Long-term Adaptation to Blur and Its Impact On Myopia

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Blur

- Atmosphere
- Depth of field
- Retinal location
- Ocular Aberrations
  - Myopia

Compensation for Blur

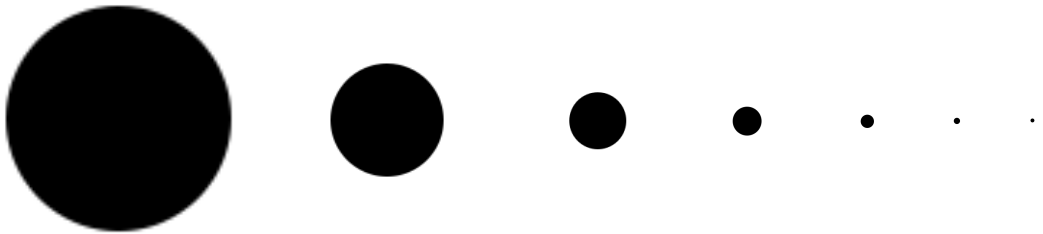
- Blur Adaptation
  - Visual acuity (Mon-Williams et al., 1998)
  - Perceived Blur (Webster et al., 2002)

Does adaptation in myopia become faster and stronger with practice?

- Anecdotal “New Prescription Effect”
  - See also Yehezkel et al. 2010, Vinas et al., 2012
- Different processing modes

Is compensation for blur faster and stronger in myopia?

- -2.0D myopes (N = 8)
  - Compared perception with and without correction
- Control group: Comparable blur, little experience
  - Emmetropes (N = 8) with +2.0D blurring lenses
- Measures
  - Luminance appearance
  - Acuity



Appearance Measure

Engel et al., in prep

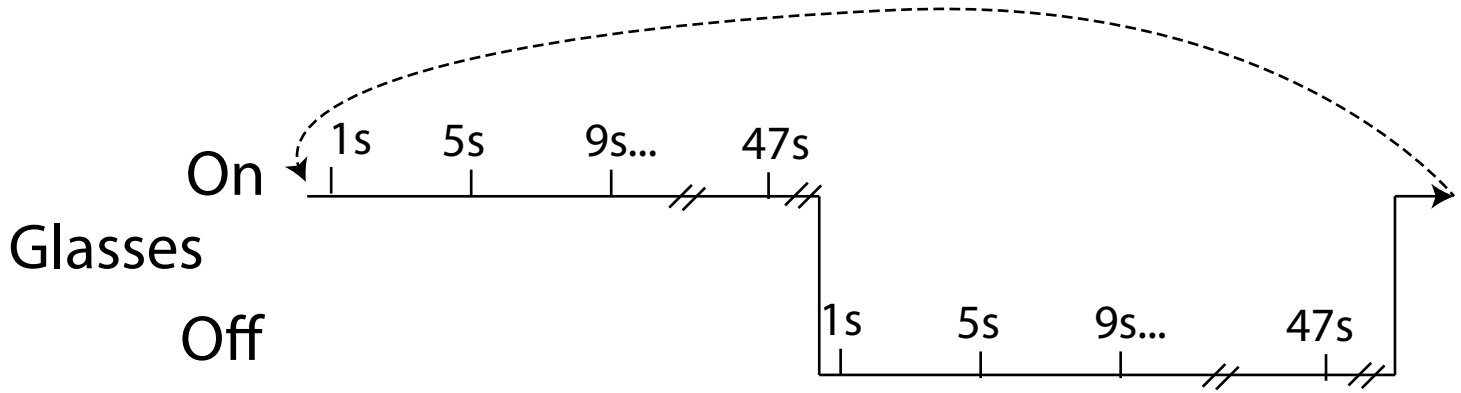
- Which appears lighter?
- Large circle relatively unaffected by blur
- Staircase adjusts luminance of large circle to measure **apparent luminance** of small circle

Appearance Measure

- .25 deg and 1 deg circles
- 5.9 cd/m^2
- 500 msec presentations
- 1 Trial every 4 sec
- Fixation moves around image between trials

Methods: Time course

- "Method of one thousand staircases"
  - Each time point has own independent staircase



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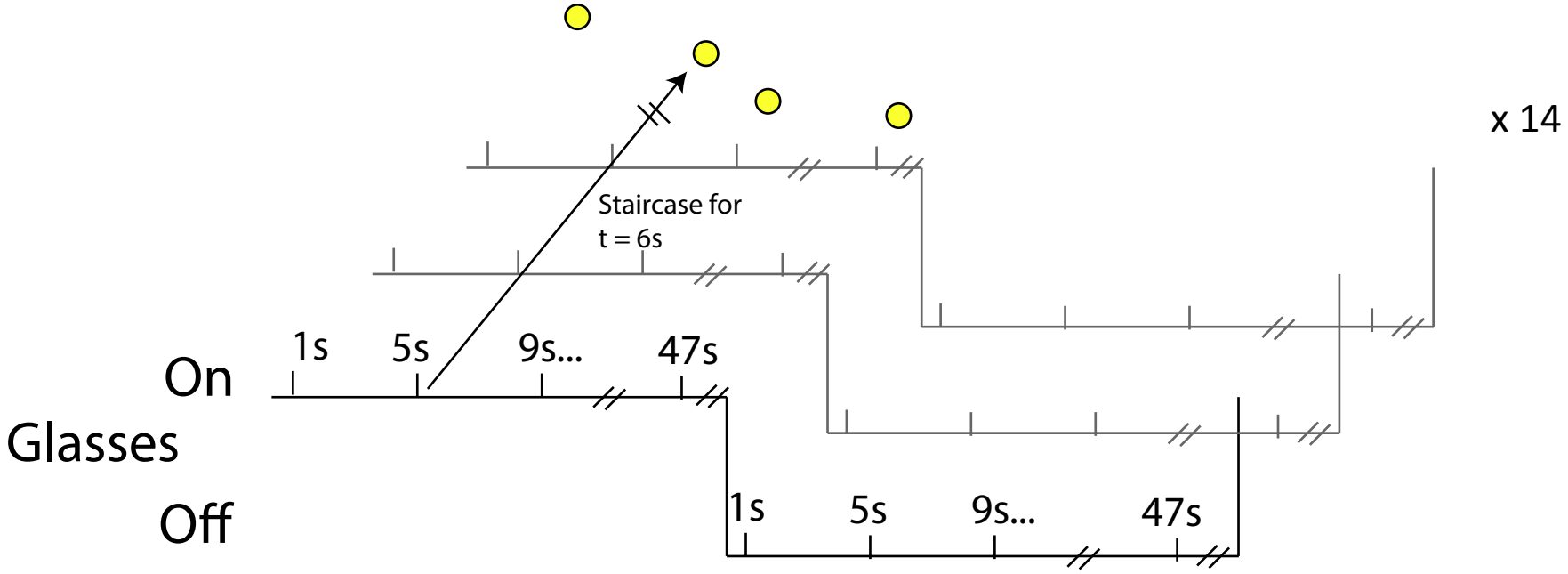
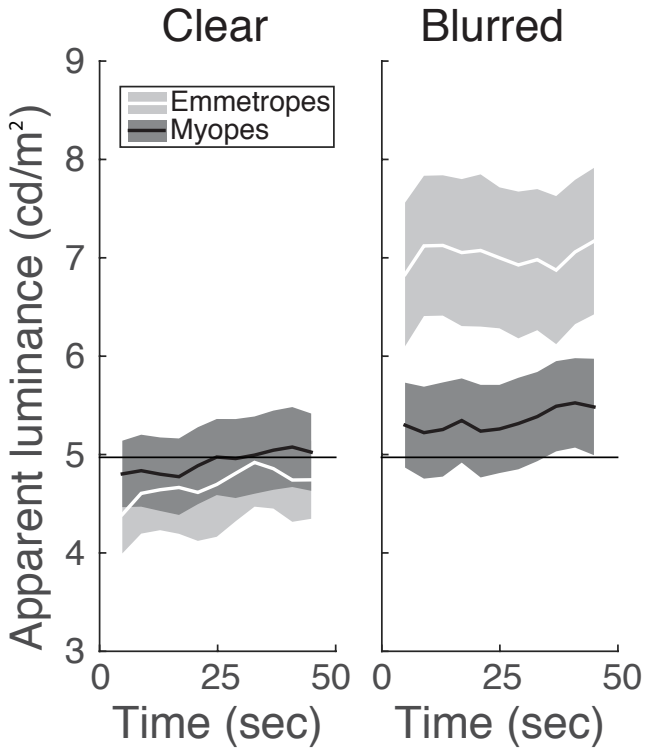
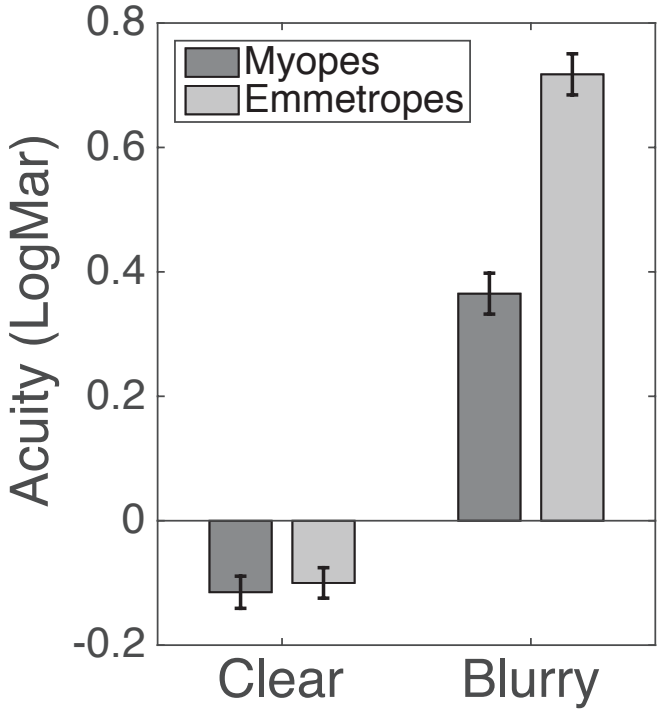


Results



- Little effect of blur on myopes

Results: Acuity



Discussion

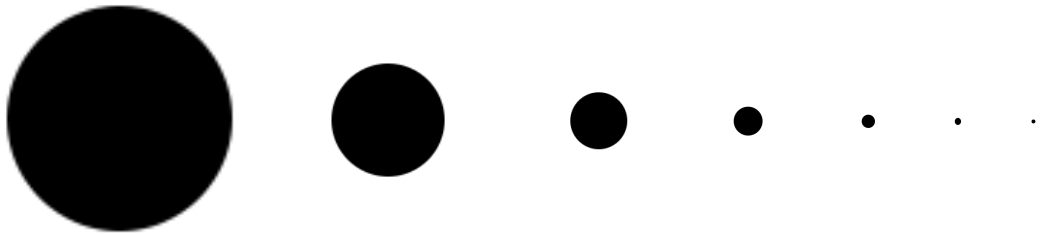
- Myopes adapt to blur more strongly than emmetropes
  - Happens immediately
- Past literature is mixed
- Key differences
  - Used myopes' own prescription, where experience is highest
  - Used appearance measure
  - Change in context obvious
  - Myopia was relatively mild
- Not likely due to changes in accommodation
  - **But**…

Caveats

- Effects measured with contrast are smaller
  - 83% display contrast for dots (bg = 33 cd/m^2)
  - Matched clear with 84% contrast
  - Matched blurry with 79% contrast for emmetropes
  - Difference *in effective optical power* could also be small

Caveats

- Tentative basic optics
  - No empirical measure of pupil size
- Small circle
  - Clear: ~80% Contrast
  - Blurry: < 40% contrast (4 models)
  - Implies significant compensation even in emmetropes
    - Differences between groups likely small relative to that



Conclusions

- Myopes immediately compensate for blur when glasses are removed.
- Letter acuity effect is large
  - Could be due to perceptual learning
- Appearance compensation is potentially very large
  - But may only be a bit smaller than for emmetropes