ROYAL INSTITUTE OF TECHNOLOGY

DH2323 DGI17

INTRODUCTION TO
COMPUTER GRAPHICS AND INTERACTION

USER STUDIES AND PERCEPTION

Christopher Peters

CST, KTH Royal Institute of Technology, Sweden

chpeters@kth.se

http://kth.academia.edu/ChristopherEdwardPeters

ROYAL INSTITUTE OF TECHNOLOGY

Annoying Humans

- Computer graphics inherently **human-centered**
- Images, animations, behaviour
- Computer applications are used by humans

ROYAL INSTITUTE OF TECHNOLOGY

Obvious?

ROYAL INSTITUTE OF TECHNOLOGY

Obvious?

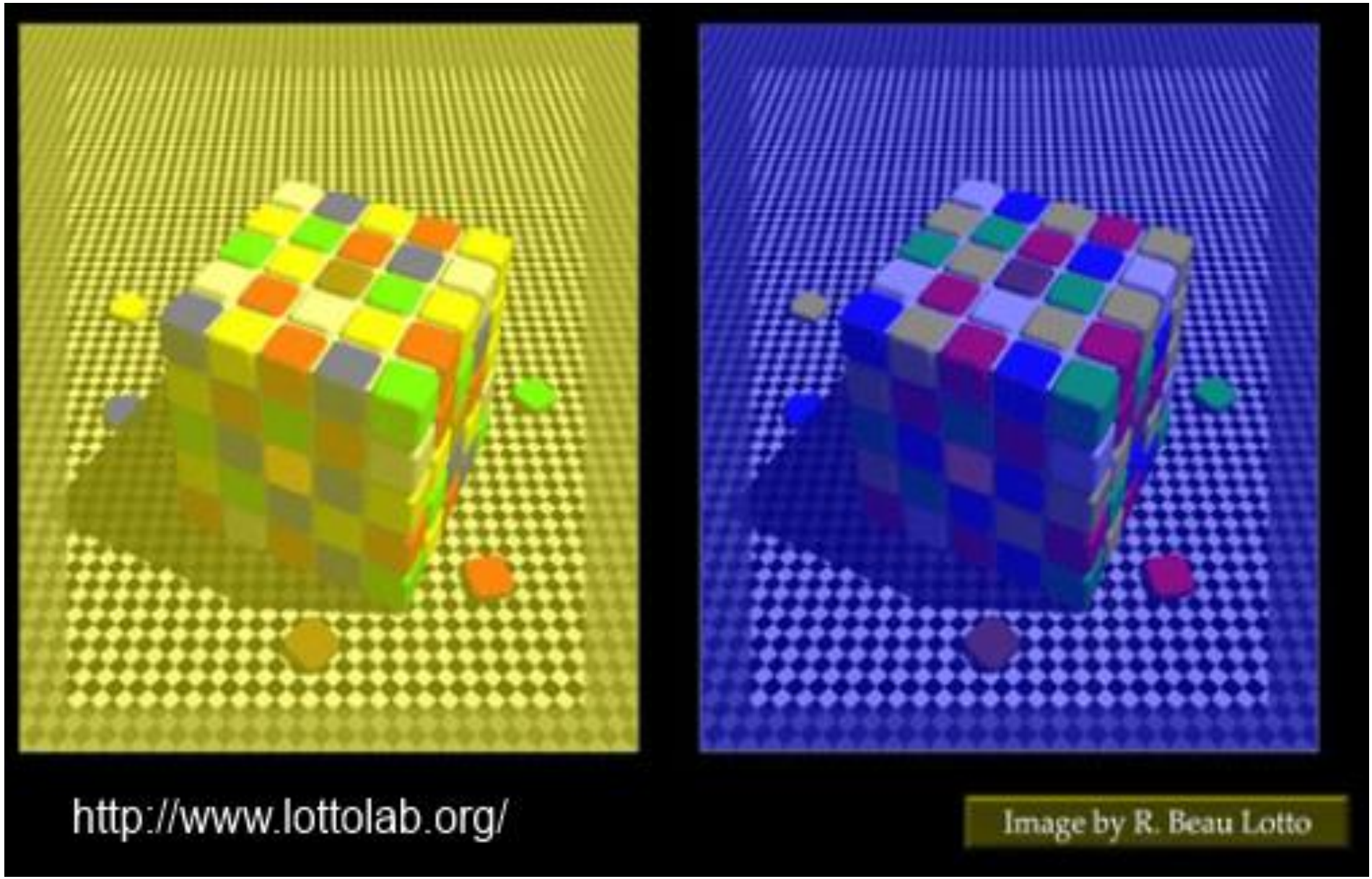
Blindingly!

ROYAL INSTITUTE OF TECHNOLOGY

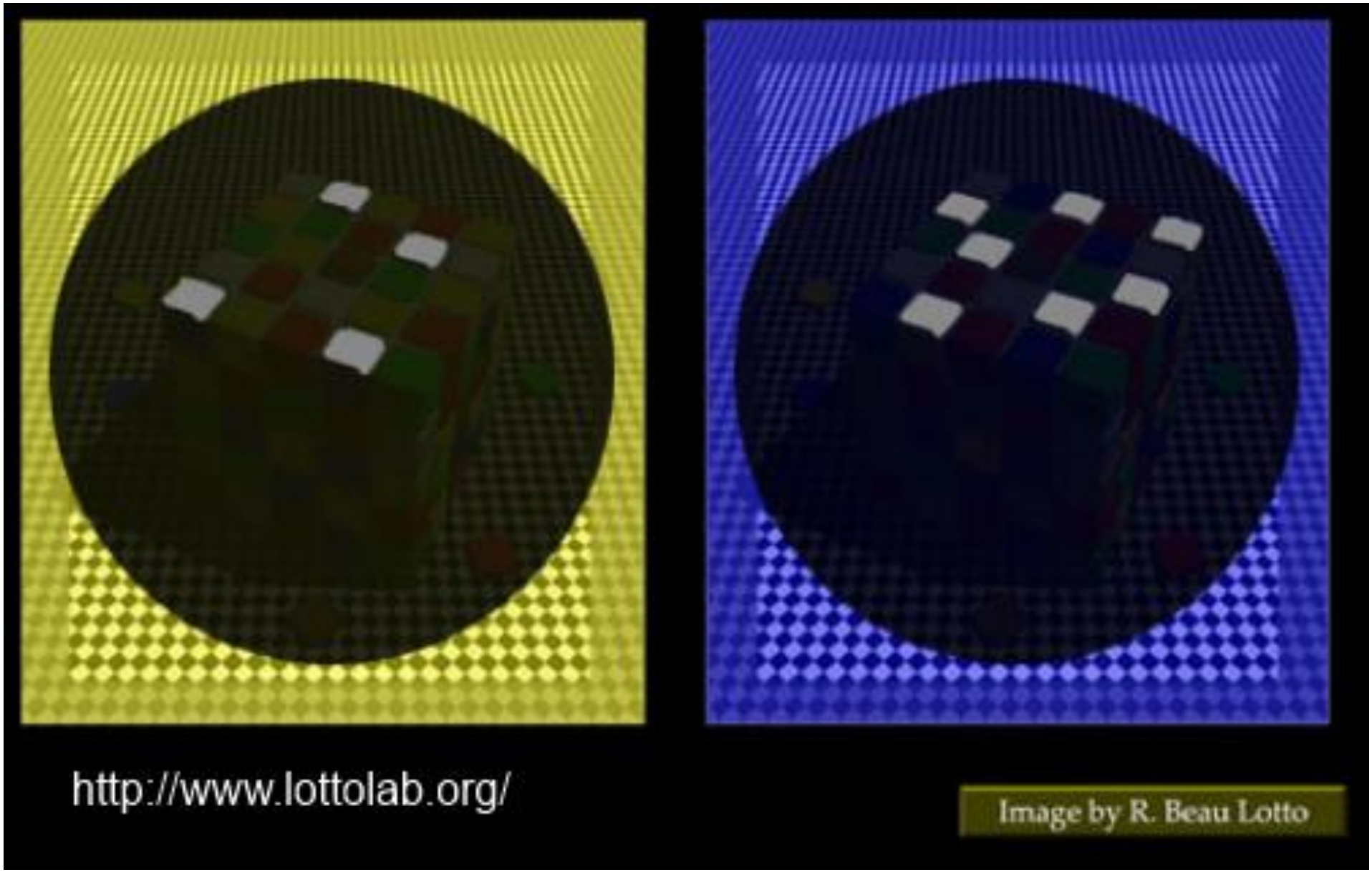
Annoying Humans

- But it takes exceptional and continuous conscious effort to *properly* keep humans in the process
- Partly because we are human...
- In computer graphics
  - Useful to test human sensitivities to artificially created scenes, characters and behaviours

Example



Example



ROYAL INSTITUTE OF TECHNOLOGY

User Studies for Evaluation

- Human experiments
- Process of evaluating or understanding a technique, tool or idea in terms of needs, preferences and abilities of humans
- Have people use your system or observe stimuli
- Evaluate what they do

ROYAL INSTITUTE OF TECHNOLOGY

Process Overview

- Design
- Procedure
- Data analysis
- Conclusions

ROYAL INSTITUTE OF TECHNOLOGY

Process Overview

- Design
  - *Hypothesis*: what do you want to find out?
  - Who will be the *population*?
  - How will you recruit them?
  - *Metrics*: what will be measured / recorded?

ROYAL INSTITUTE OF TECHNOLOGY

Process Overview

- Design
- Procedure
  - All participants sign up for a time slot
  - *Informed consent*
  - Execute study
  - Questionnaires/debrief

ROYAL INSTITUTE OF TECHNOLOGY

Process Overview

- Design
- Procedure
- Data analysis
  - Chance and confidence: *Significance*
  - *T-test*
  - *ANOVA*
  - F statistic, *p* values

ROYAL INSTITUTE OF TECHNOLOGY

The Role of Chance

85% success rate: Euro 2008, World Cup 2010

Paul the Octopus, Animal Oracle

ROYAL INSTITUTE OF TECHNOLOGY

Controlled Experiments

- Events or actions caused by the experimenter intentionally
- Controlled: only variables being examined will change

  Everything held constant except for one variable
- Control group: *normal* or *usual* state
- Repeatedly and reliably produce a specific event or situation

Cause and effect (correlation v causation)

The Task

Set context through a scenario and task

- Clearly specify it
- Evaluation:

  "A mouse is faster than a keyboard for numeric entry"
- Hypothesis:

  "Participants using a keyboard to enter a string of numbers will take less time than participants using a mouse"

ROYAL INSTITUTE OF TECHNOLOGY

Conditions

- Each condition changes something
- Independent variables (IV)

- In controlled experiment:
  - Two group types: *Control group* and *Experiment group(s)*

- Need to consider the ordering of conditions

ROYAL INSTITUTE OF TECHNOLOGY

Participants

- *Within-subjects* vs *between-subjects*
- Within-subjects
  - *Repeated measures* design
  - Participant tested under each condition

ROYAL INSTITUTE OF TECHNOLOGY

Participants

- *Within-subjects* vs *between-subjects*
- Within-subjects
- Between-subjects
  - *Independent measures*
  - Participant tested under one condition only
  - Avoid order effects, boredom; more participants needed

ROYAL INSTITUTE OF TECHNOLOGY

Participants

- Record *relevant* participant details!
  - Gender
  - Age
  - Handedness
  - Vision
- Pay close attention to ethics/legal considerations!
  - **Anonymity**
    - Data needs *to be* anonymous and participant needs to *know*

ROYAL INSTITUTE OF TECHNOLOGY

Notes

- Power: the more participants there are, the better they sample the population
- ~20-30 participants per condition often considered a good/minimum number

The Test Environment

The Test Environment

ROYAL INSTITUTE OF TECHNOLOGY

Pitfall #1

People sometimes do strange things, so they need to be observed

ROYAL INSTITUTE OF TECHNOLOGY

Pitfall #2

People sometimes do strange things because they are being observed

Pitfall #3

- Be very careful about the wording of questions

  "About how fast were the cars going when they *smashed* into each other?"

  (Loftus & Palmer, 1974)

- **Garbage in -> garbage out**

ROYAL INSTITUTE OF TECHNOLOGY

Pitfall #4

- Experimenter bias
- **Seeks evidence conforming to one's expectations**
- 'Cherry picking'
  - Keep/focus on the *good* data, discard/ignore *bad* data
- Unintentional
- There are *many* more

  Google: "List of cognitive biases"

ROYAL INSTITUTE OF TECHNOLOGY

Pitfall #5

- Response bias
- **Participants may try to give you the answers they think you want**
- Conceal expectations
- Preserve anonymity
  - Data collection should be anonymous
- Add *catch trials*

General Advice

- Always do a *pilot study*
- Smaller number of participants
- Not statistically valid
- But highlights problems with the experiment design and procedure…

  …***before*** the main experiment

ROYAL INSTITUTE OF TECHNOLOGY

A ‘Live’ Example

ROYAL INSTITUTE OF TECHNOLOGY

4 Experiment

Thirty two participants (12F, 20M) age 18 to 30, were seated in front of a computer screen. They were told that the experiment consists of three blocks and were given an instruction sheet: two photographs of the corridor and open zone were shown and they were told that the images they were about to see were derived from real photographs, but in some the character formations were real, while in others they were synthetically generated. For the first block of the experiment the participants were told to focus only on the positions of the characters. For each image displayed, participants were asked if they thought the positions of the *pawn* figure characters were real or synthetically generated. For the second block, participants were asked to look at the orientations of the characters only and judge if they were real or synthetically generated. For the final block of the experiment, participants were asked to take both position and orientation of the characters into account and judge whether the scenes were real or synthetically generated. The reason that we presented the experiment in this order was to avoid biasing participants. If the pawn figures were viewed after the humanoid characters, this could have caused them to perceive the scenes as less realistic due to the reduced realism of the characters, which was not the effect being tested. Furthermore, the scenes with position and orientation combined were presented during the final block, to prevent participants from taking position into consideration when conducting the orientation only trial. Between each trial, a blank-screen was displayed for 5 seconds, after which the number of the next trial was displayed alerting participants.

Cathy Ennis, Christopher Peters, Carol O'Sullivan: Perceptual evaluation of position and orientation context rules for pedestrian formations. Applied Perception in Graphics and Visualization (APGV) 2008: 75-82

Methodology

- Consisted of 4 phases:
  - Data Collection Phase
  - Annotation Phase
  - Reconstruction Phase
  - **Modification Phase**

Data Collection Phase

- Videos taken of 2 locations:

Unconstrained / Open Scene
30 Characters

Constrained / Corridor Scene
12 Characters

APGV 08
applied perception in graphics and visualization

Annotation Phase

- Still images annotated to highlight Positions, Orientations and Groupings
- Colour-coded *Dynamic vs. Static* groups and *8 different Orientations*

APGV 08
applied perception in graphics and visualization

Position Rules

Still Image

Real

Random

Context:
Bounds Sensitive, Group Sensitive

APGV 08
applied perception in graphics and visualization

Orientation Rules

Still Image

Real

Random

Context:
Flow Sensitive, Adjacency Sensitive, Group Sensitive

APGV 08
applied perception in graphics and visualization

Reconstruction Phase

- Creation of virtual replicas of real images that were captured and annotated

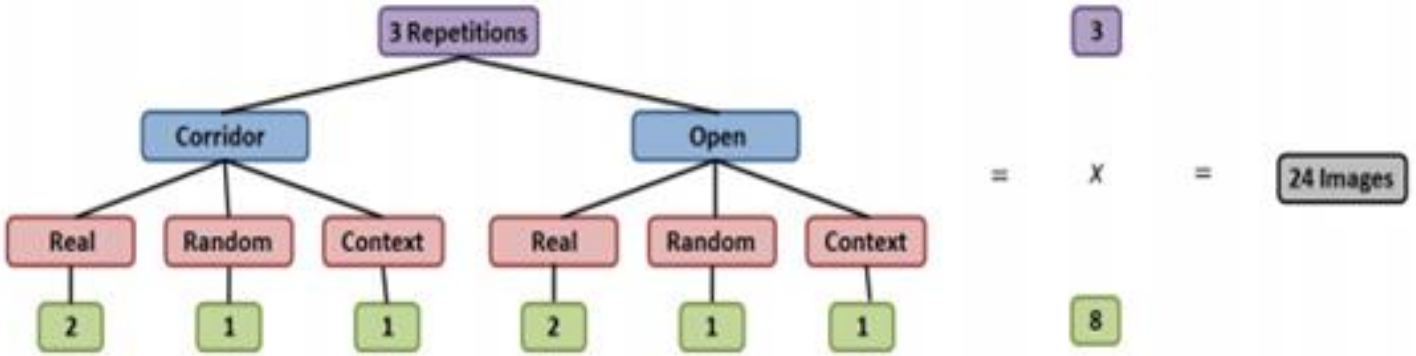
- Using image as viewport background in 3ds Max
- Tweaking Camera parameters to align model and still image

APGV 08
applied perception in graphics and visualization

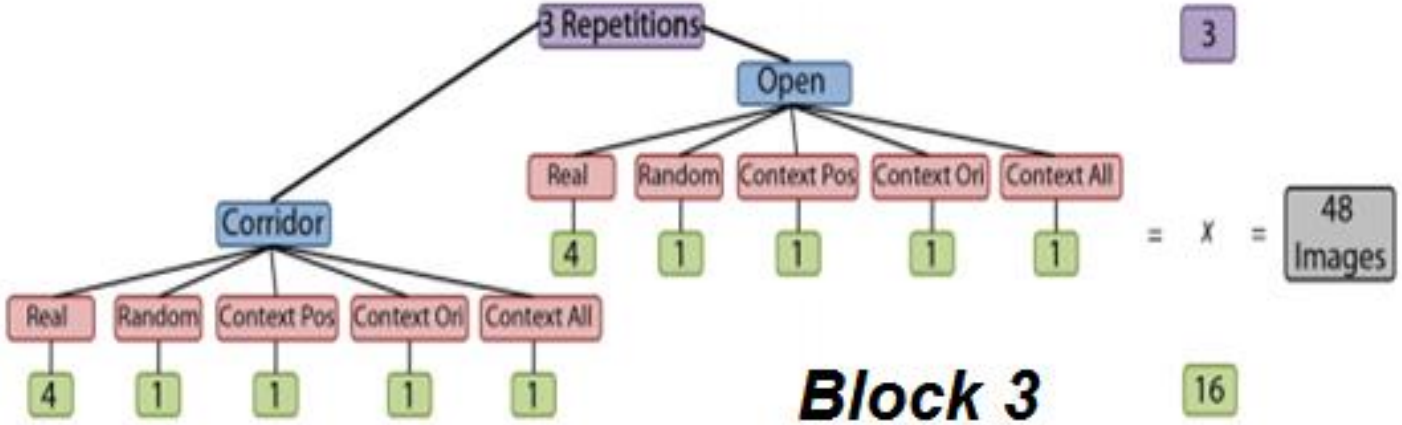
Experiment

- 32 participants (12F 20M) aged 18 – 30
- 3 Blocks – Position, Orientation, Both
- Participants were asked whether they thought the formation was *Real* or *Synthetically Generated*
- Images displayed for 4 seconds

Experiment 1: Pos and Ori

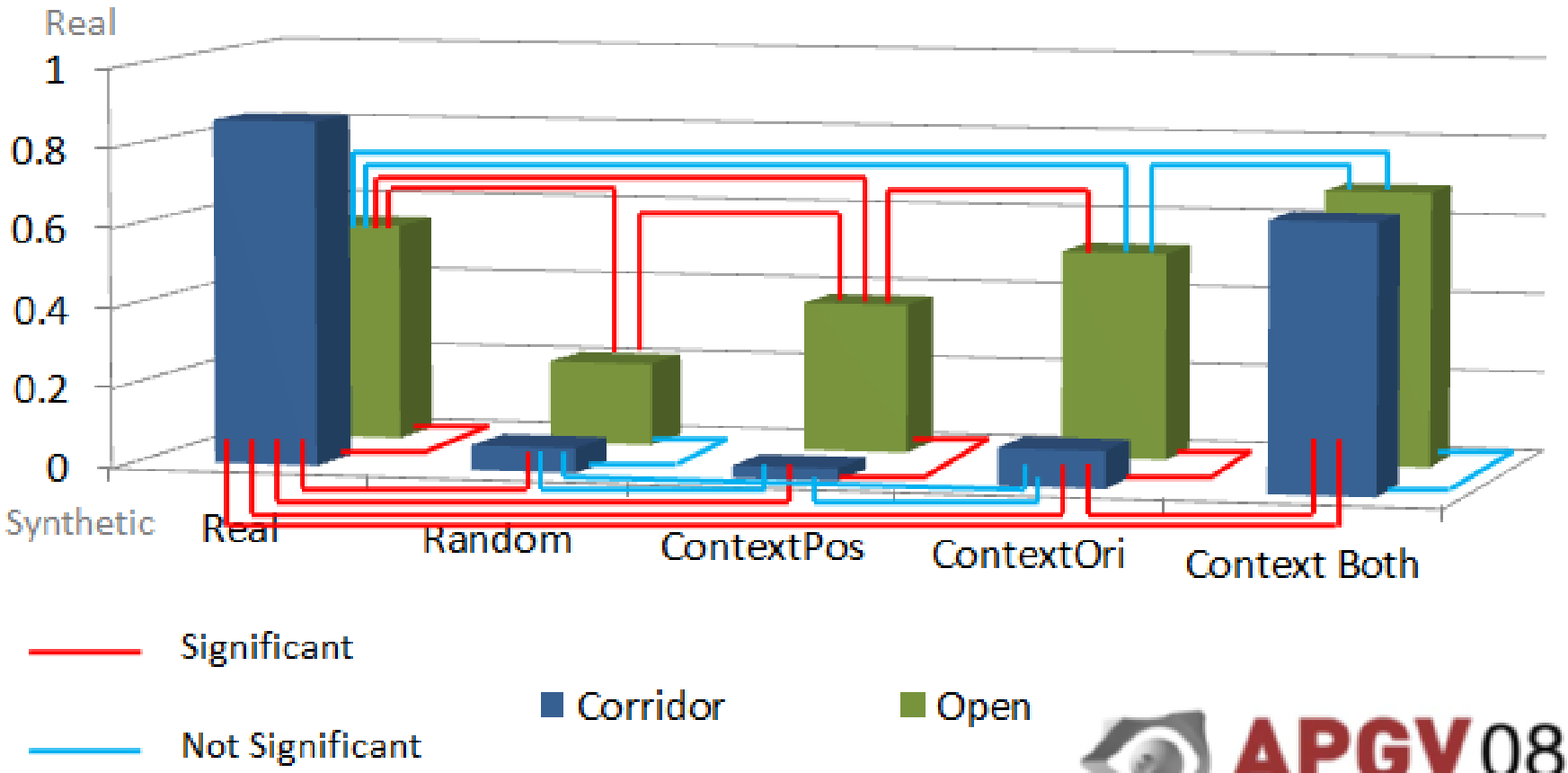


Block 1 and 2



Block 3

Position and Orientation



ROYAL INSTITUTE OF TECHNOLOGY

Perception and graphics

- Determine human sensitivities
  - Reduce level of detail in parts of the scene that are not salient
- Drive algorithms in real-time
  - Eye-gaze and detection
  - *Concealing Rendering Simplifications Using Gaze Contingent Depth of Field*, Tim Lindeberg, 2016
  - Project's page: http://www.csc.kth.se/~chpeters/projects.html
- Evaluate
  - How the results of your rendering algorithm improves on previous approaches

ROYAL INSTITUTE OF TECHNOLOGY

An Overview

- Perceptually Driven Interactive Rendering
  David Luebke and Benjamin Hallen
  https://www.cs.virginia.edu/~luebke/publications/pdf/perceptual.ir.pdf

ROYAL INSTITUTE OF TECHNOLOGY

In Your Project

- Report on a *potential* perceptual experiment related to your project
- A good example is available here:

  http://proceduralclouds.blogspot.se/

ROYAL INSTITUTE OF TECHNOLOGY

Upcoming Lectures

- Wed 17 May: 13:00-15:00, D2
  HCI Introduction

- Mon 22 May: 13:00-15:00, VIC
  - Guest lecture:
    Catharine Oertel (TMH),
    Intelligent Virtual Agents

ROYAL INSTITUTE OF TECHNOLOGY

Lab Help Sessions

- Thursday 18th May
  13:00-15:00, VIC (Visualisation Studio)

- Friday 26th May
  10:00-12:00, VIC (Visualisation Studio)

- All submissions open on Canvas
  Need Canvas access?