

Evaluating the Visual Accessibility of Stairs in Public Spaces

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INTRODUCTION

- **Status quo architectural designs are not visually accessible**
 - **Low vision:** uncorrectable loss of visual acuity (below 20/60), reduced contrast sensitivity, and restricted visual field
 - **Visual accessibility:** use of visual information to help navigate and orient oneself in a space
 - Architectural designs sometimes focus on aesthetics at the expense of challenges experienced by people with low vision.
- **Purpose of this project**
 - The Designing Visually Accessible Spaces (DEVA) project aims to provide tools to enable the design of safe environments for mobility
 - This specific project analyzes the effects of different factors on the visual accessibility of stairs
- **Hypothesis**
 - Visibility of stairs depends on both **viewpoint** and **acuity level**; viewpoint has a stronger effect at lower acuities.
 - Various factors, such as visual texture and lighting, affect visibility

METHODS

Photo Collection: High Dynamic Range (HDR) images of stairs in 50 locations across campus

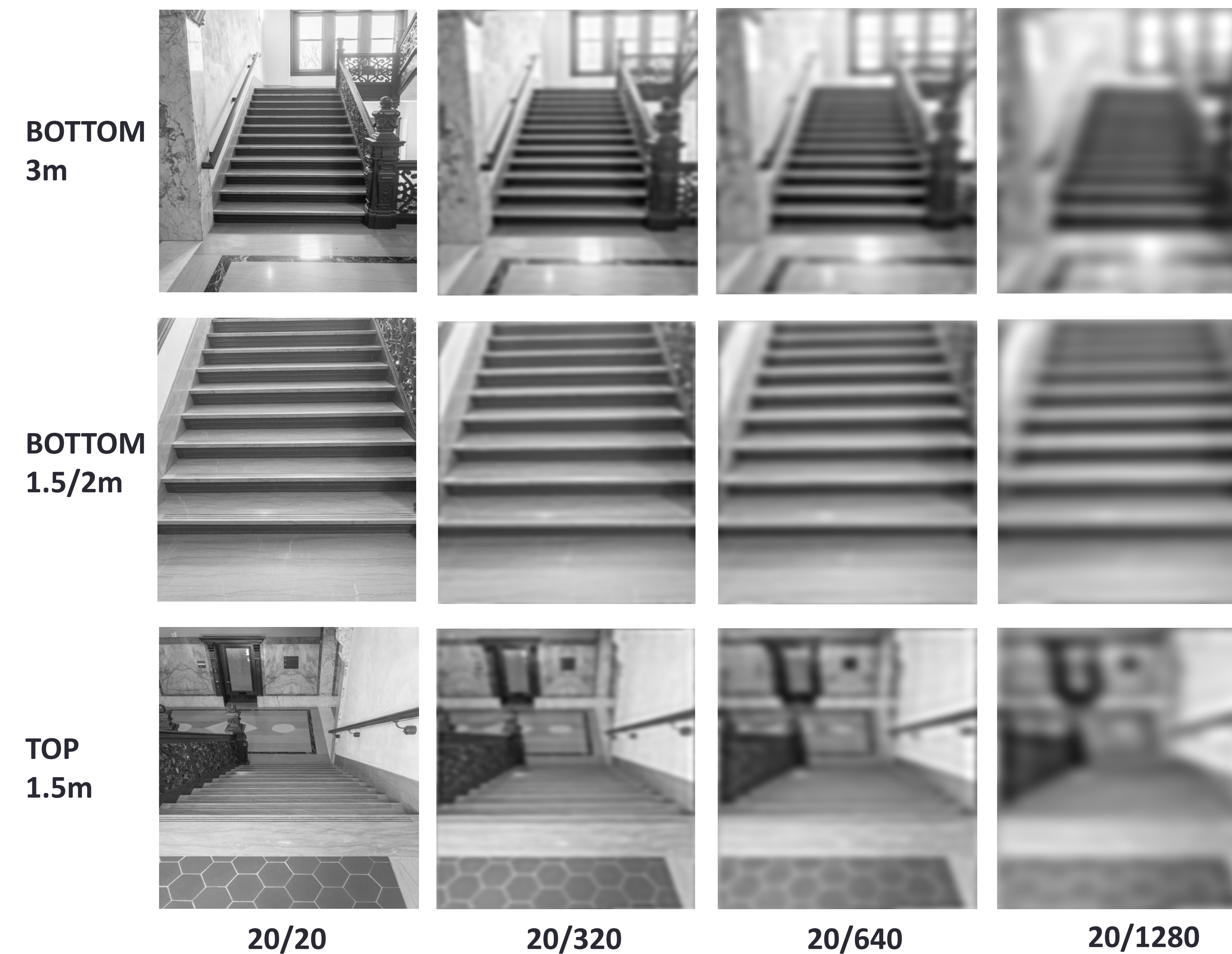
Simulate Reduced Acuity: Filter images with MATLAB to different levels of blurring to simulate 3 levels of reduced acuity

Subject Testing: Normally-sighted subjects rate visibility of stairs in original and filtered images on a scale of 0-9 (0: worst, 9: best visibility). Display original photo followed by 3 photos with different levels of blurring

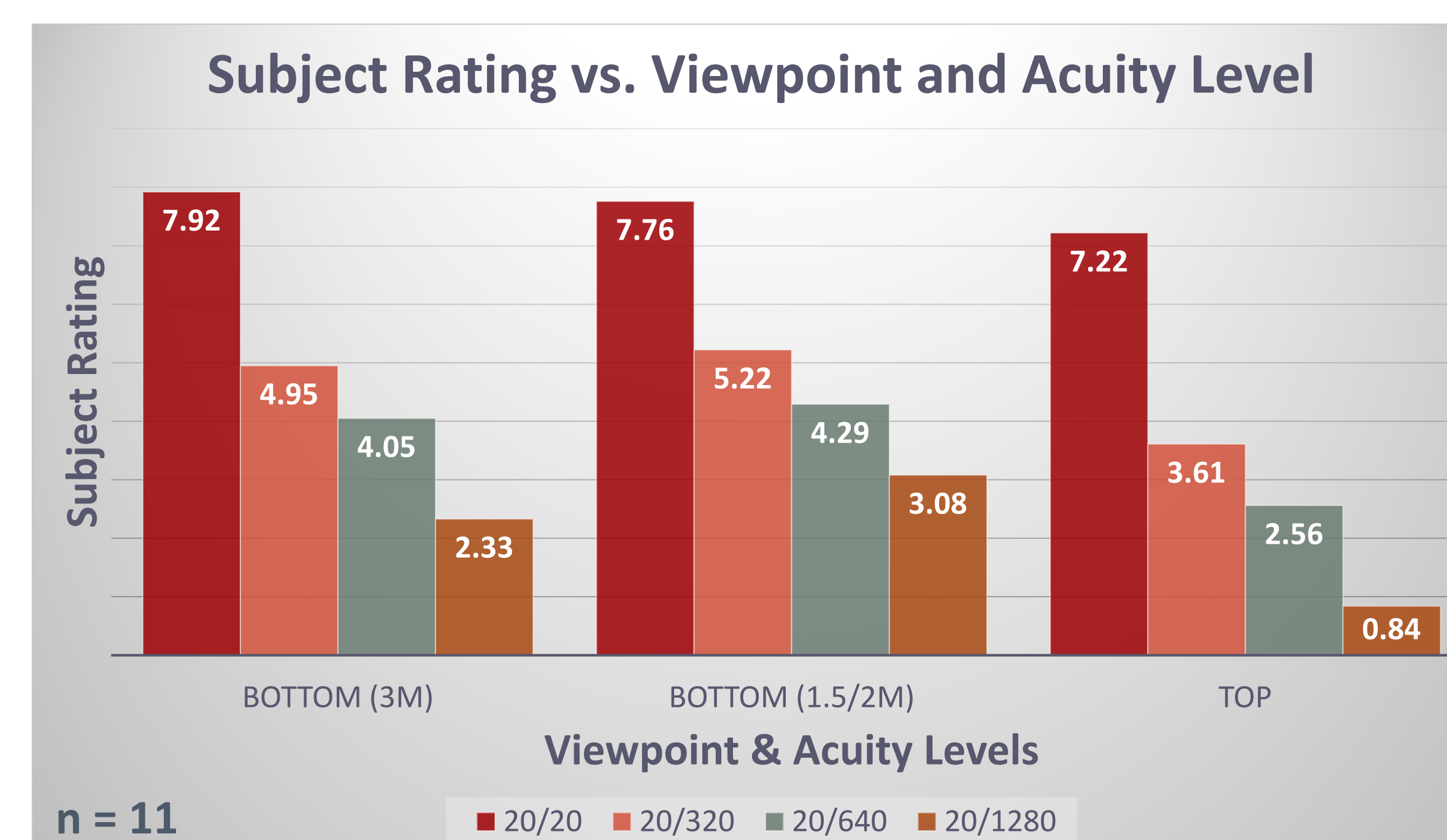
Experiment Design

- **Variables:**
 - **Viewpoint:** 2 bottom viewing distances (3m & 2/1.5m), and 1 top view (1.5m) for each of 50 stairs
 - **Simulated acuity:** 20/20, 20/320, 20/640, 20/1280
- **Stimulus variations:** texture, daylight vs. indoor lighting, shape etc.

PHOTO SAMPLES

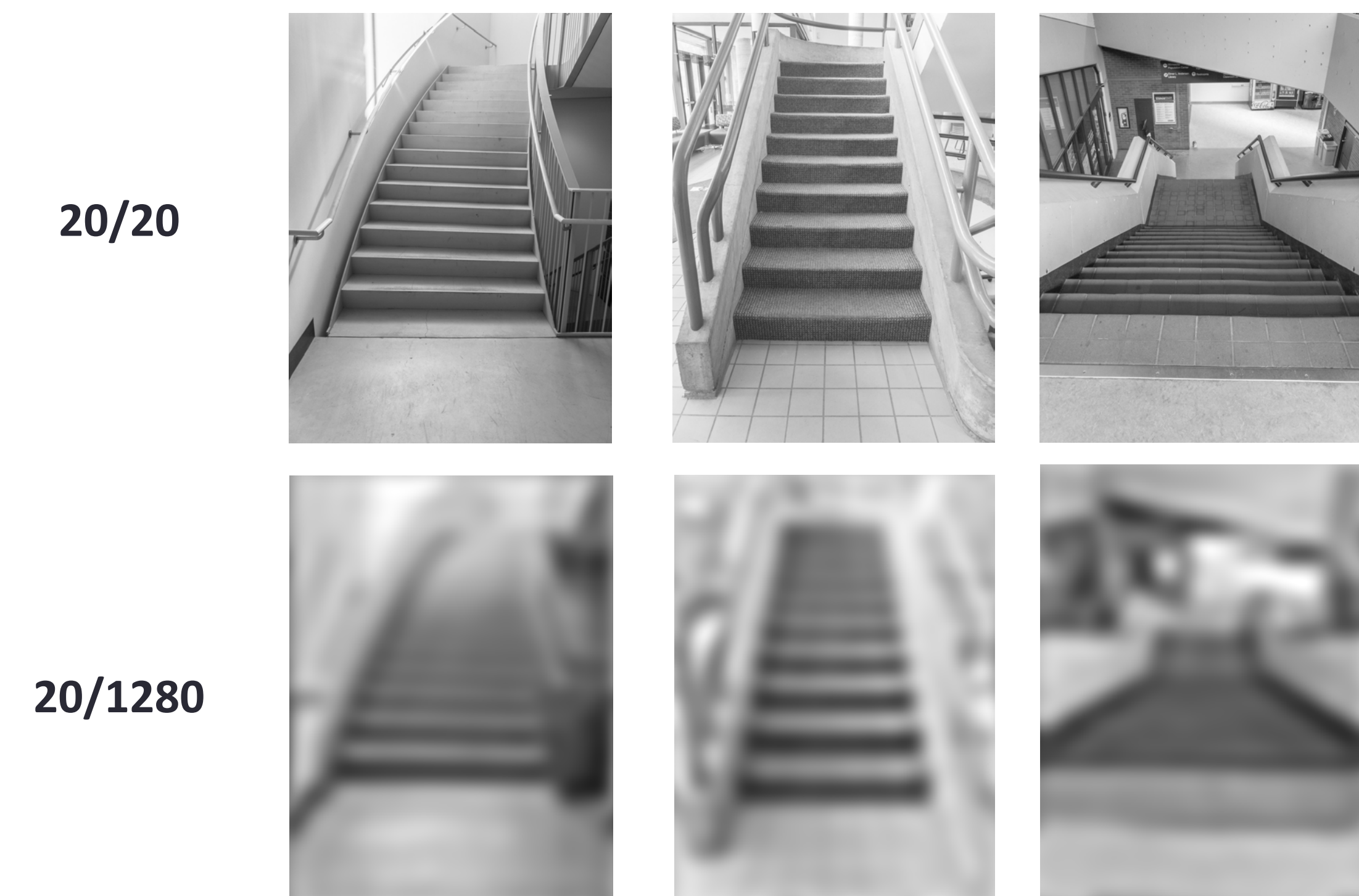


RESULTS



- **Effect of Viewpoint** (p -value < .001): rating is lowest for *top view*, and highest for *bottom near view*
- **Effect of Acuity** (p < .001): visibility rating decreased with simulated acuity reduction
- **Interaction between Viewpoint and Acuity** (p < .001): *top view* showed the largest decrease in visibility from normal to severely reduced acuity, and *bottom near view* showed the least decrease
- At reduced acuity levels, being closer to the stairs increases visibility

Photos with high ratings:



Photos with low ratings:



DISCUSSION

- Various factors, such as the acuity level of potential users, viewpoint, and lighting, need to be considered when designing stairs to achieve a reasonable level of visual accessibility.
- An important factor determining visibility of stairs is the visual contrast across individual steps.
- Better designs of stairs should ensure visibility even at low-acuity levels, enhancing safety for people with low-vision.

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