
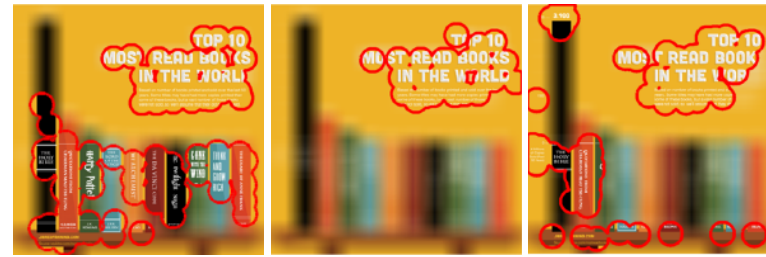


Predicting Attention for Design Feedback





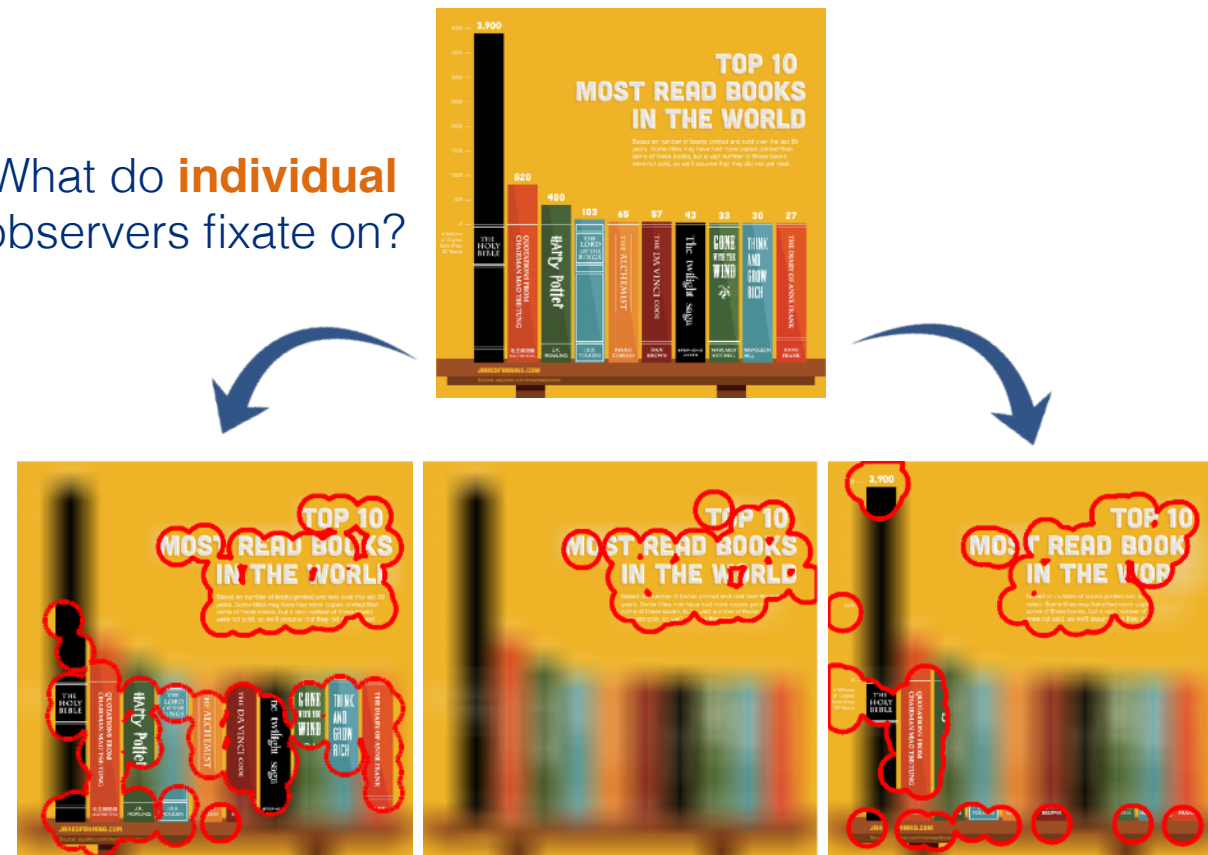
individual
attention

population
attention

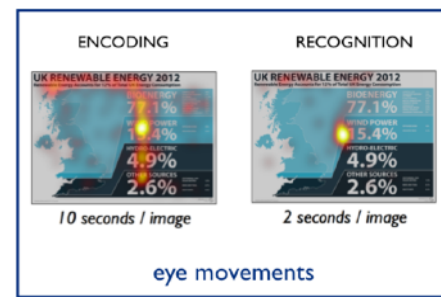


In this talk, I want to overview possible applications of eye movement studies for visualizations. On the one hand, we can make personalized predictions on a per-user basis; on the other hand, we can aggregate attention data across a population to make generalized conclusions about the design itself.

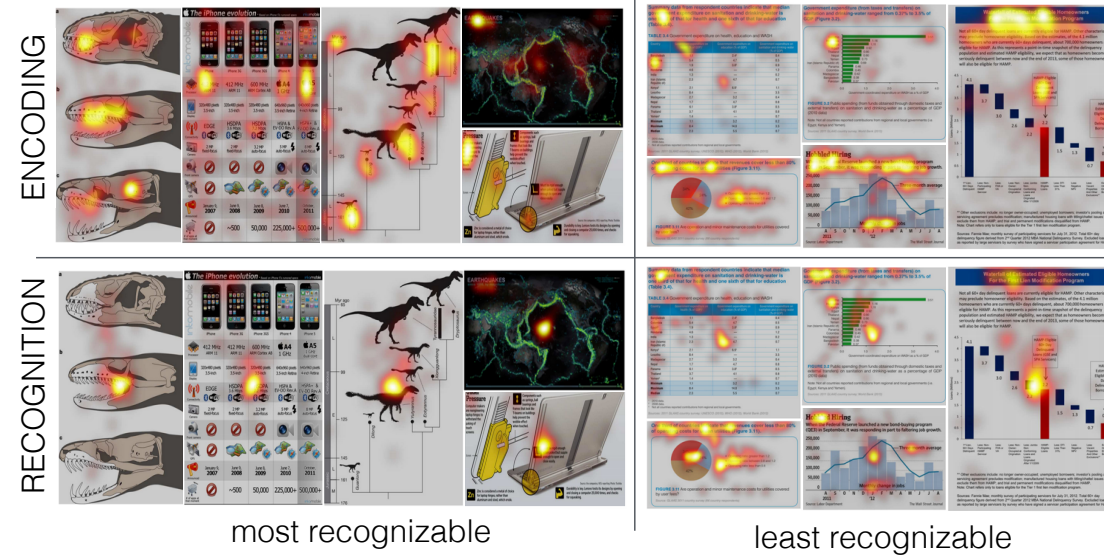
What do **individual** observers fixate on?



We can learn to associate an individual user's eye movements with what trends the user has picked up on or what will be stored in memory.



What elements do individuals
encode into
and retrieve from
memory?

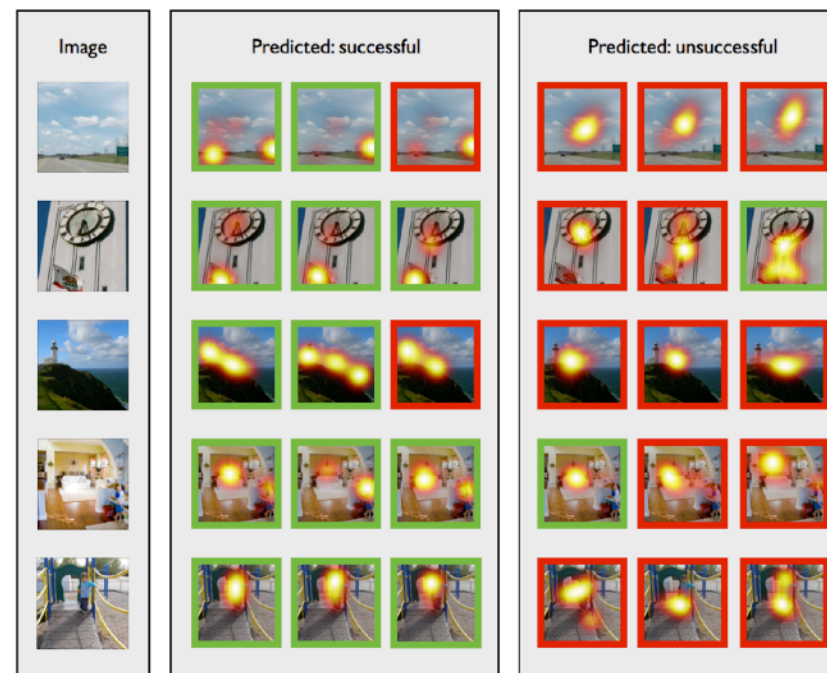


Borkin*, Bylinskii*, et al. [InfoVis 2015]

For instance, in a past InfoVis paper, we have shown that eye movements can give us clues about which elements of a visualization are encoded into memory, and which elements help with retrieval from memory.

Paper ref: https://vcg.seas.harvard.edu/files/pfister/files/infovis_submission251-camera.pdf

An **individual's** eye movements
can be used to predict the **individual's** memory



Bylinskii, et al. [Vision Research 2015]

In a Vision Research paper, we were able to make individualized memory predictions: we used an individual user's eye movements on a natural image to predict whether that user will remember an image later on.

Paper ref: <http://web.mit.edu/zoya/www/docs/figrimProof.pdf>

Is a design successful at guiding observer attention?

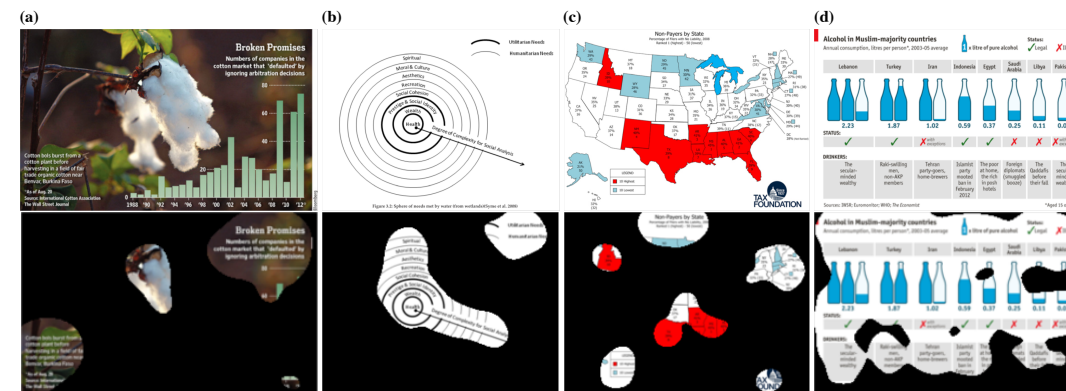


Bylinskii, et al. [ETVIS 2015]

By comparing the eye movements of a group of users on the same visualization, we can ask if a design consistently guides observers or if all observers will pay attention to different aspects of the design?

Paper ref: http://web.mit.edu/zoya/www/docs/Bylinskii_fixation_metrics.pdf

Is a design successful at guiding observer attention?

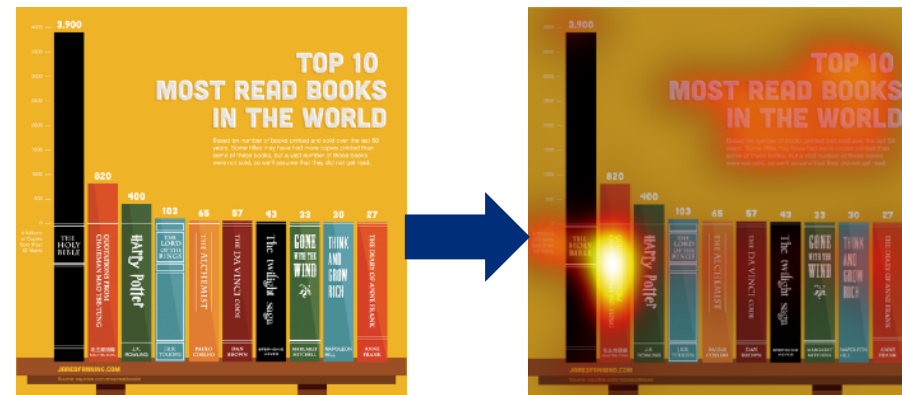


Bylinskii, et al. [ETVIS 2015]

We can also ask if all observers are likely to miss the same design regions.

Paper ref: http://web.mit.edu/zoya/www/docs/Bylinskii_fixation_metrics.pdf

What is salient to a **population** of observers?

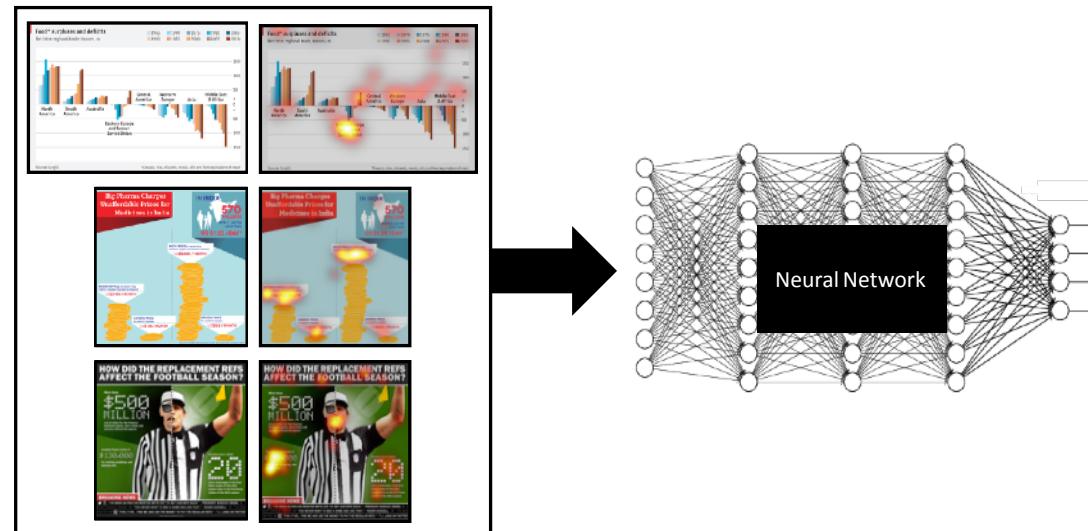


Bylinskii et al. [accepted to UIST 2017]

At a population level, we can ask what a group of participants pick up from a visualization - what is generally salient in the design.

Project page: <http://visimportance.csail.mit.edu/>

Learning **population** attention patterns



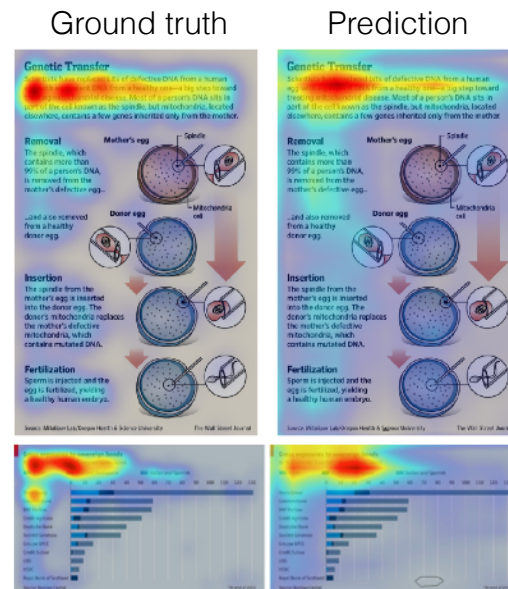
Bylinskii et al. [accepted to UIST 2017]

Motivated by all these applications, we sought a way to scale up data collection of attention patterns. So using the BubbleView tool (massvis.mit.edu/bubbleview) that was described in the previous talk, we have gathered attention maps for thousands of visualizations.

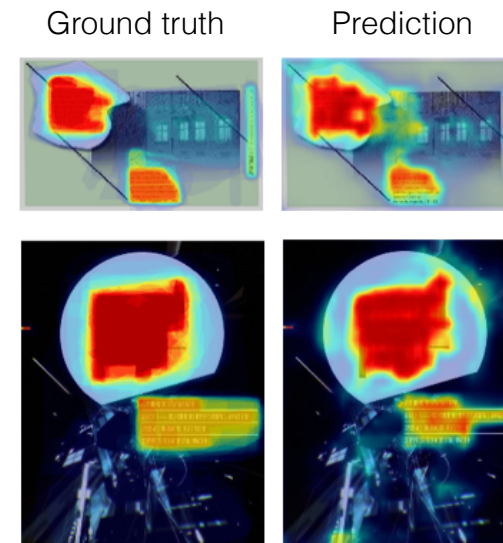
Project page: <http://visimportance.csail.mit.edu/>

Predicting **population** attention patterns

Data visualizations



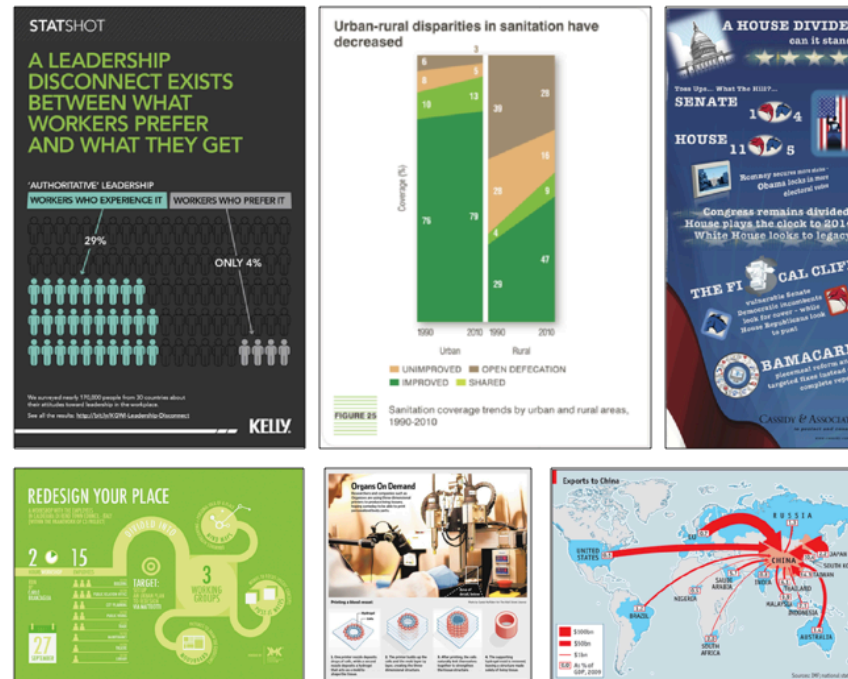
Graphic designs



Bylinskii et al. [accepted to UIST 2017]

This has allowed us to make automated, real-time predictions of attention patterns on new data visualizations, and separately, graphic designs.
Project page: <http://visimportance.csail.mit.edu/>

Application: thumbnailing



Bylinskii et al. [accepted to UIST 2017]

We have used these predictions to compute automatic thumbnails for visualizations.

Project page: <http://visimportance.csail.mit.edu/>

Application: thumbnailing



Bylinskii et al. [accepted to UIST 2017]

Using a set of users studies, we show that these thumbnails capture the parts of the visualizations that can facilitate their quick retrieval from a database.

Project page: <http://visimportance.csail.mit.edu/>

Application: automatic feedback within design tools

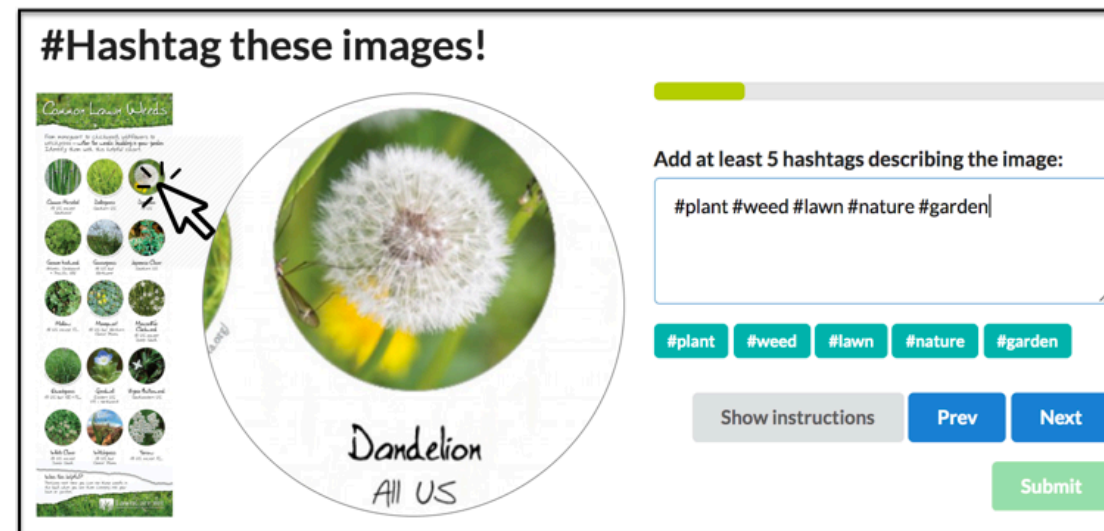


Bylinskii et al. [accepted to UIST 2017]

We can also display these predictions in realtime on a graphic design tool.

Demo: <http://visimportance.csail.mit.edu/design/create/>

Learning **population** attention patterns



Finally, we are currently exploring new ways of capturing attention patterns in crowdsourced settings. For instance, showing small images, and having people use a zoom lens to explore those images.

<http://phone-vis.herokuapp.com/vss/vis>



Or, in our new PosterViewer mobile web app, we capture participant interactions as they pinch-zoom to explore academic posters. We will use all these collected attention patterns for summarization applications.

Thank
you!



*my advisors:
Aude Oliva and Fredo Durand*



*my Adobe collaborators:
Aaron Hertzmann, Bryan Russell, Peter O'Donovan*



*my Harvard Vis & HCI collaborators:
Hanspeter Pfister, Nam Wook Kim, Michelle Borkin, Krzysztof Gajos*



*my awesome students:
Sami Alsheikh, Spandan Madan, Matt Tancik, Kimberli Zhong*