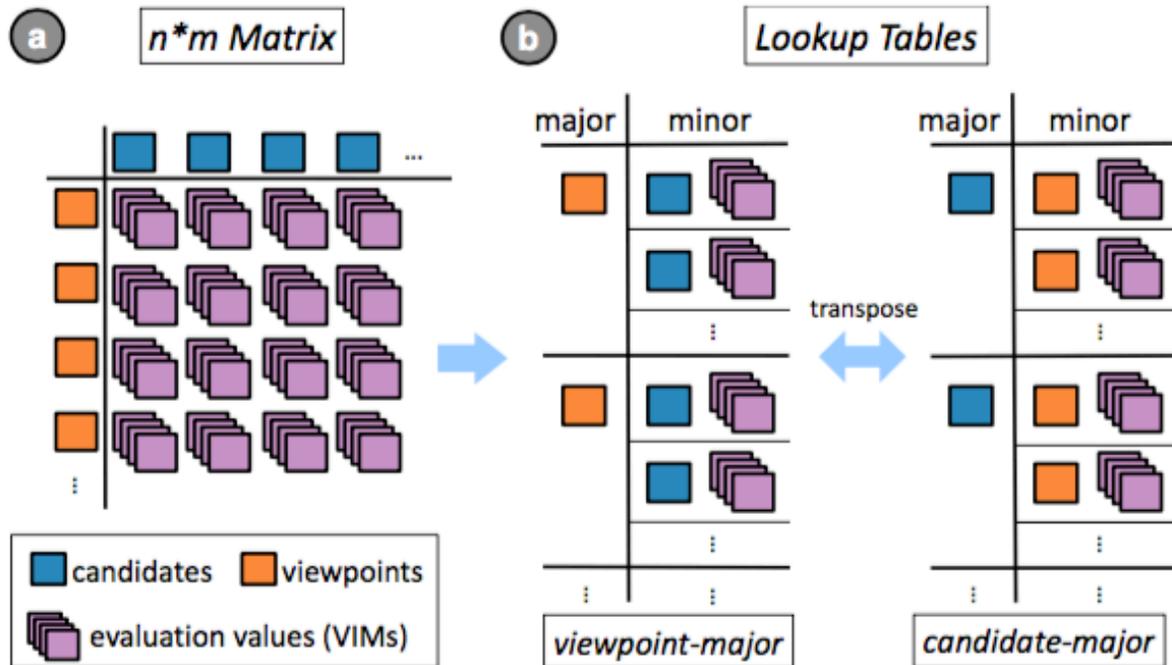


© Viewpoint Coverage:



System Overview – Transposable Ranking View (TRV)

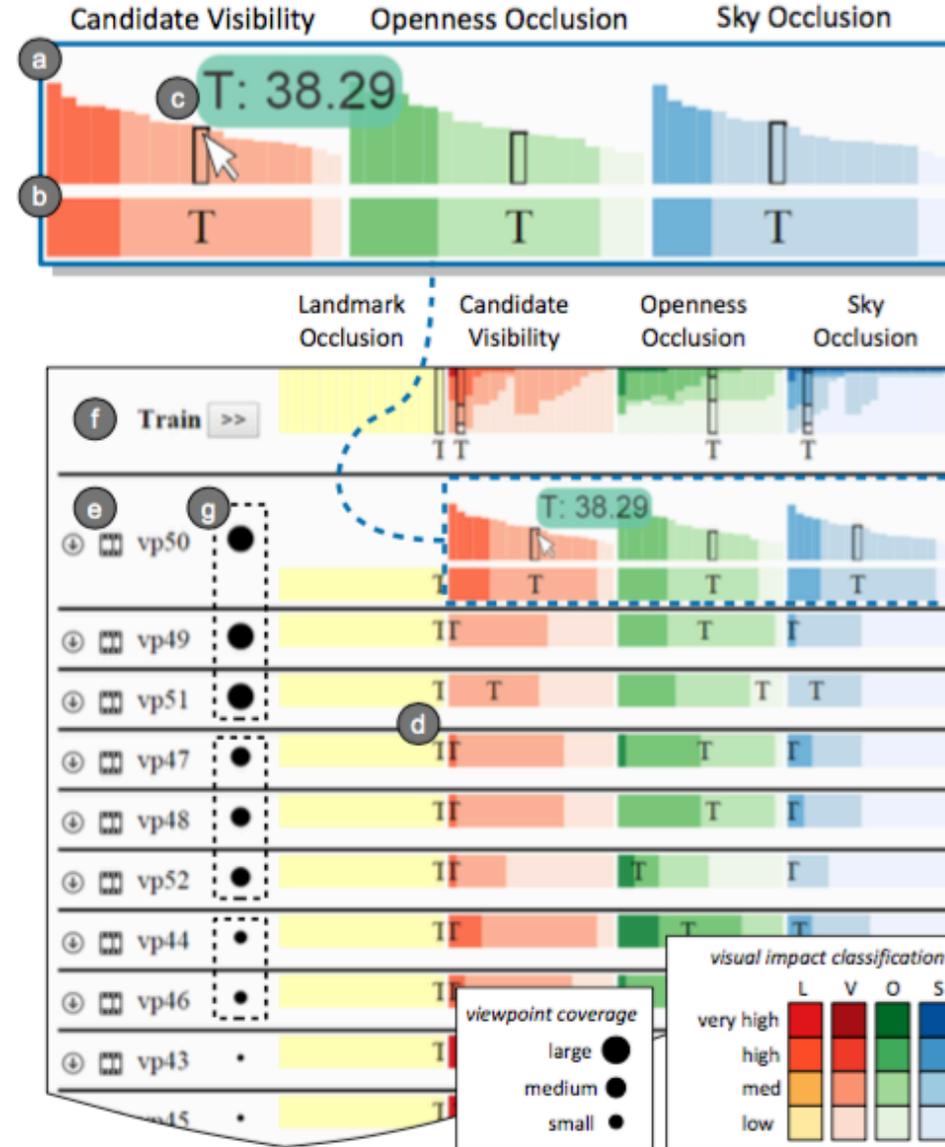
- Main way to filter, rank, compare candidates based on VIM
- Data Model



Transposable Ranking View (TRV) - Visual Encoding

Viewpoint Major Mode

- a) Bar charts show VIM for each candidate (letter) in distribution, saturation shows impact class



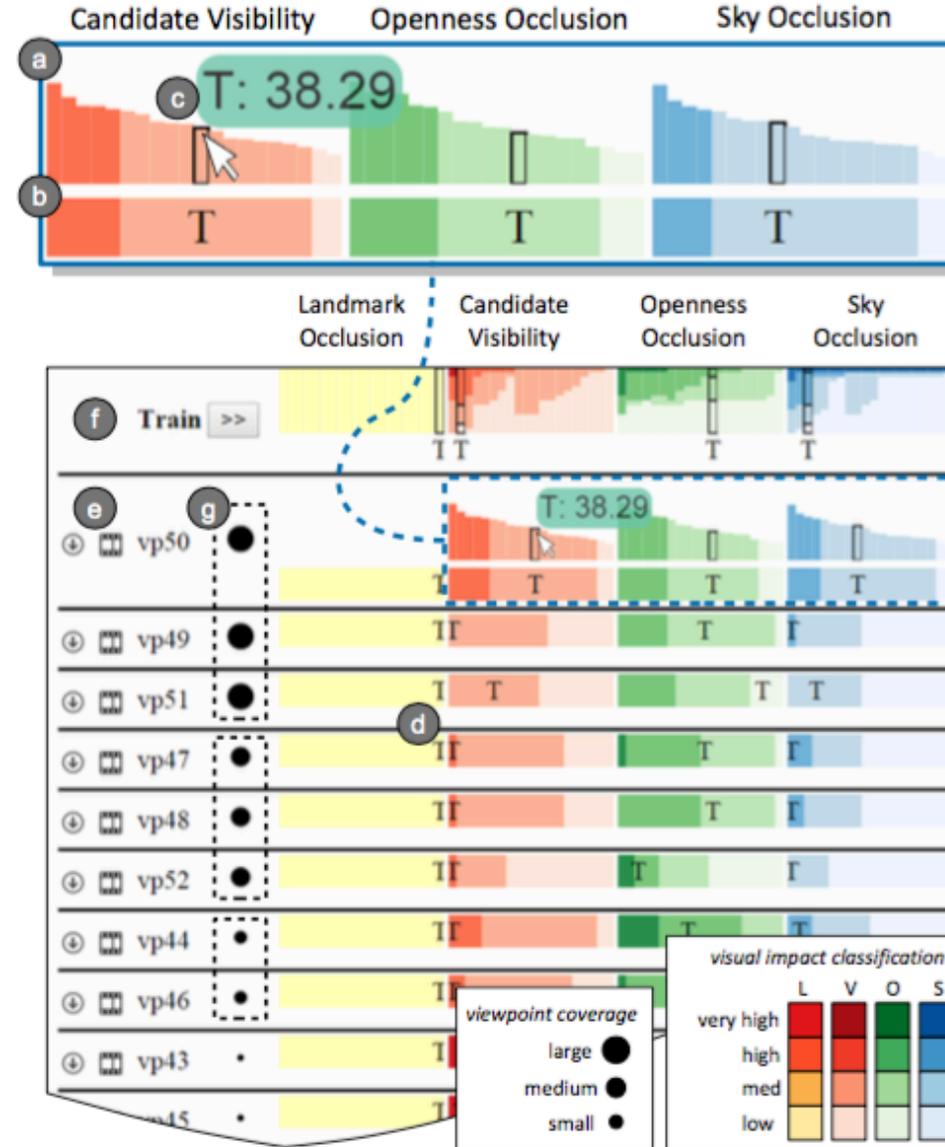
Pop-out is for example

Click on row to "expand it" for more detailed view

Transposable Ranking View (TRV) - Visual Encoding

Viewpoint Major Mode

- a) Bar charts show VIM for each candidate (letter) in distribution, saturation shows impact class
- b) Stacked bar chart is compact rep. of bar charts



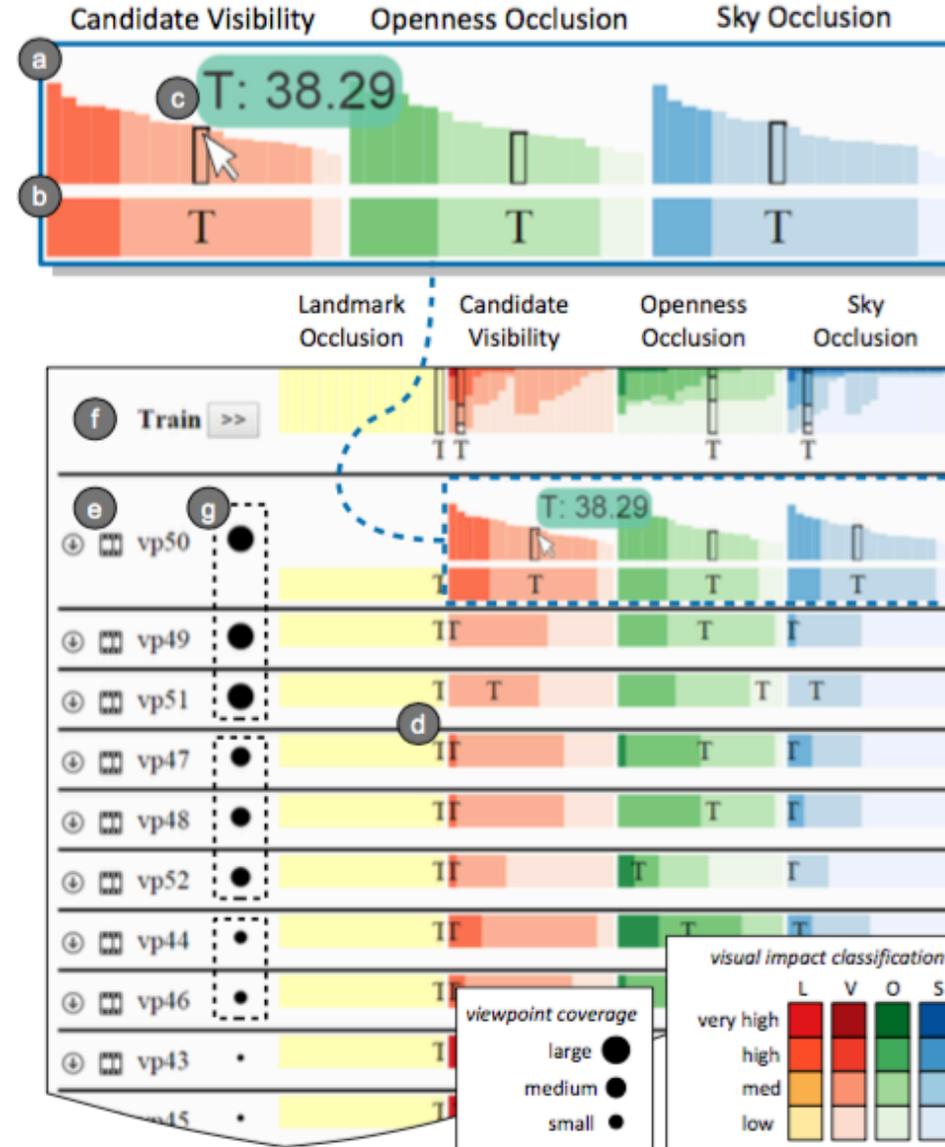
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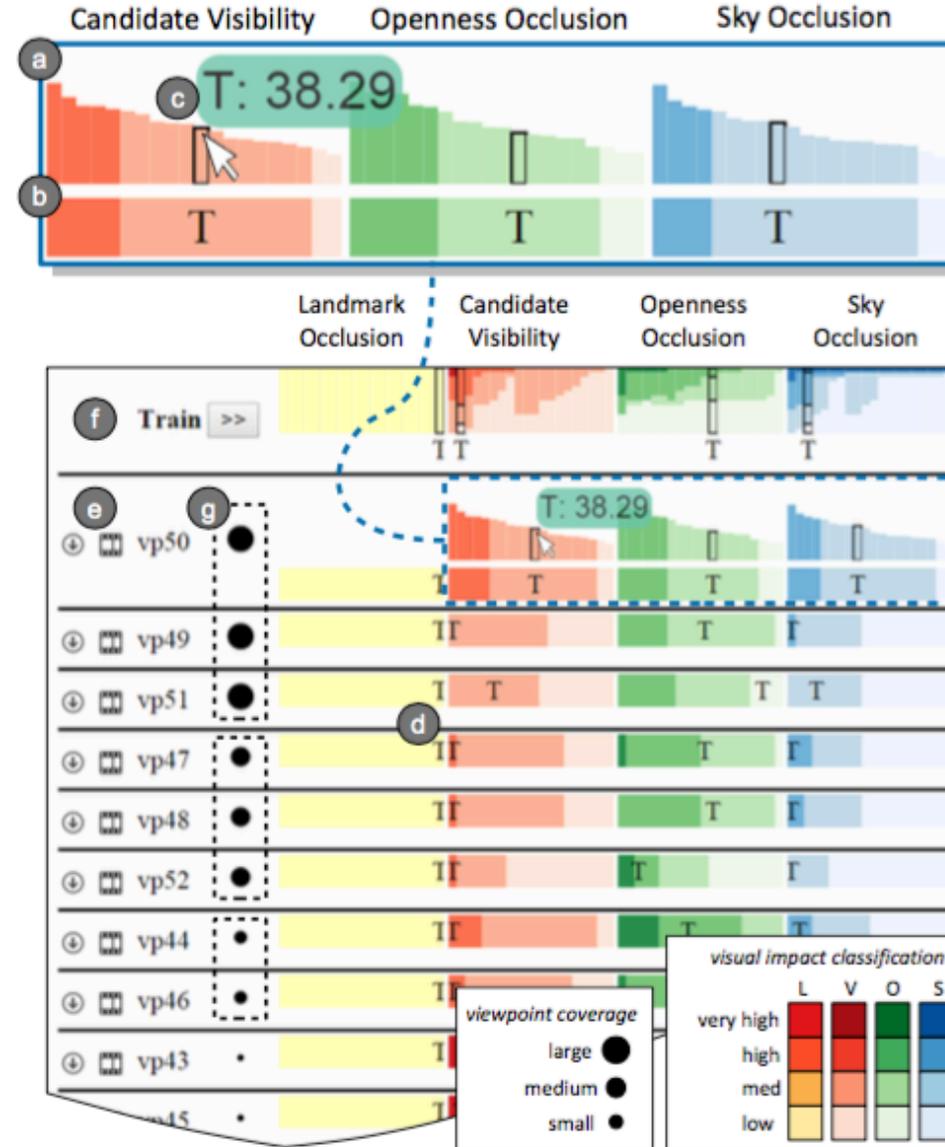
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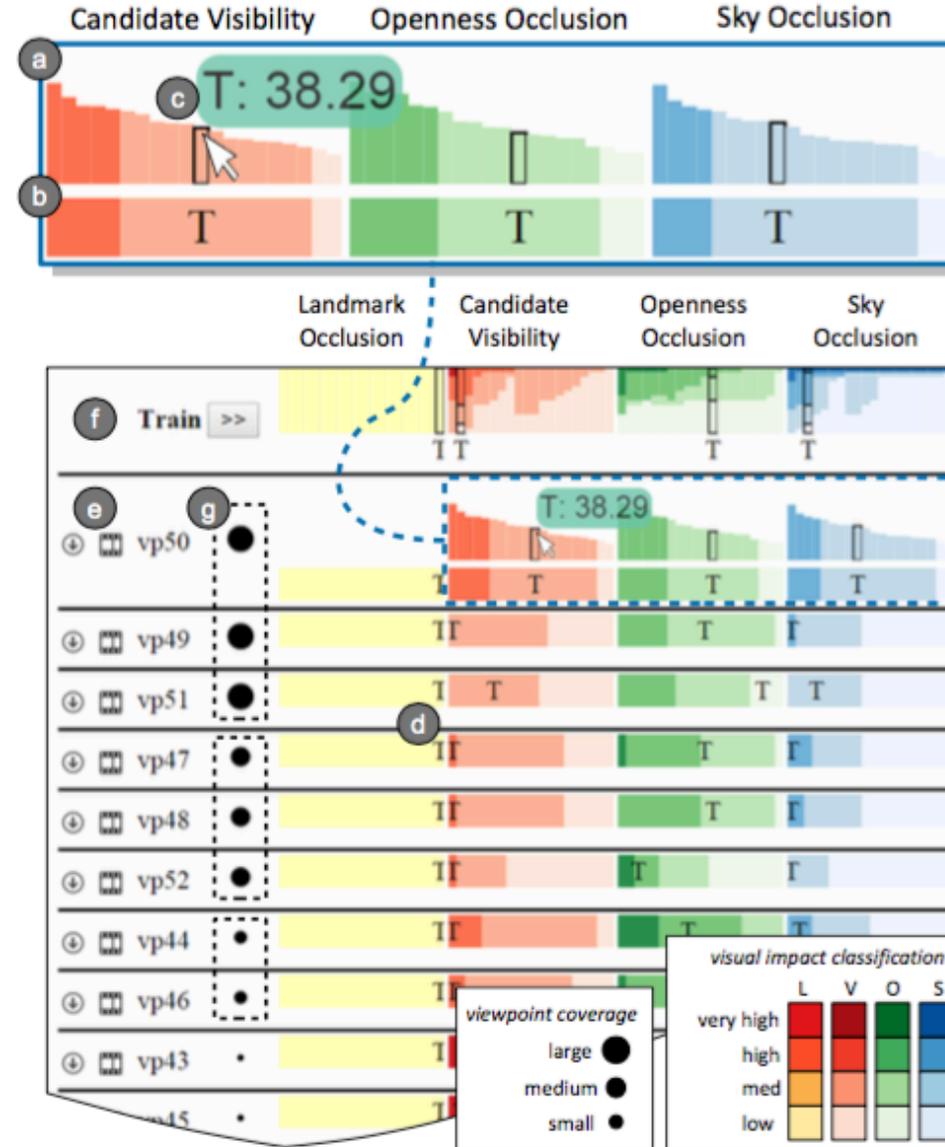
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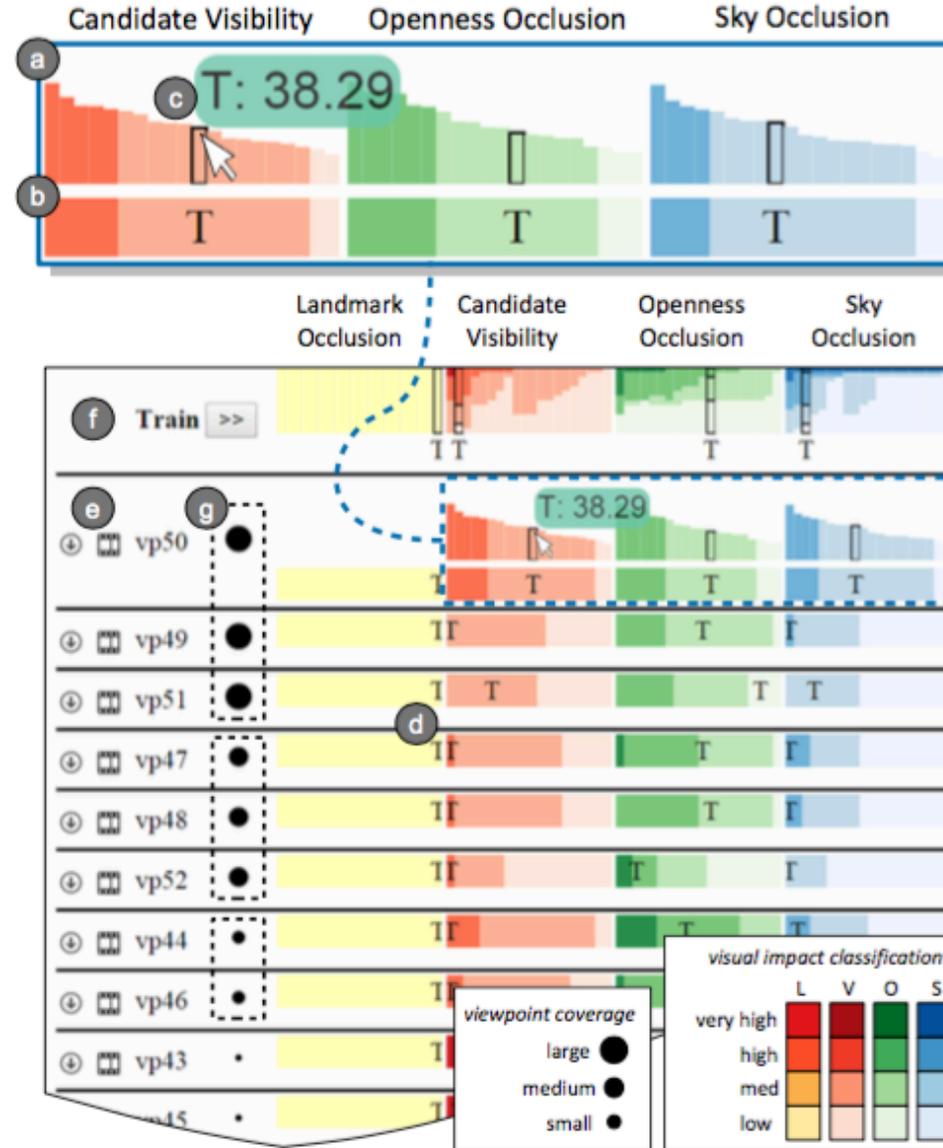
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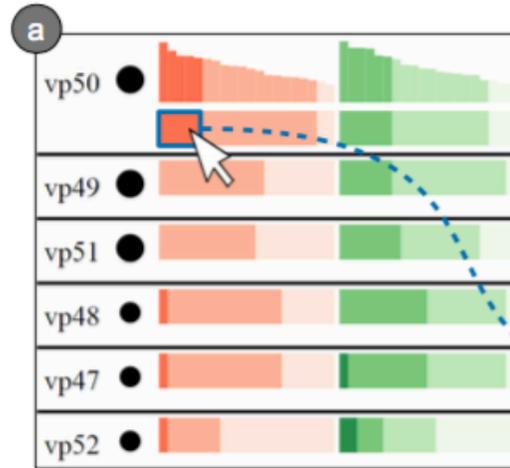
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- e) Arrow icon loads into spatial view of tool (Map)
- f) A high level summary of a category of viewpoint



Pop-out is for example

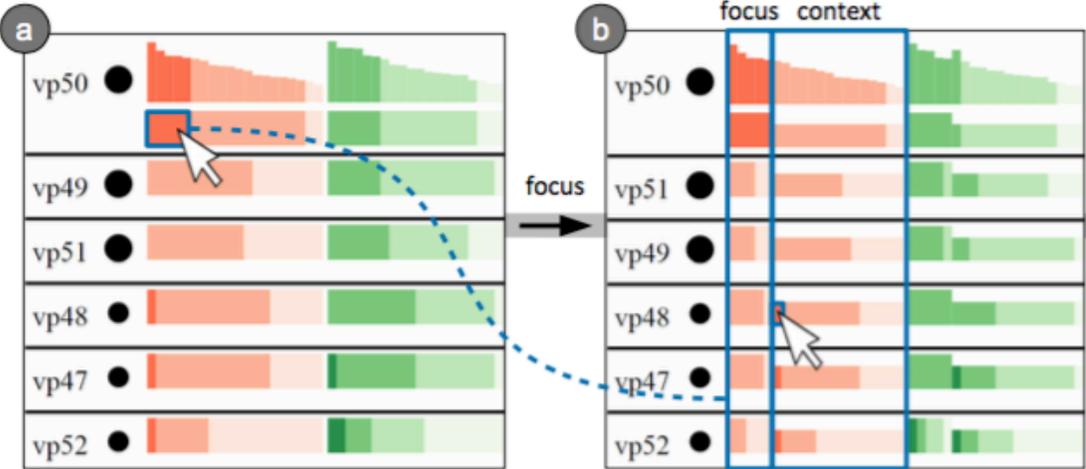
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Transposable Ranking View (TRV) – Focus, Filter, Transpose Workflow Example



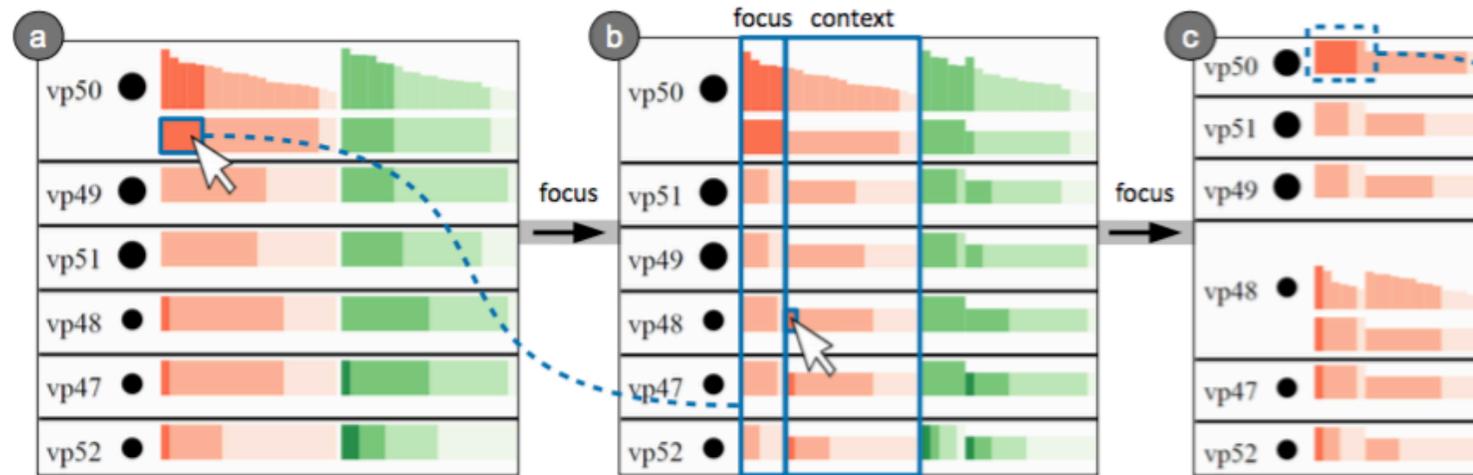
Select high impact
VIM portion across
all viewpoints
(Candidate Visibility)
of interest

Transposable Ranking View (TRV) – Focus, Filter, Transpose Workflow Example



Focused subset now emphasized with split heightened bar charts (left). Remaining distribution lowered in height for **context** (right).

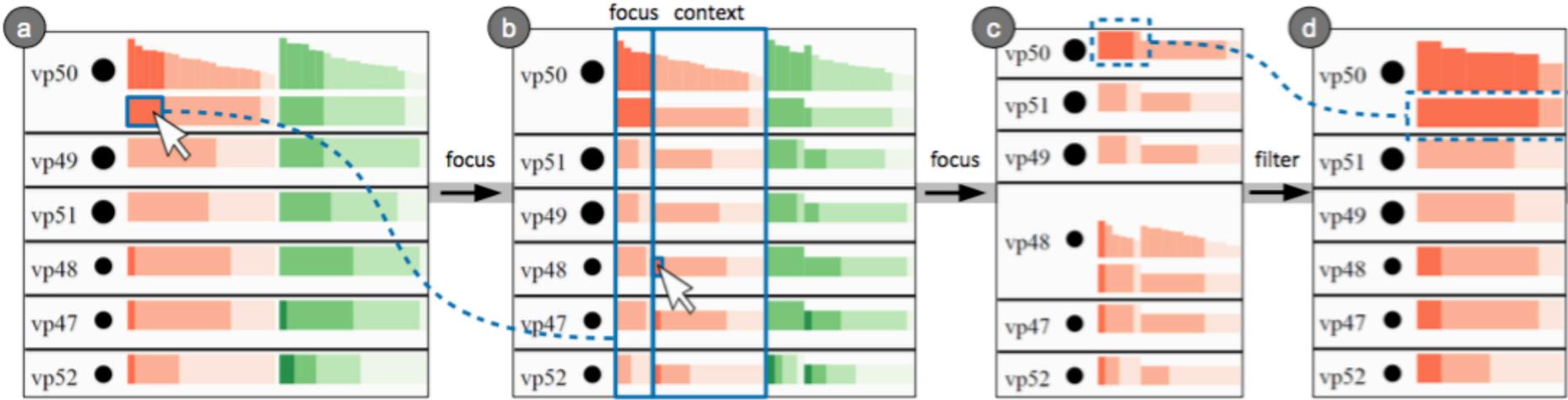
Transposable Ranking View (TRV) – Focus, Filter, Transpose Workflow Example



Can focus again. Can expand a row (vp48) for more detailed bar chart -> exact candidate VIM values

Transposable Ranking View (TRV) – Focus, Filter, Transpose Workflow Example

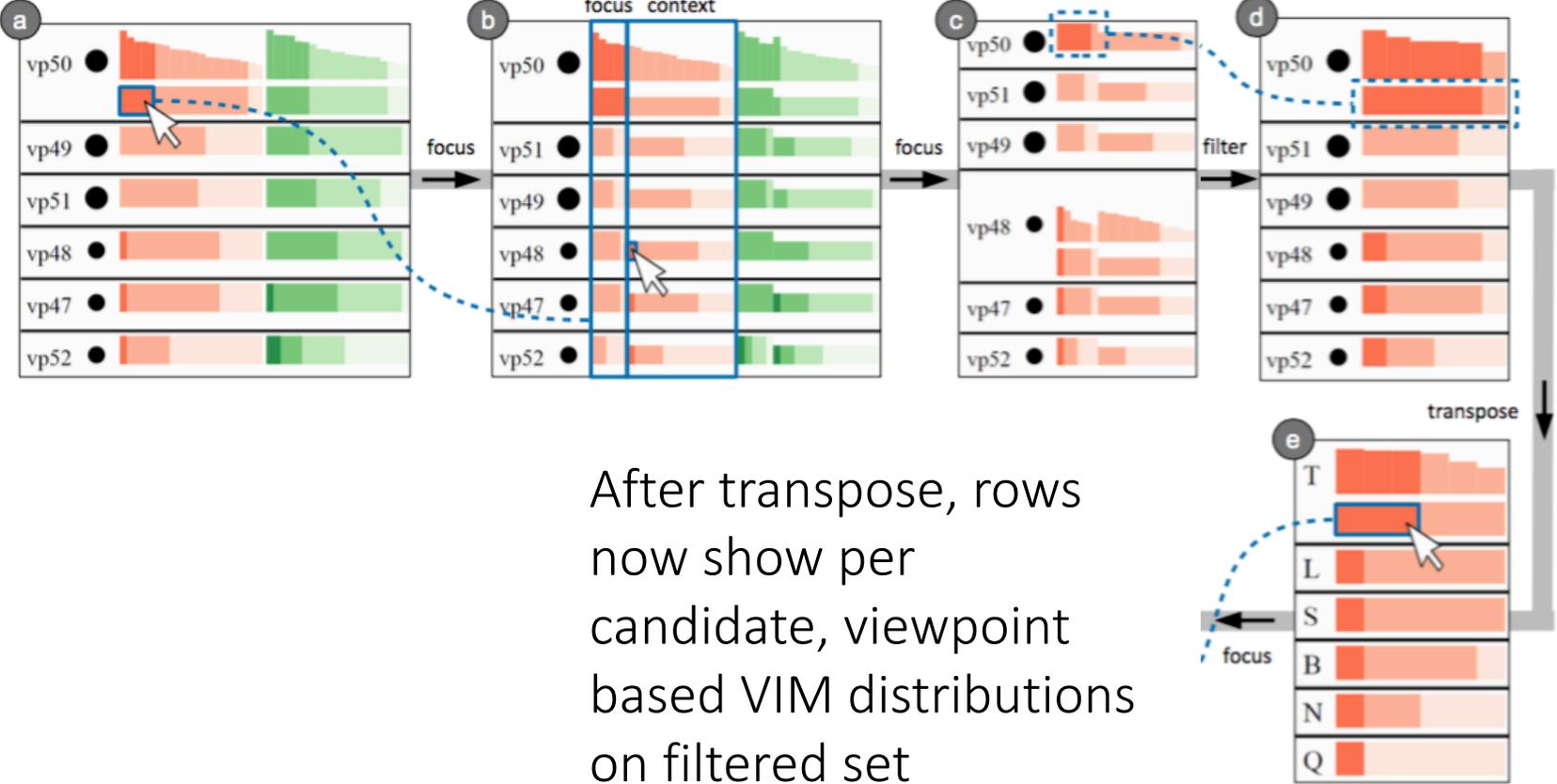
Filter/transpose
option on focused set



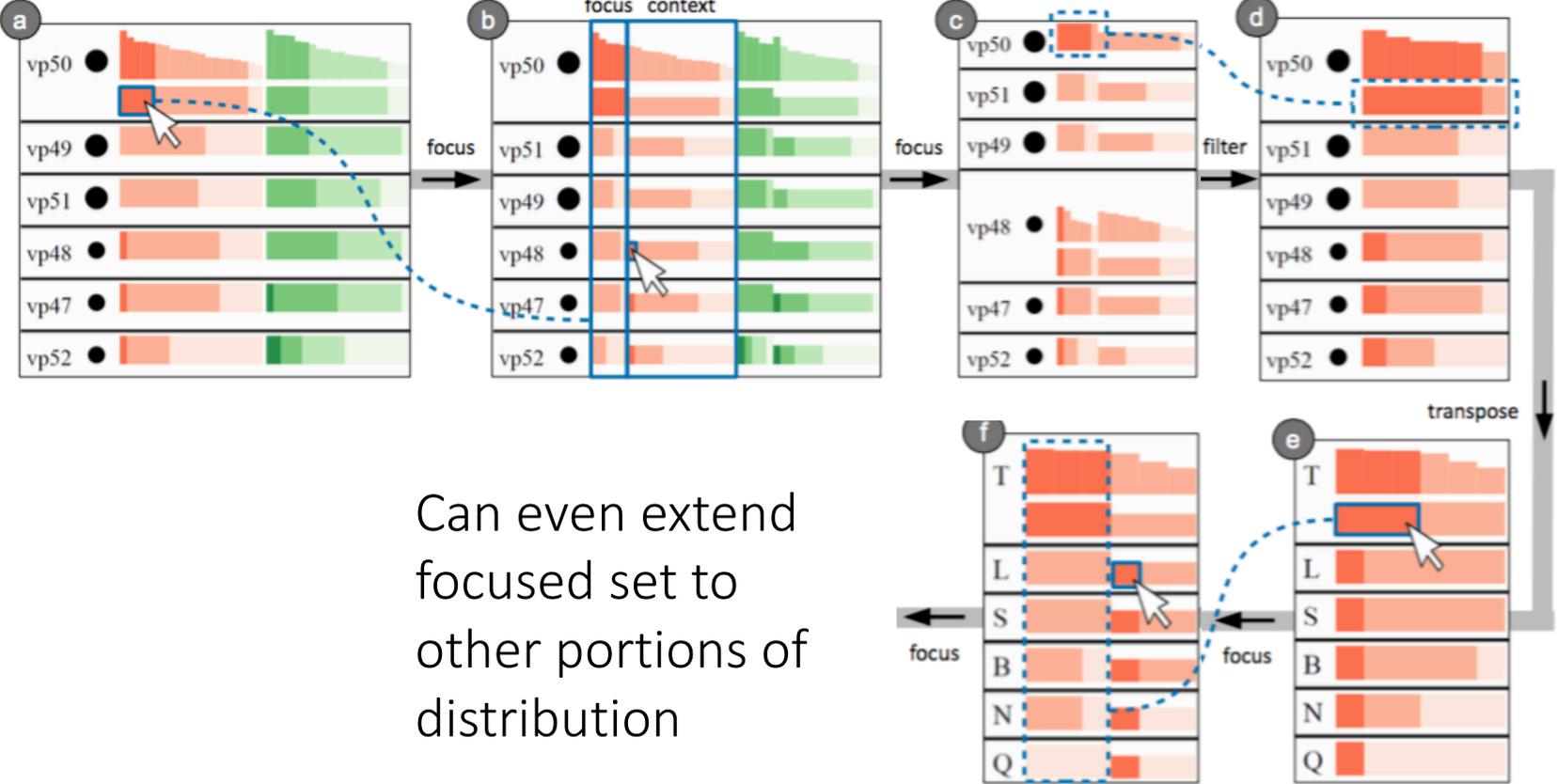
Use filter option above to see filtered viewpoint distributions now. Emphasize focused area for inspection.

Transposable Ranking View (TRV) – Focus, Filter, Transpose Workflow Example

Transpose to switch row ordering

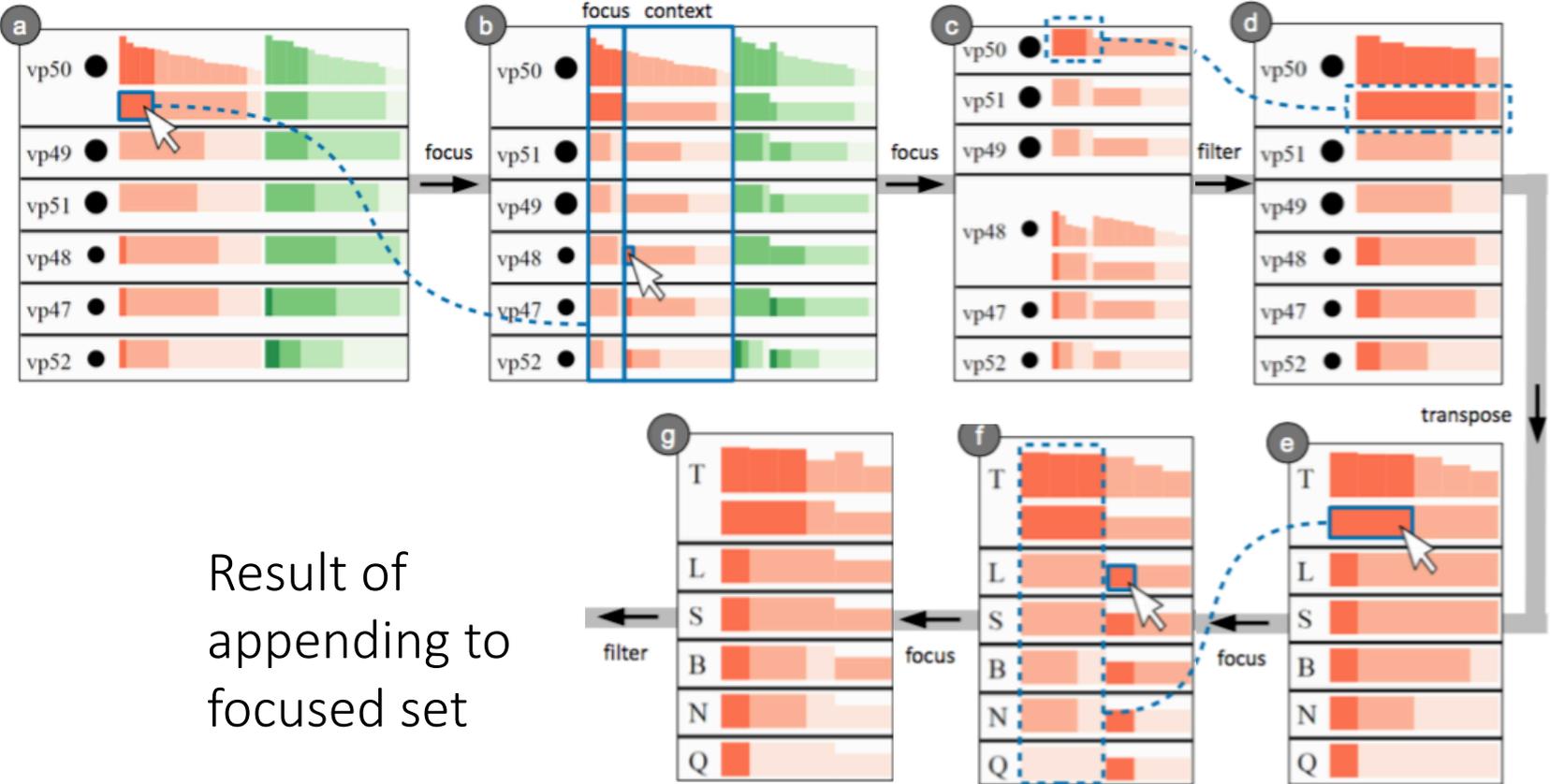


Transposable Ranking View (TRV) – Focus, Filter, Transpose Workflow Example



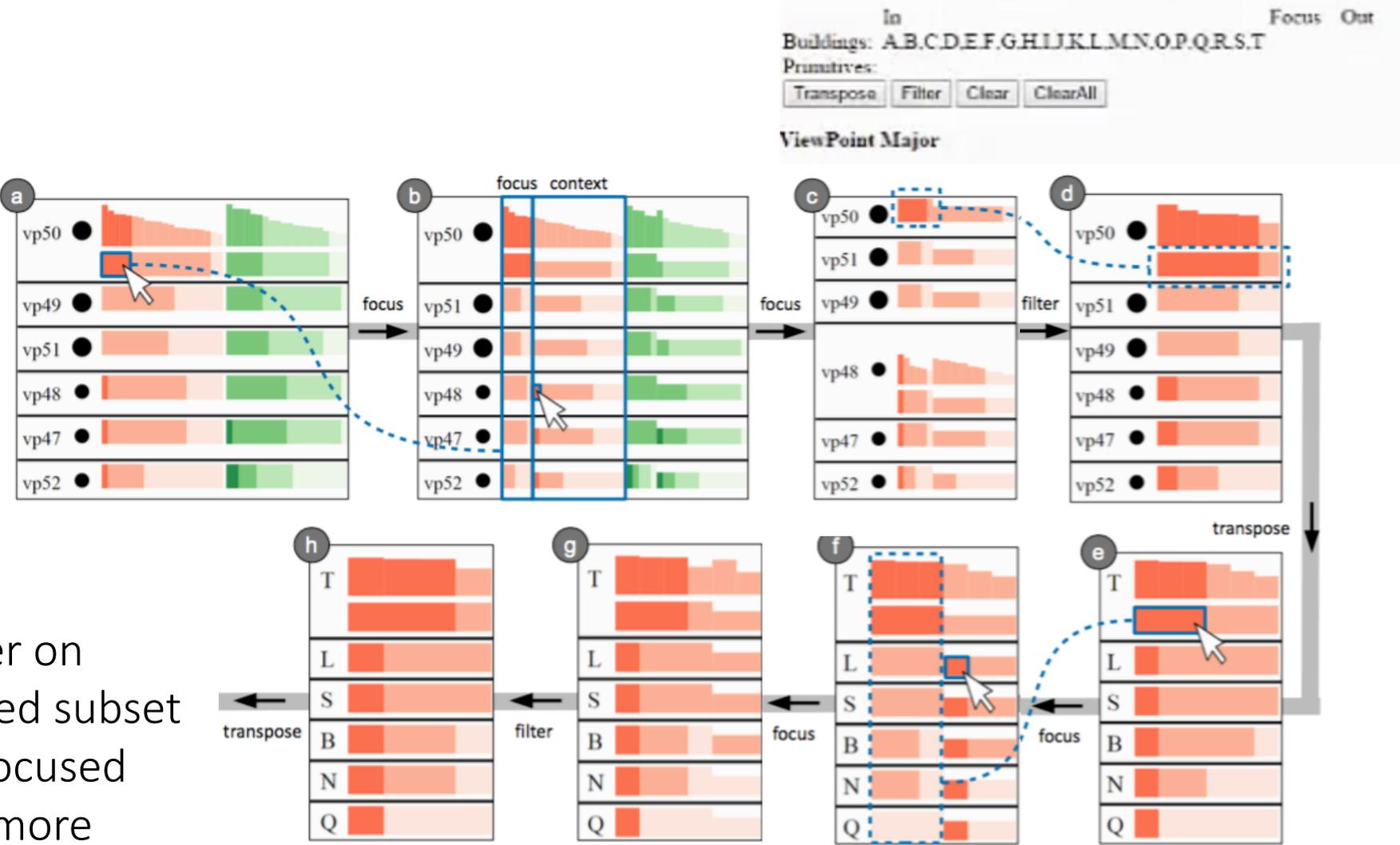
Can even extend focused set to other portions of distribution

Transposable Ranking View (TRV) – Focus, Filter, Transpose Workflow Example



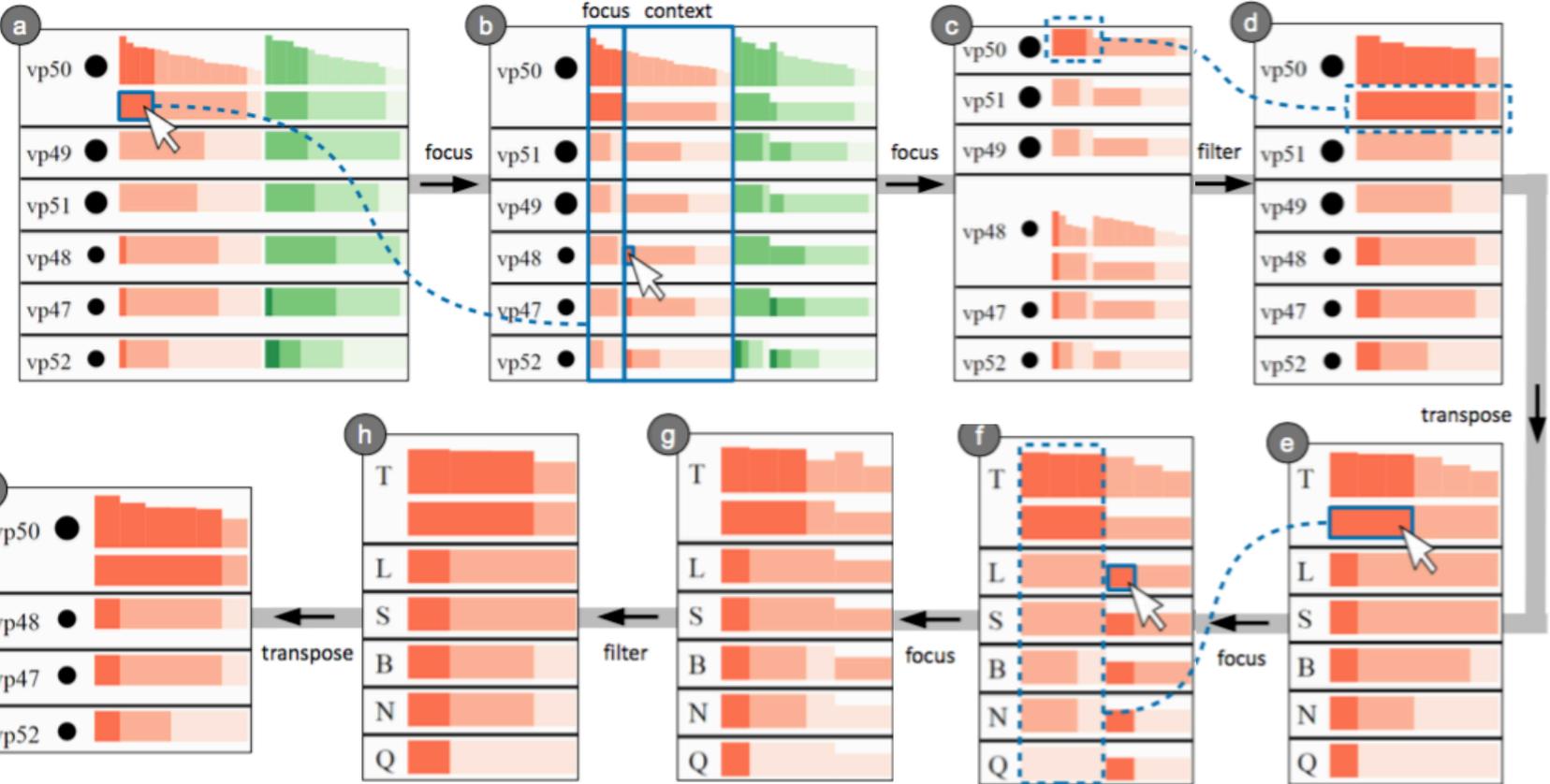
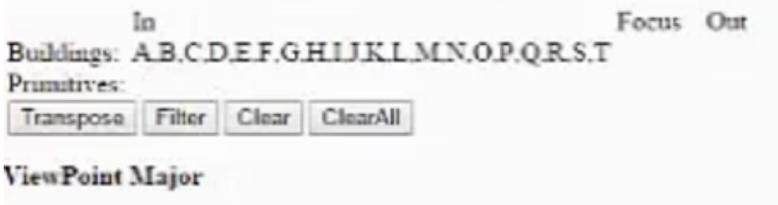
Result of
appending to
focused set

Transposable Ranking View (TRV) – Focus, Filter, Transpose Workflow Example



Can filter on appended subset to see focused area in more detail

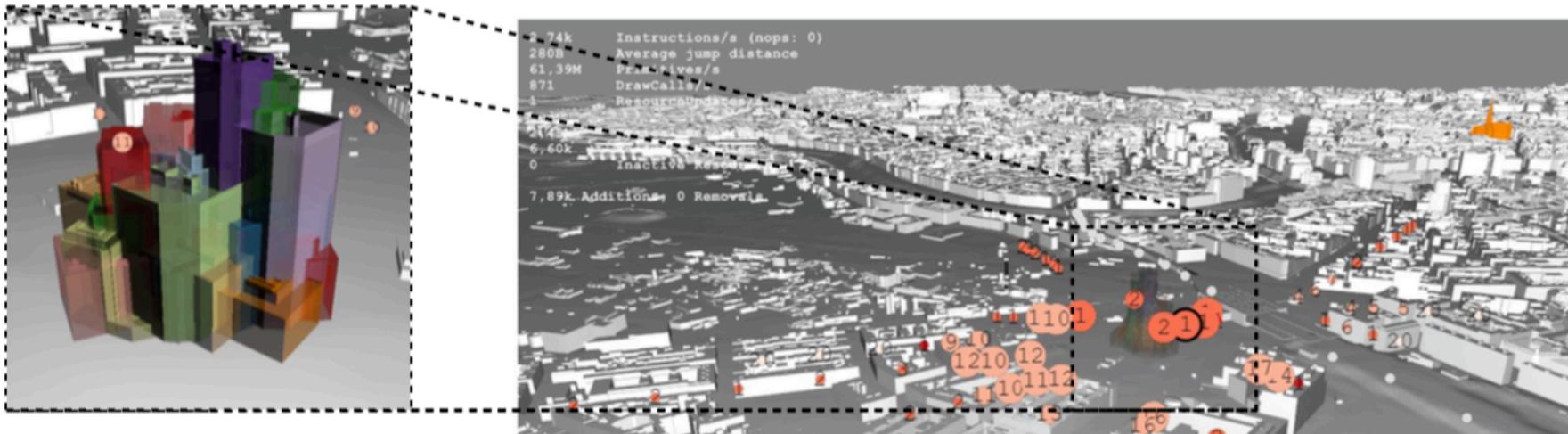
Transposable Ranking View (TRV) – Focus, Filter, Transpose Workflow Example



Final transpose to see final viewpoints based on high impact VIM candidates

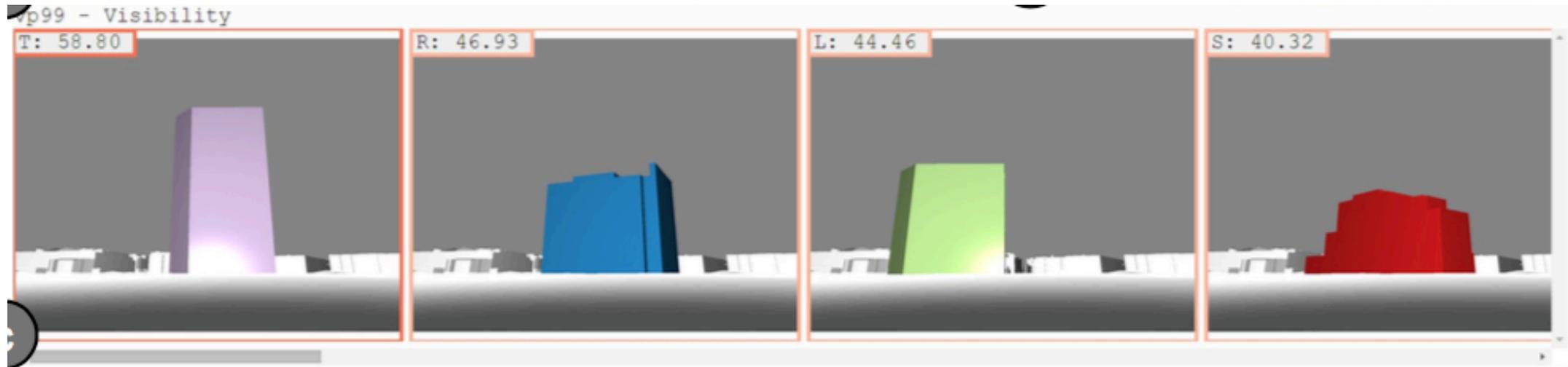
System Overview – 3D Spatial View

- City model and associated landmarks, buildings, similar to GIS
- Candidate buildings denoted by repeating 10 colours
- Viewpoints shown as circular glyphs
 - Size denotes how many candidates are covered
 - VIM Majority denoted by VIM colour
 - Number denotes how many candidates are covered
- TRV Linked Highlighting
 - Only viewpoints expanded rows shown, other viewpoints are “context” (greyed out)
 - Highlighted candidate buildings rendered opaque and coloured -> compare spatial properties with other candidates visually



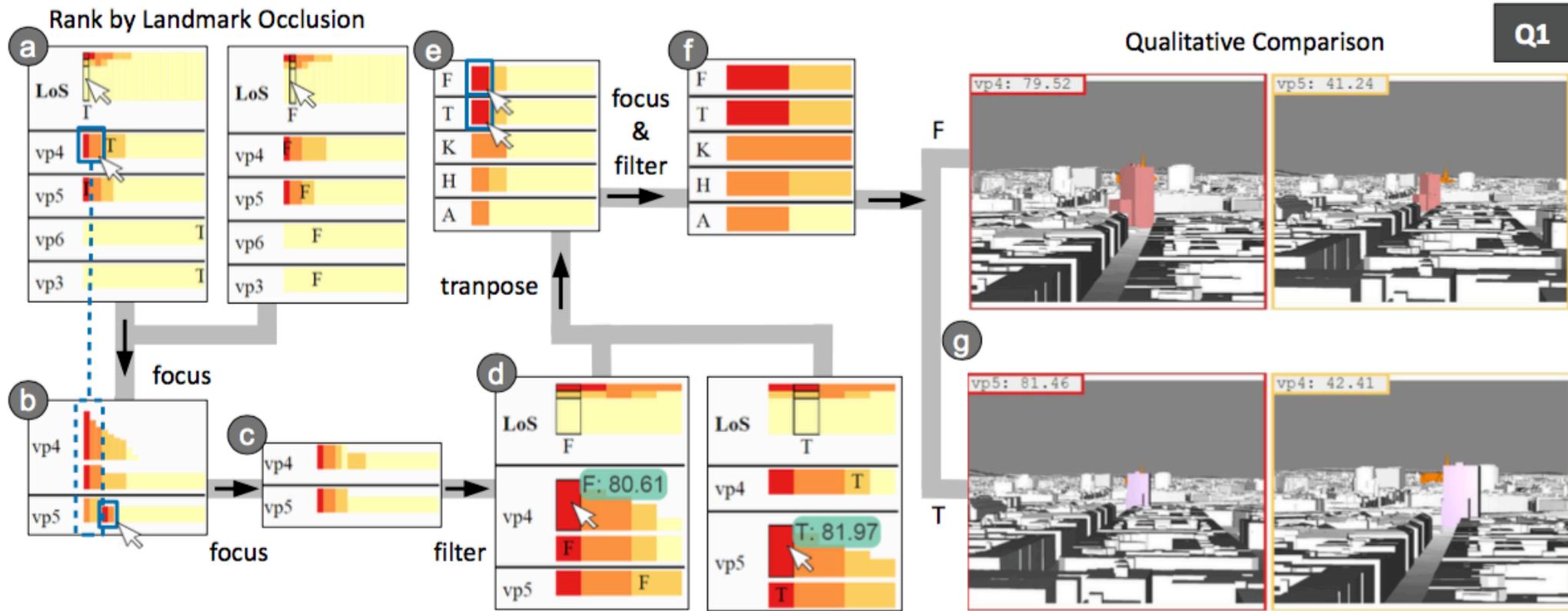
System Overview - Filmstrip

- Based on TRV loaded viewpoints/candidates
 - Show images of all candidates in one viewpoint (viewpoint major)
 - Show one candidate in all viewpoints (candidate major)
- Header in filmstrip box shows identifier of row from TRV
 - Name and value of VIM selected as well



Task Analysis Example

- Which candidates cover a landmark and how strong is the occlusion?



User Feedback

- During development, received feedback from 10 experts
 - VIM validation only with 1 expert
- Positive reactions
 - Could see benefits of large scale viewpoint evaluation for streets
 - Liked visual linking between spatial view and VIM values
 - Most popular VIM was landmark occlusion (Vienna)
- Would have liked
 - Attribute to indicate shape of a candidate

Known Limitations

- Openness metric not clear for most
 - Use depth to quantify volume of open space occluded by candidate
- Expand TRV to other “hard criteria” eg. Max height, min. floor space, office to apartment ratio, etc
- VIM for shadow cast by candidate
- Movement profiles of a viewpoint eg. # people at a viewpoint passing through

Summary

- What: Data
 - Spatial locations of candidate buildings
 - VIM derived metrics
- How: Encode
 - Spatial 3D view -> 3D map
 - Non-spatial transposable rank view -> histograms, bar charts, stacked bar charts
- How: Reduce
 - Elide (bar height change) and filter option to chosen focus set
- Scale
 - 30 candidates tested
 - Viewpoints problematic -> suggested further filtering of viewpoints with low coverage to compensate
 - More than 4 VIM metrics could be possible

My Take

- What it did well
 - Great willingness to carry over domain techniques for familiarity with target users
 - Liked how they quantified aesthetic information for easier comparison, ranking, and filtering
 - Good use of linking between views to understand a candidate/viewpoint in terms of a VIM
- Improvements
 - Gallery view for filmstrip instead of horizontal strip area (visually compare viewpoints more at once)
 - “History” feature since filtering will eliminate previous steps, may have to go back?
 - Stronger VIM metric definitions -> get more experts
 - Ability to define viewpoint coverage criteria or other VIM metrics further (might be different and context dependent)
 - Figures not always clear, especially filter/transpose ... had to consult video to realize

Thanks for watching!

- Title images
 - <http://www.wrirosscities.org/news/three-lessons-negotiating-urban-planning-process-embarq%E2%80%99s-city-building-exercise>
 - <http://archinect.com/dariomatteini/project/m-arch-in-projecting-and-urban-planning-dublin-docklands-new-masterplan>
- Domain Practice images
 - <http://dunster.ca/services/land-use-planning-services/examples-past-projects/>
 - <http://udv.lab.uic.edu/education/managingphotos/types.htm>
 - [http://www.world-architects.com/architektur-news/insight/On Architectural Models 2247](http://www.world-architects.com/architektur-news/insight/On_Architectural_Models_2247)
 - <http://www.siliconoutsourcing.net/cad-design-drafting/architecture-rendering.html>
- Related Work images
 - <https://docs.unity3d.com/460/Documentation/Manual/OcclusionCulling.html>
 - <http://www.nationalgeographic.org/encyclopedia/geographic-information-system-gis/>
 - P. van der Corput and J. J. van Wijk, "ICLIC: Interactive categorization of large image collections," 2016 IEEE Pacific Visualization Symposium (PacificVis), Taipei, 2016, pp. 152-159.
doi: 10.1109/PACIFICVIS.2016.7465263
URL: <http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=7465263&isnumber=7465233>
- Remaining images are from main paper