IEEE GlobalSIP
3rd IEEE Global Conference on Signal & Information Processing
Orlando, Florida, USA December 14-16 2015
IEEE

Eccentricity Effect of Motion Silencing on Naturalistic Videos

Lark Kwon Choi*,
Lawrence K. Cormack, and Alan C. Bovik

Dec. 16, 2016

The University of Texas at Austin
Electrical and Computer Engineering

Laboratory for Image & Video Engineering
LIVE
The University of Texas at Austin

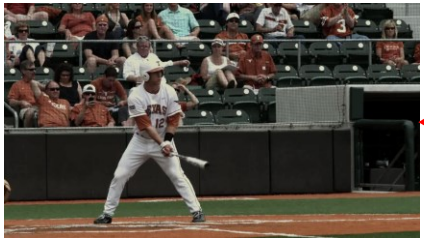
Outline

- Introduction
- Background
  - Visual Masking and Motion Silencing
- Eccentricity Effect of Motion Silencing
  - Human Subjective Studies
  - Result Analysis
- Conclusion and Discussion

Perception of Visual Distortions



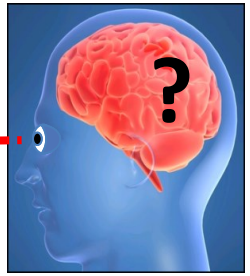

Humans are generally the ultimate arbiter of digital videos.


Natural Scene

Capture


Video Processing


Processing, Display



Human

Spatial distortions

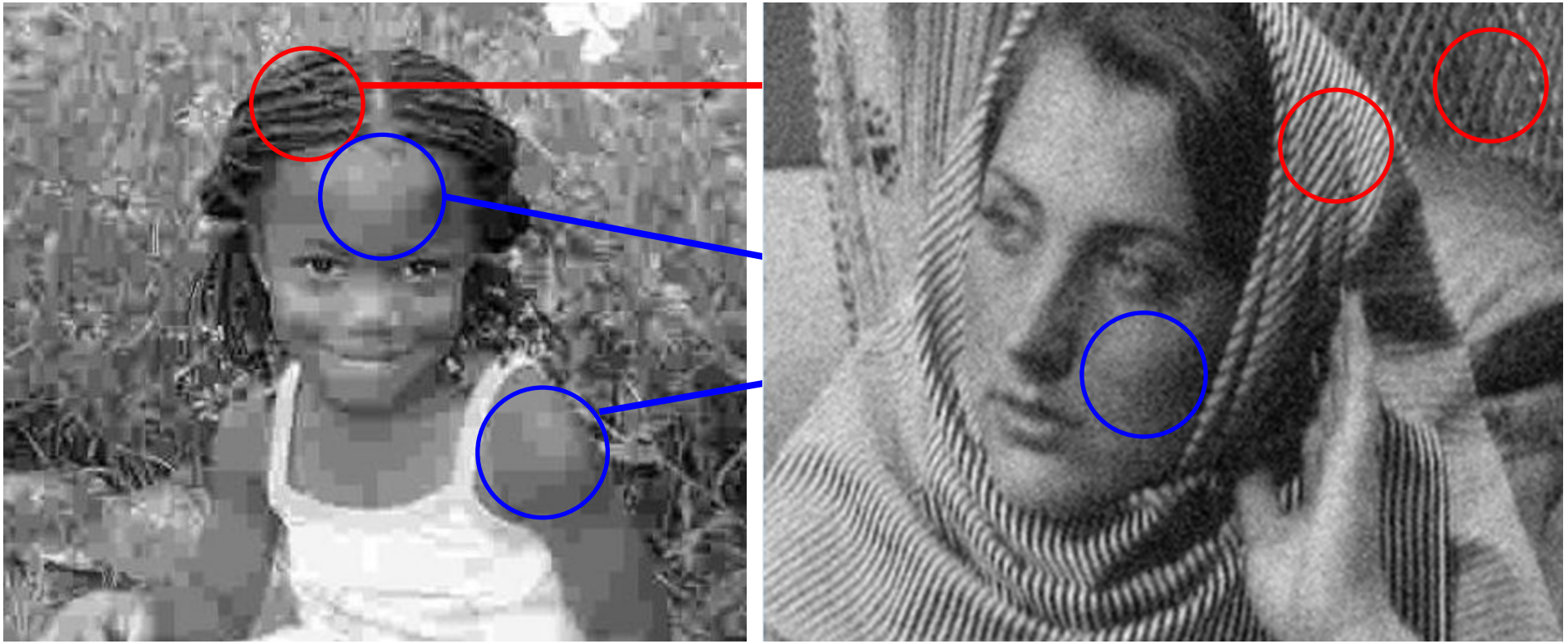
- Blocking
- Ringing
- False contouring
- Blur
- Noise …

Temporal distortions

- Motion compensation mismatch
- Mosquito effects
- Ghosting
- Jerkiness
- Flickering …

Visual Masking

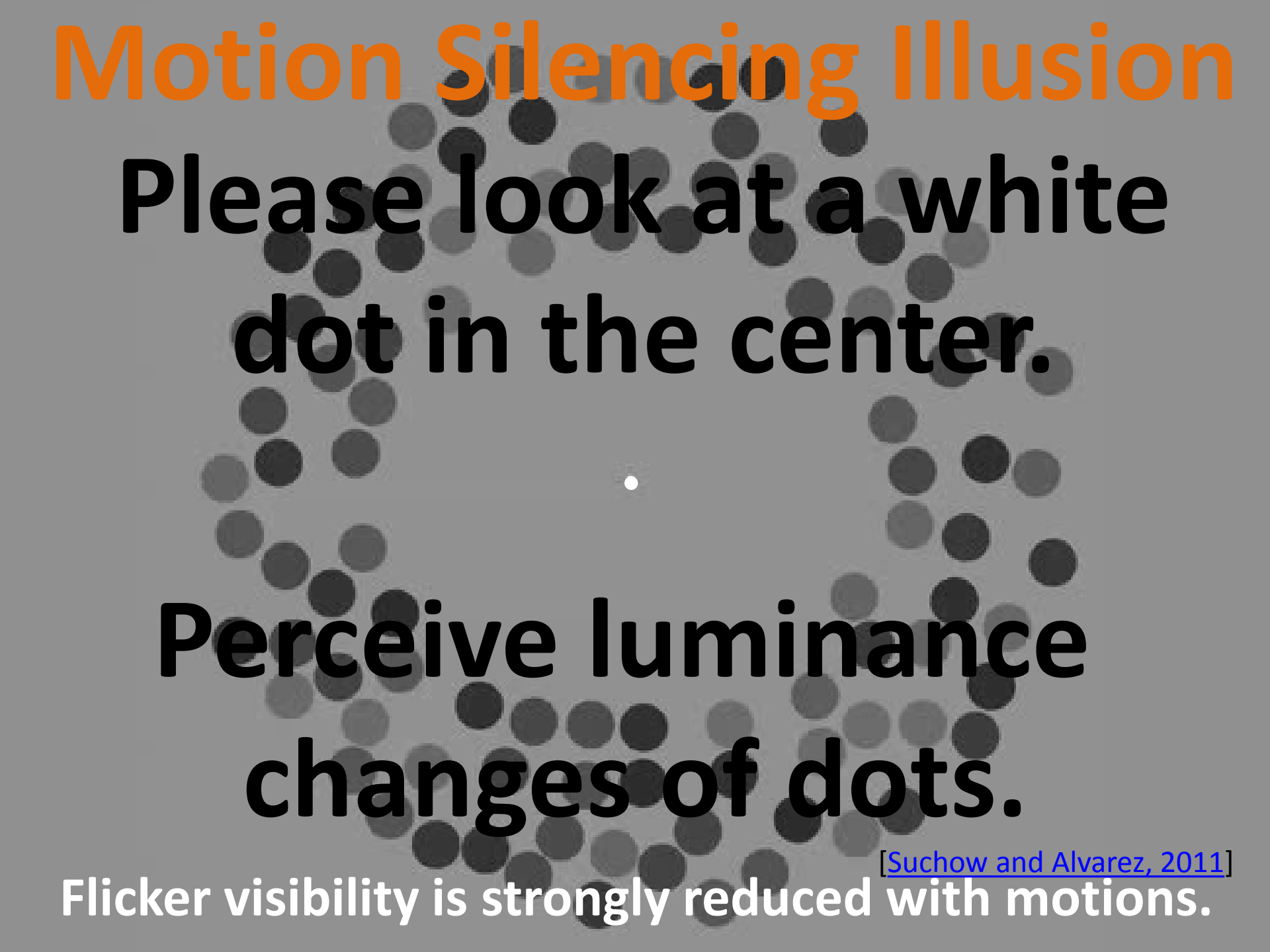
Visibility reduction of a stimulus (target) caused by the presence of another stimulus (mask) in space and/or time.



Spatial masking is well known and widely used for visual processing.

[Bovik, 2010; Wang and Bovik, 2011]

Motion Silencing Illusion



[Suchow and Alvarez, 2011]

Flicker visibility is strongly reduced with motions.

Flicker Visibility on Naturalistic Videos

Q1: Does motion silencing work on real naturalistic videos?
Q2: What's motion effects on motion silencing?
Q3: What's eccentricity effects on motion silencing?

↓

Execute a series of human subjective studies.

Develop LIVE Flicker Video Database

http://live.ece.utexas.edu/research/quality/live_flicker_video.html

Phase I: Motion effects

Phase II: Motion and eccentricity / eccentricity effects

↓

A1: Works well. Would be useful for developing VQA algorithms.
A2: Large, coherent motions strongly reduce flicker visibility.
A3: Large motion and eccentricity much more strongly reduces flicker visibility.

LIVE Flicker Video Database

- **Source videos using RED ONE cinematographic camera**
  - 3K (3072×1728), 42MB/s (Highest quality), and 30fps.
  - Diverse object motions.
  - 6 Source videos and 92 distorted (72 test, 20 training) videos.

*Tractor content was obtained from Technical Univ. of Munich.

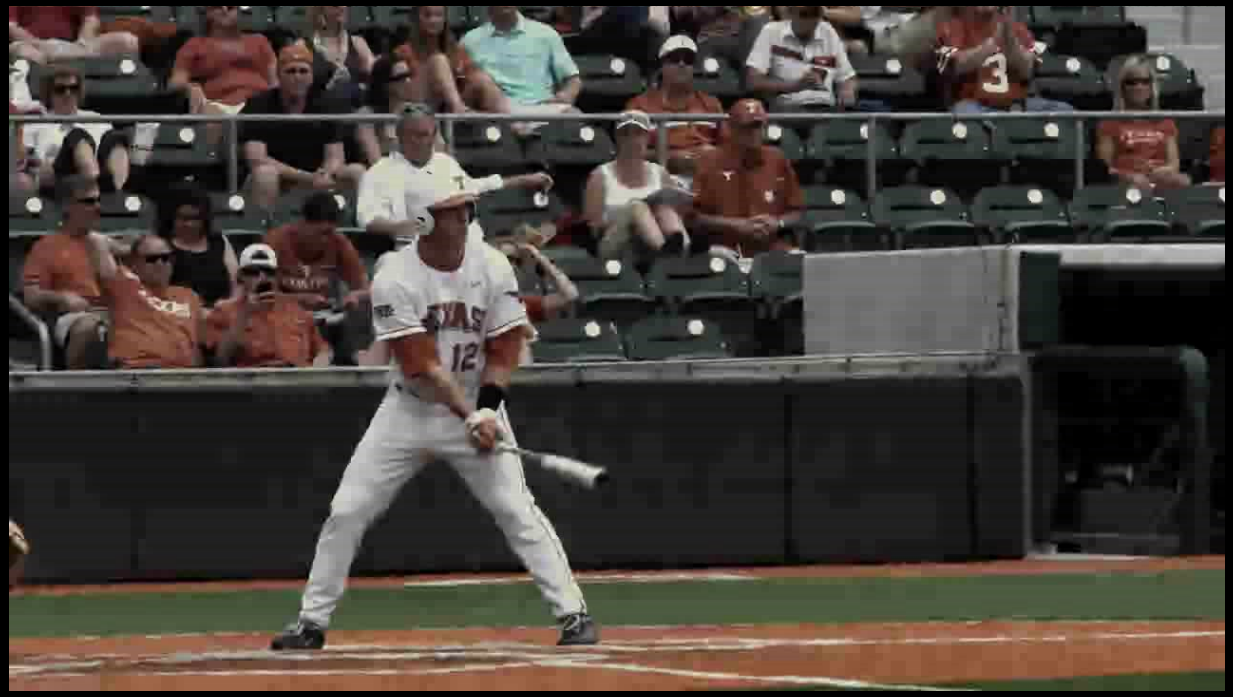
LIVE Flicker Video Database

- **Quantization Flicker simulations**

Source video → Downsample (720p) → H.264 codec compression → 4 different quality levels → Alternate video frames

- **Phase I: Motion effects on flicker visibility (Experiment)**

Target: Baseball batter in white uniform



Extremely

Highly

Medium

Little

Hardly

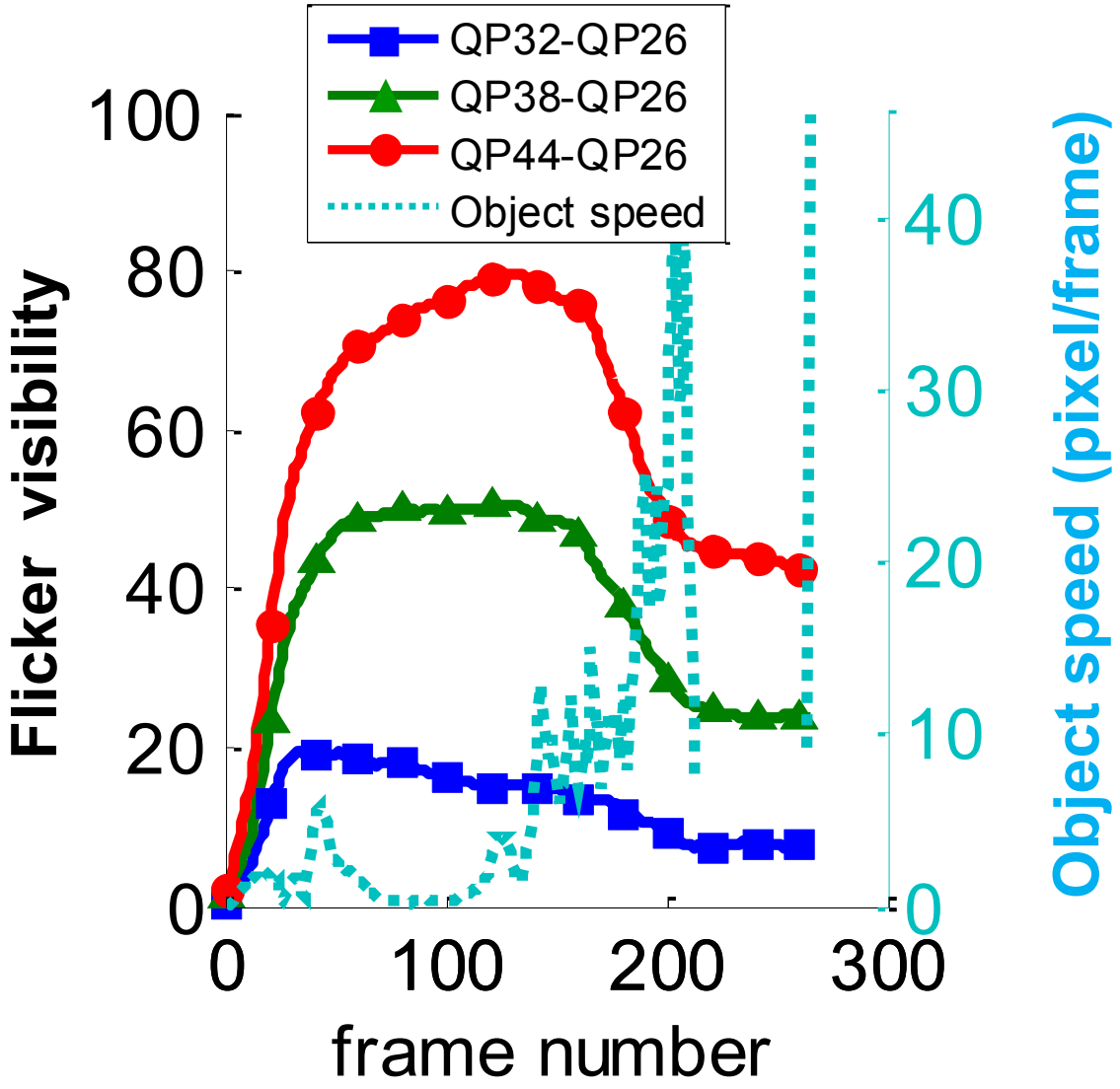
Please fixate and follow your eyes on the target, and rate the visibility of flickering on the target by moving the mouse up or down the scale continuously.

When you are ready, Please press the spacebar to play

[Choi *et al*. QoMEX 2013, SPIC 2015]

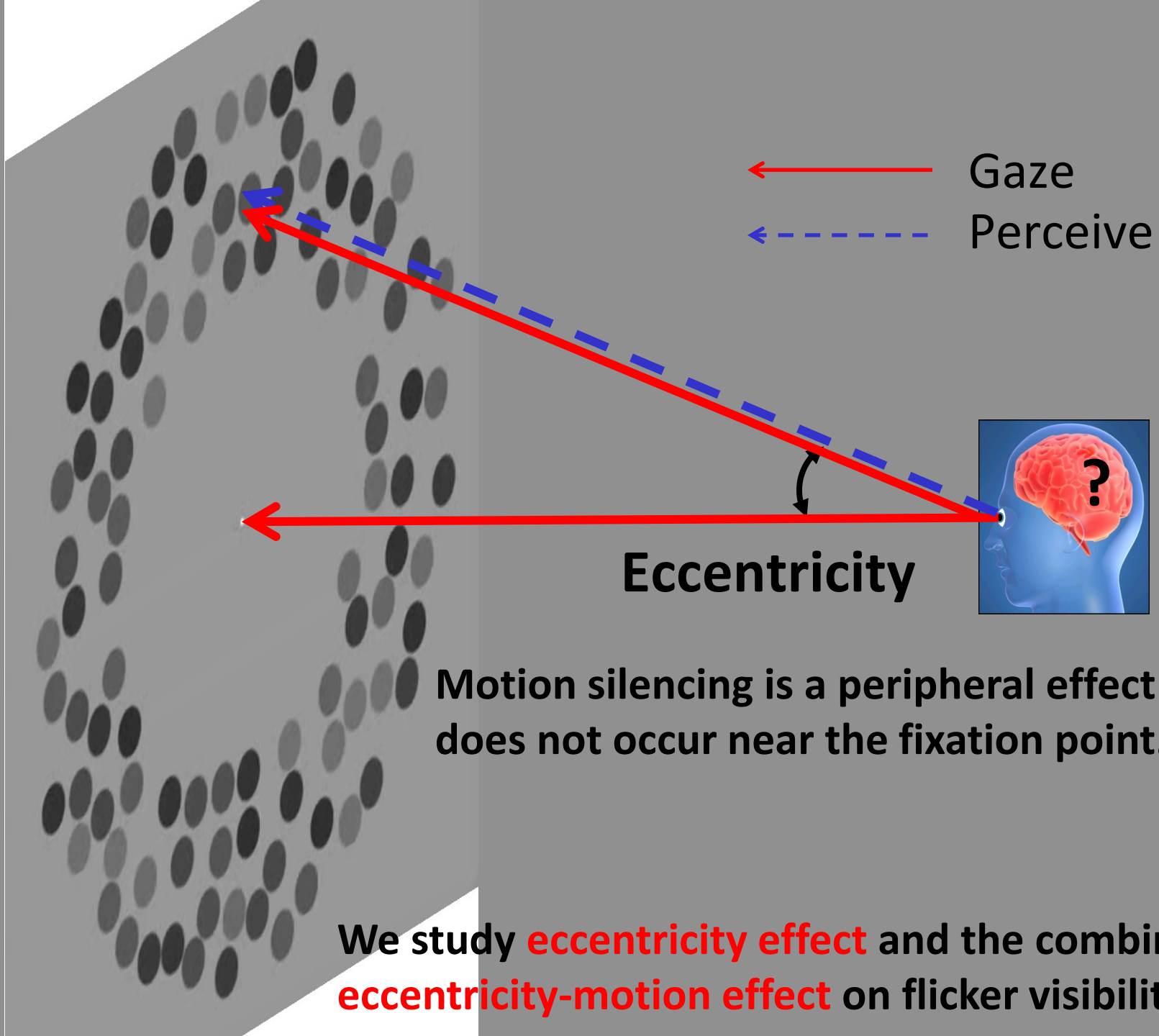
- **Phase I: Motion effects on flicker visibility (Result)**

- 43 subjects
- Eye tracker (FaceLAb5)
- 24’ monitor



As motion increases, flicker visibility is strongly suppressed.

[Choi *et al*. QoMEX 2013, SPIC 2015]



Motion silencing is a peripheral effect that does not occur near the fixation point.

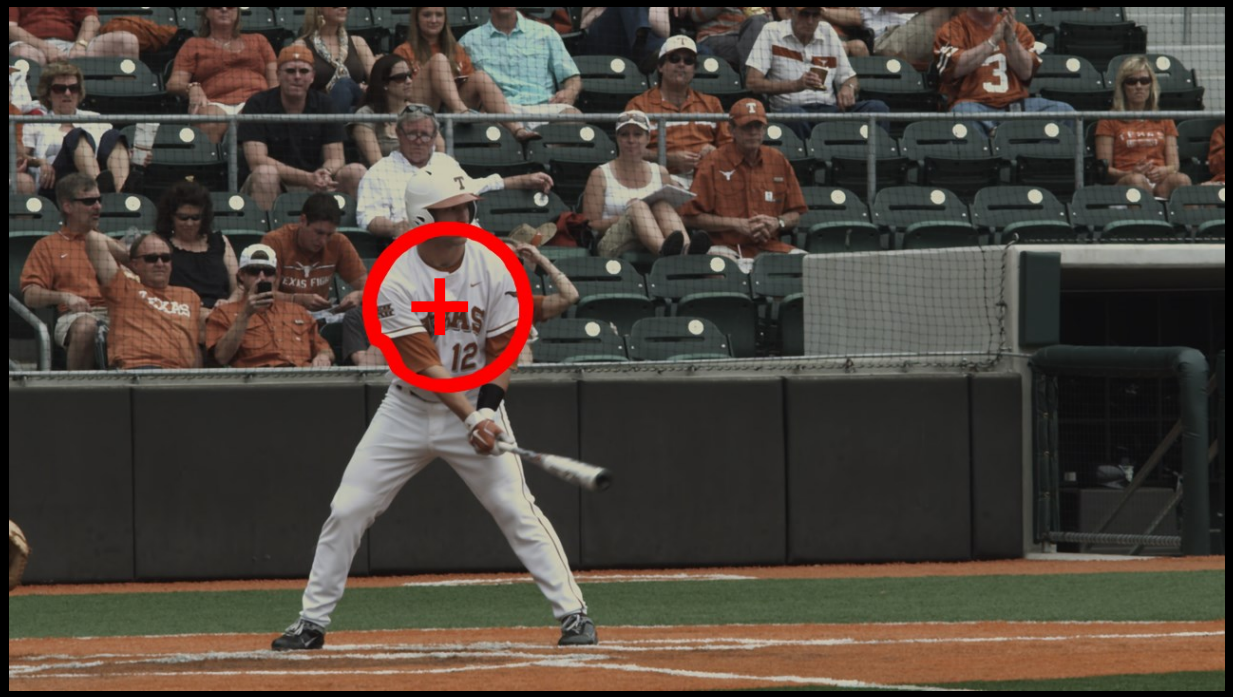
We study eccentricity effect and the combined eccentricity-motion effect on flicker visibility.

- **Phase II: Eccentricity and motion effects on flicker visibility**

Task 1 “Gaze the fixation mark”: INSTRUCTION

1. Please find the red fixation mark (+) and fixate your eyes always on the fixation mark.
2. Rate flicker visibility on the target by moving the mouse up or down continuously.

Target: Circled regions on the batter.



Extremely

Highly

Medium

Little

Hardly

When the video begins, the instruction and the rating bar disappear except for a white score gauge.

Do immediately move the mouse after pressing the spacebar.

When you are ready, please press the spacebar to start.

[Choi *et al*. GlobalSIP 2015]

- **Phase II: Eccentricity and motion effects on flicker visibility**

Task 2 “Follow the moving object”: INSTRUCTION

1. Please find the target and fixate your eyes always on the target by following it.
2. Rate flicker visibility on the target by moving the mouse up or down continuously.

Target: Circled regions on the batter.

Extremely

Highly

Medium

Little

Hardly

When the video begins, the instruction and the rating bar disappear except for a white score gauge.

Do immediately move the mouse after pressing the spacebar.

When you are ready, please press the spacebar to start.

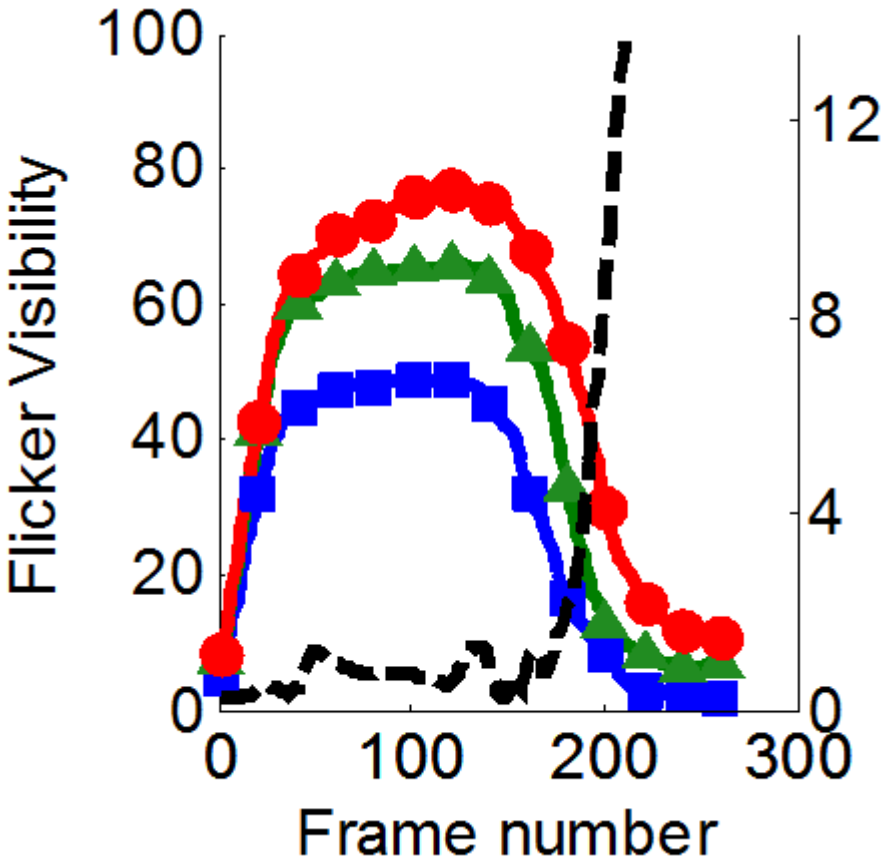
[Choi *et al*. GlobalSIP 2015]

- **Results: Eccentricity and motion effects on flicker visibility**

- 33 subjects

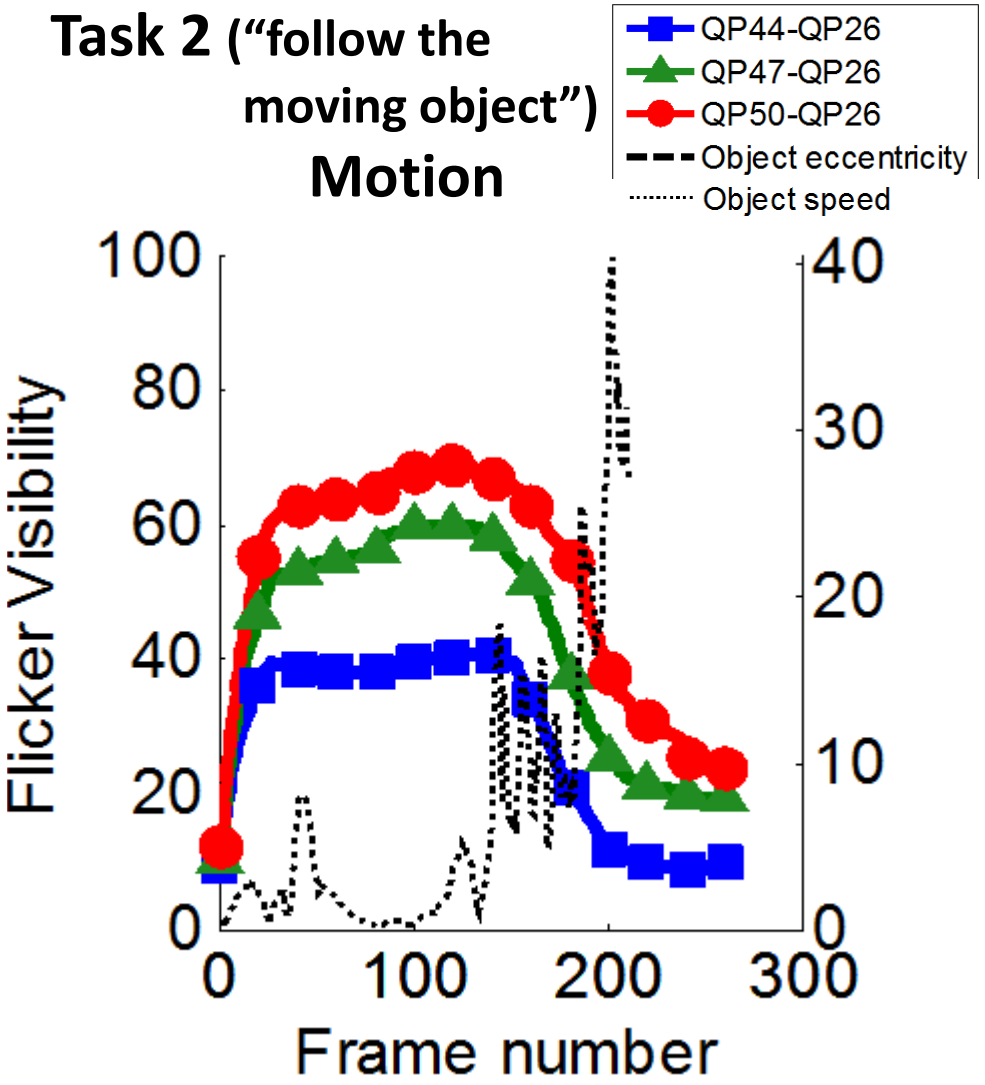
Task 1 ("Gaze the fixation mark")

Eccentricity and motion



Task 2 ("follow the moving object")

Motion

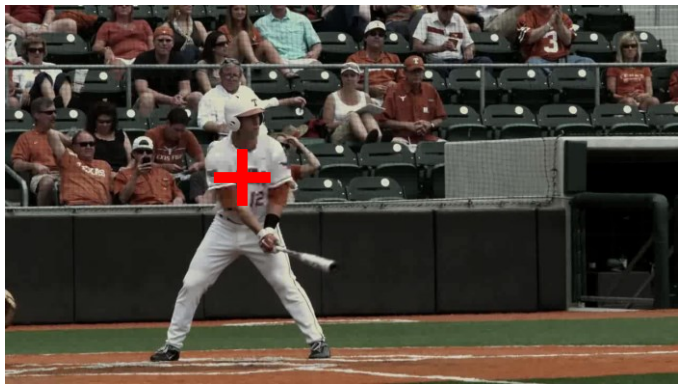


As eccentricity increases, flicker visibility is strongly suppressed.

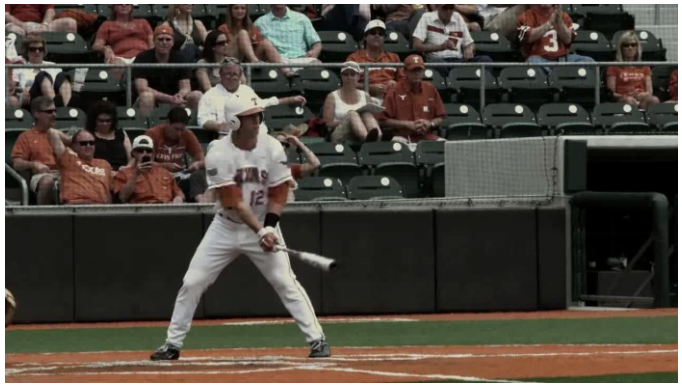
- **Phase II: Eccentricity and motion effects on flicker visibility**

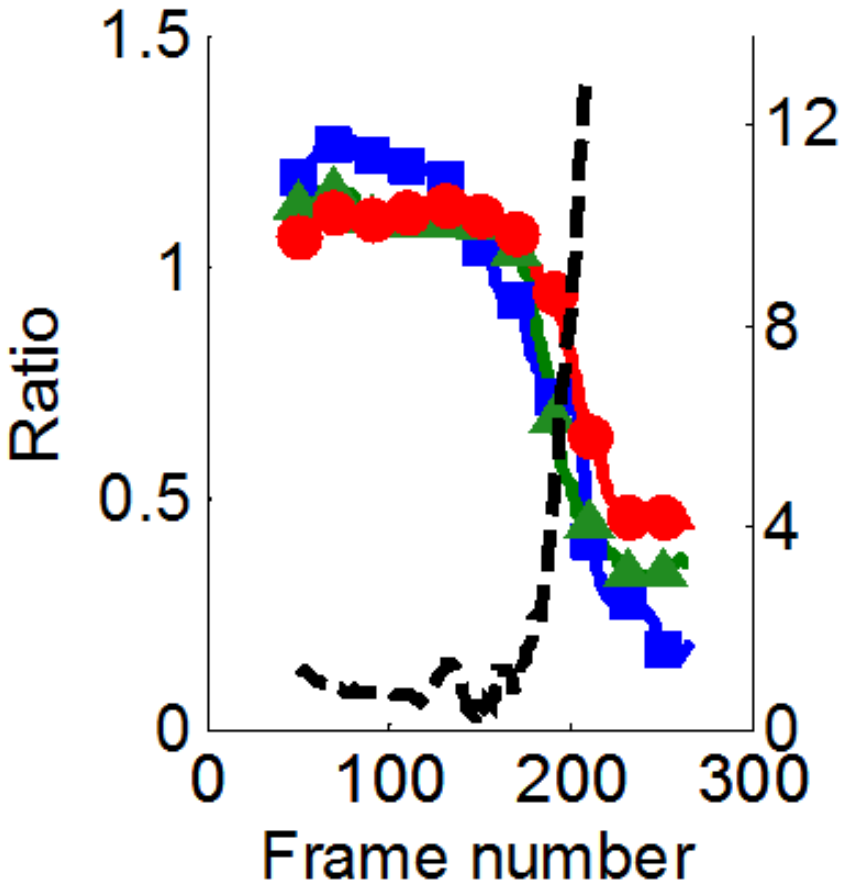
$$\text{Ratio} = \frac{Flicker\ visibiity\ in\ Task\ 1}{Flicker\ visibiity\ in\ Task\ 2}$$

Task 1 ("Gaze the fixation mark")



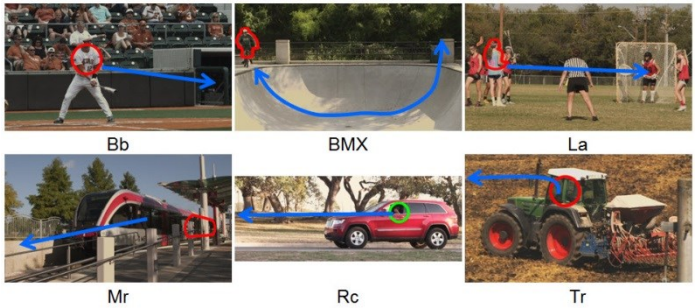
Task 2 ("follow the moving object")



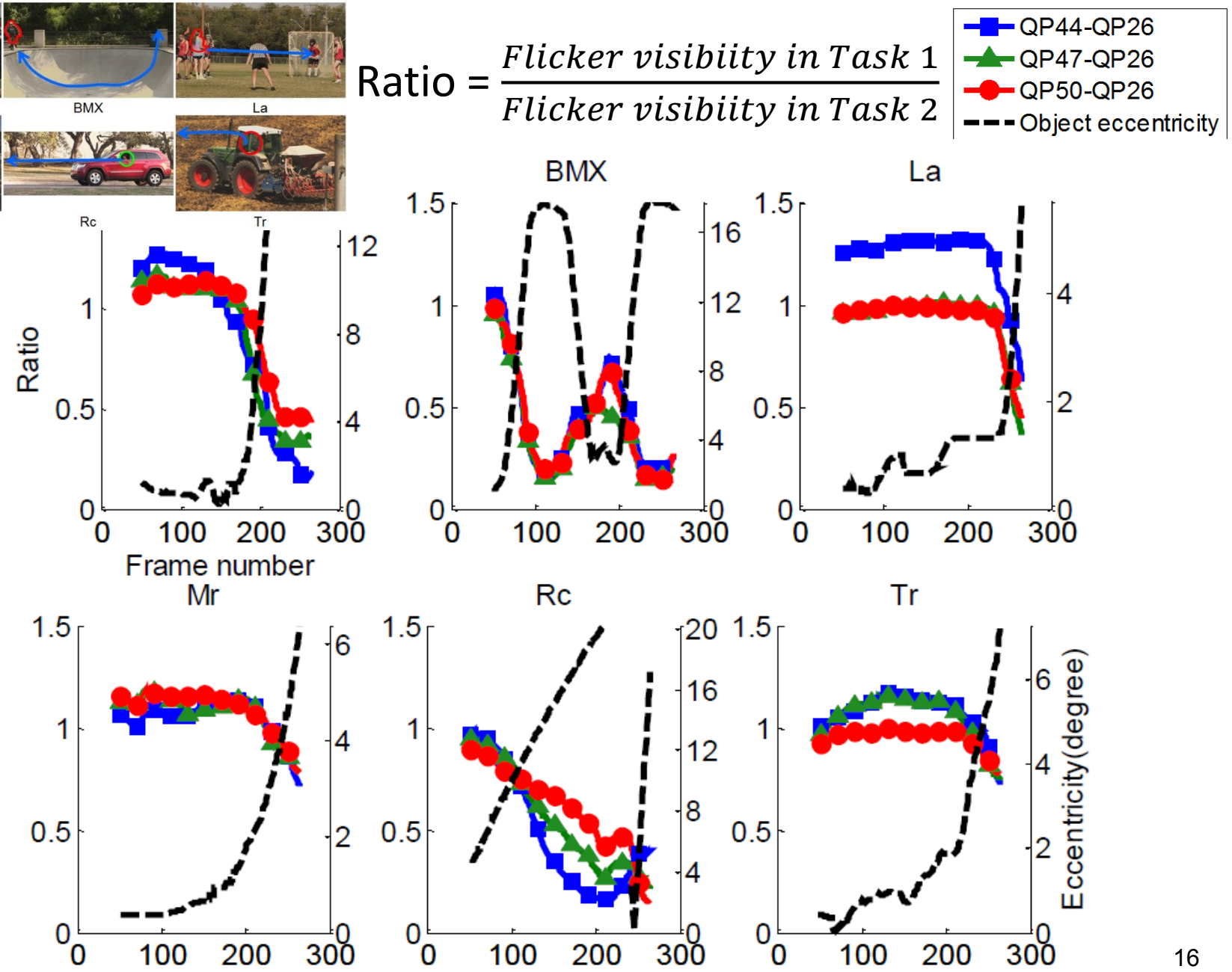


As eccentricity increases, flicker visibility is strongly suppressed.

- **Phase II: Eccentricity and motion effects on flicker visibility**

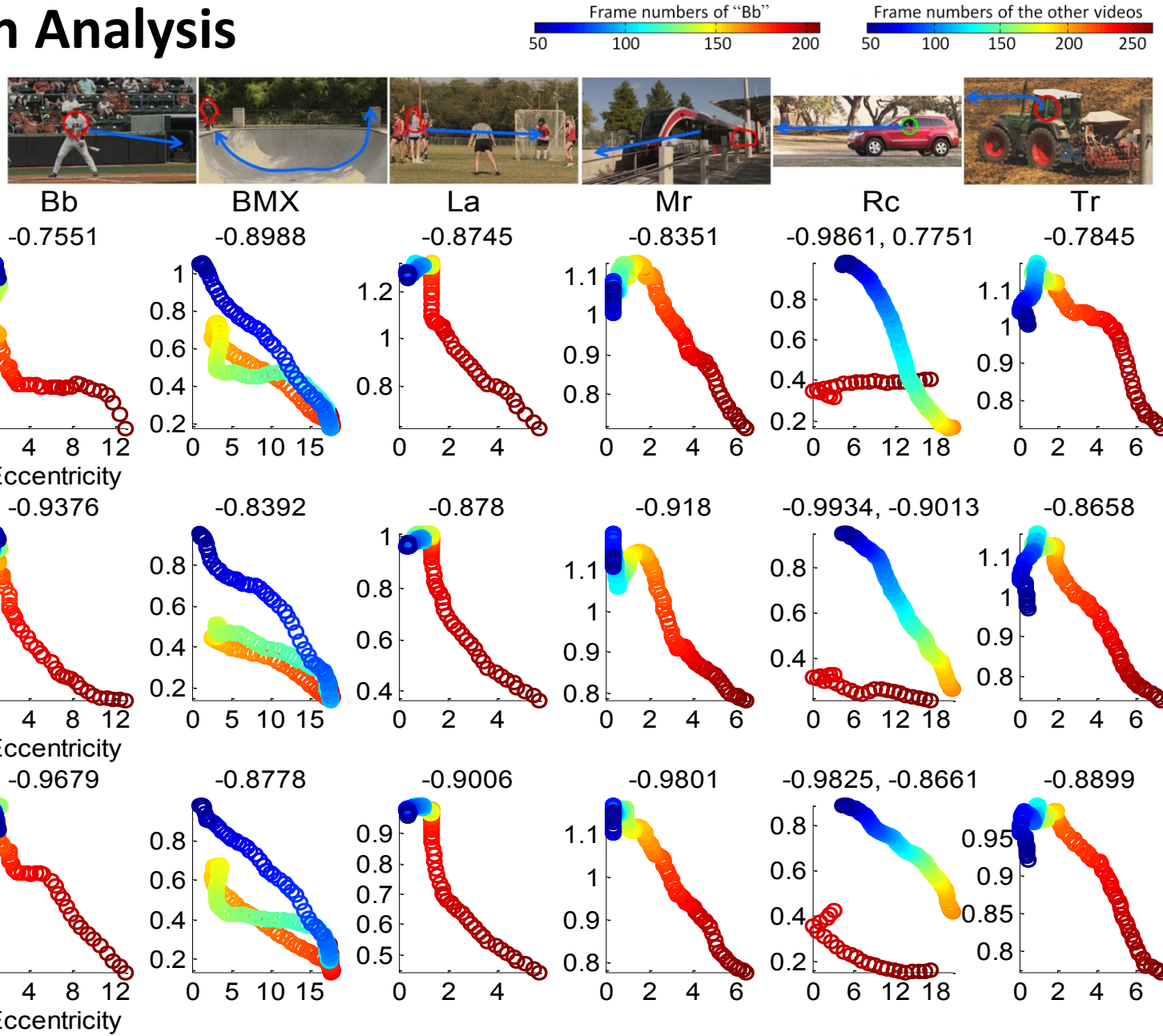


$$\text{Ratio} = \frac{Flicker\ visibiity\ in\ Task\ 1}{Flicker\ visibiity\ in\ Task\ 2}$$



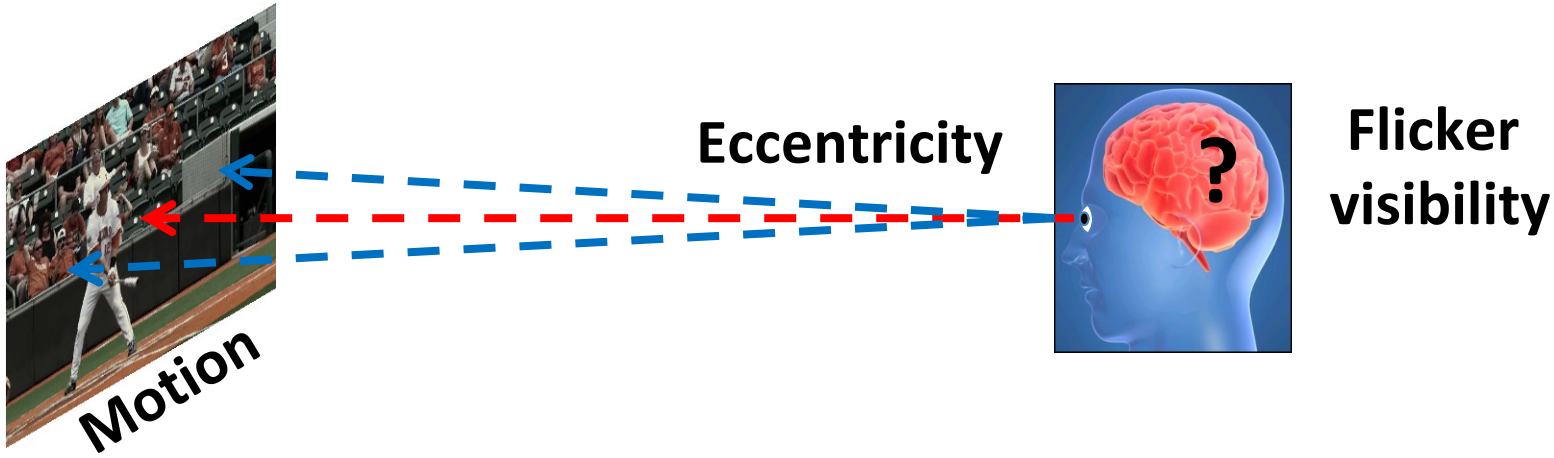
- **Phase II: Eccentricity and motion effects on flicker visibility**

Correlation Analysis



Conclusion and Discussions

- We study eccentricity effects of motion silencing on flicker visibility in naturalistic videos.



- Results show that large eccentric, large motion strongly reduces the visibility of flicker distortions on real videos.

- LIVE Flicker Video Database (Publicly available).
- Applications accounting temporal flicker masking: Perceptual flicker visibility models and VQA algorithms.

Questions?