Immersive views outdoors to assess the mediating effect of time in view preference

Francisca Rodriguez, Veronica Garcia-Hansen, Alicia Allan & Gillian Isoardi

QUT | The Luminous Environments Lab, Queensland University of Technology, Australia

LUMIE LAB

QUT Queensland University of Technology

UNIVERSIDAD TECNICA FEDERICO SANTA MARIA


90%
average time spent indoors
(Andersen, 2015)

Outdoor Views

Stimulates positive psychological and health responses

(Veitch & Galasiu, 2012)

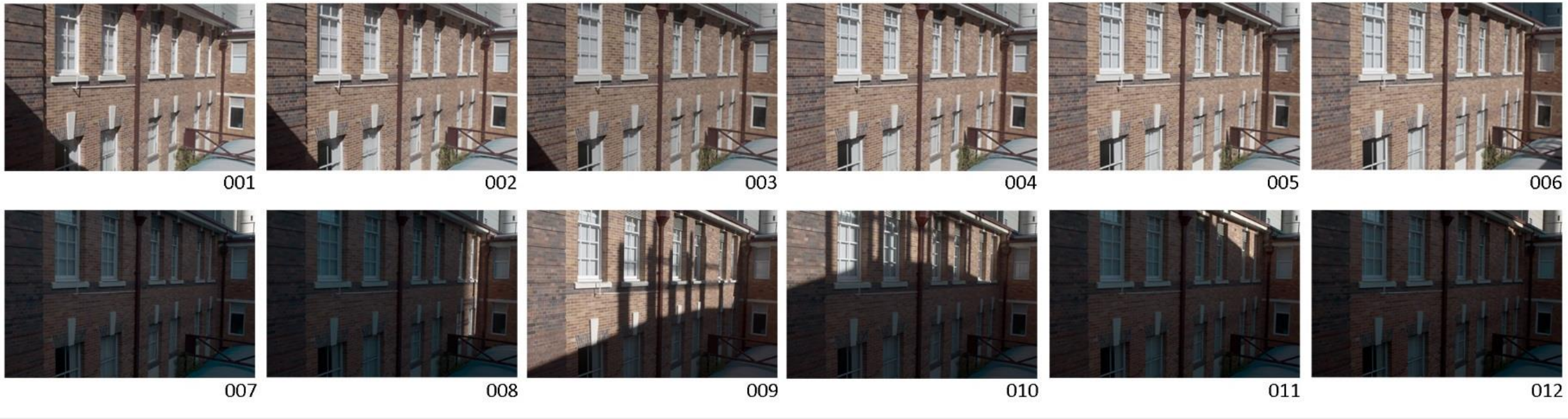
Sources of involuntary attention
Fascination

(Berto, Baroni, Zainaghi & Bettella, 2010)

Dynamic exploration
of the recovery process

(Sonnentag, Venz & Casper, 2017)

Current view assessment

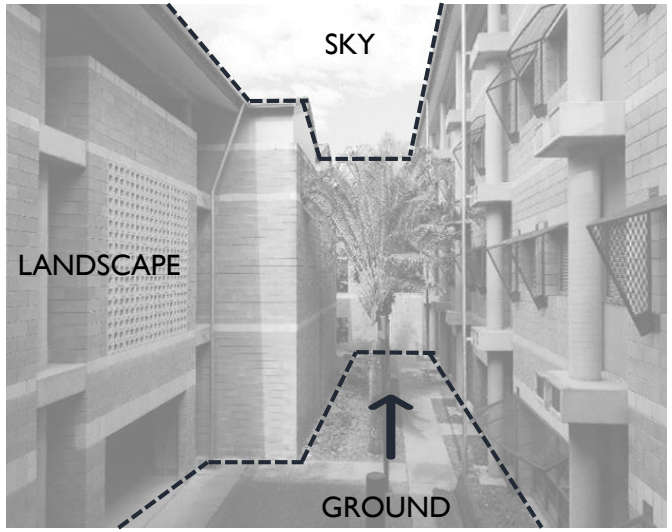


To try to predict and comprehend
(Kaplan & Kaplan, 1989)

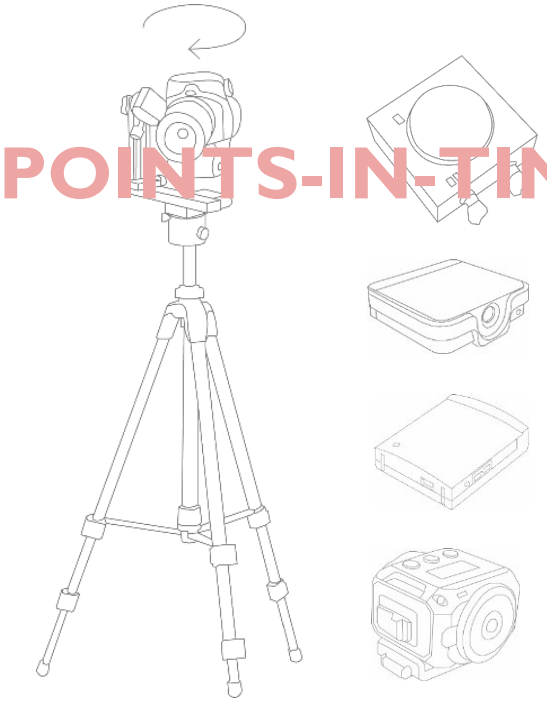
H: Intuitive responses are motivated by trying to process changes in the outdoor luminous environment
Aim: to understand the mediating effect of luminous variation in individuals' response to views

View preference > Restoration (van den Berg, Sander, Koole & van der Wulp, 2002)

GAP



Based on prEN 17037:2018 European Standard Annex C, View out



POINTS-IN-TIME

CATEGORIZATION

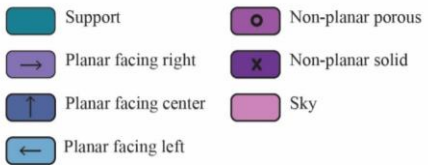
COLLECTION

EVALUATION

Part 1:
A standardized procedure for examining the dynamic character of view under daylight

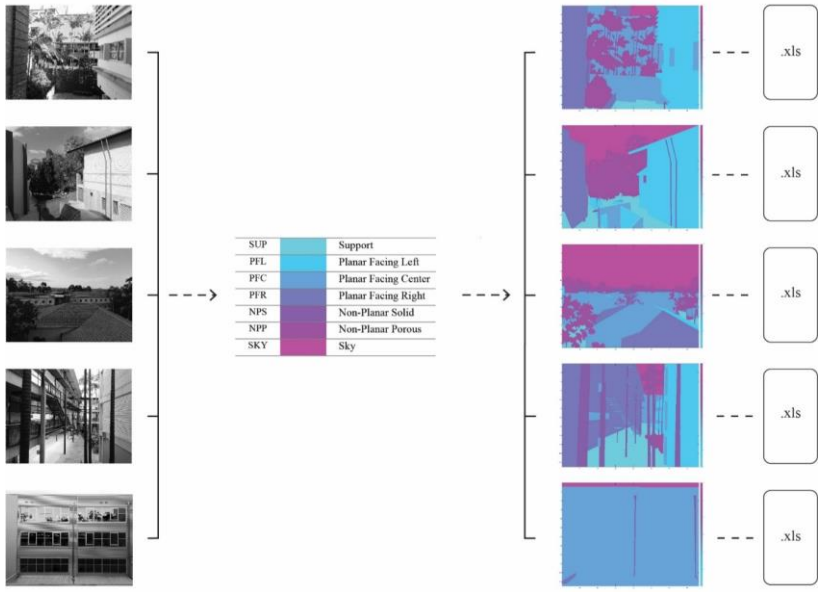
Part 2:
An experimental approach to examine how luminous changes in views mediate individuals' responses to views

Surface labeling approach - Seven geometric classes
(Hoiem, Efros & Herbert, 2007)



Part 1: Procedures

a. CATEGORIZATION



n = 160

ROI
Matlab

Per-pixel information
Label distribution

(a) Wall (b) Patio (c) Corridor (d) Roof

Part 1: Procedures

b. COLLECTION

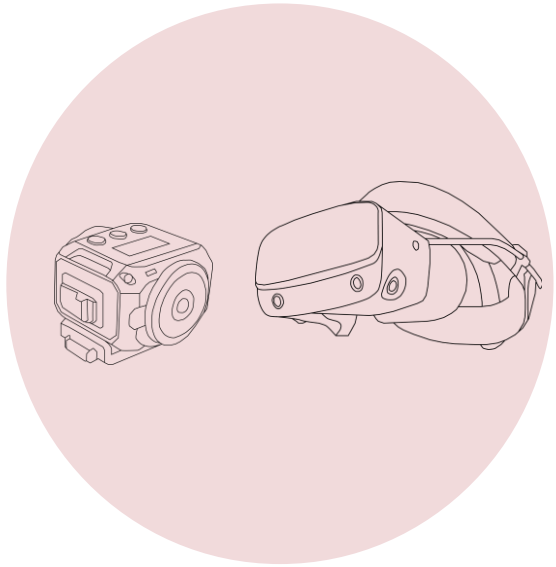
Wall

Patio

Corridor

Roof

Panorama time-lapse sequences

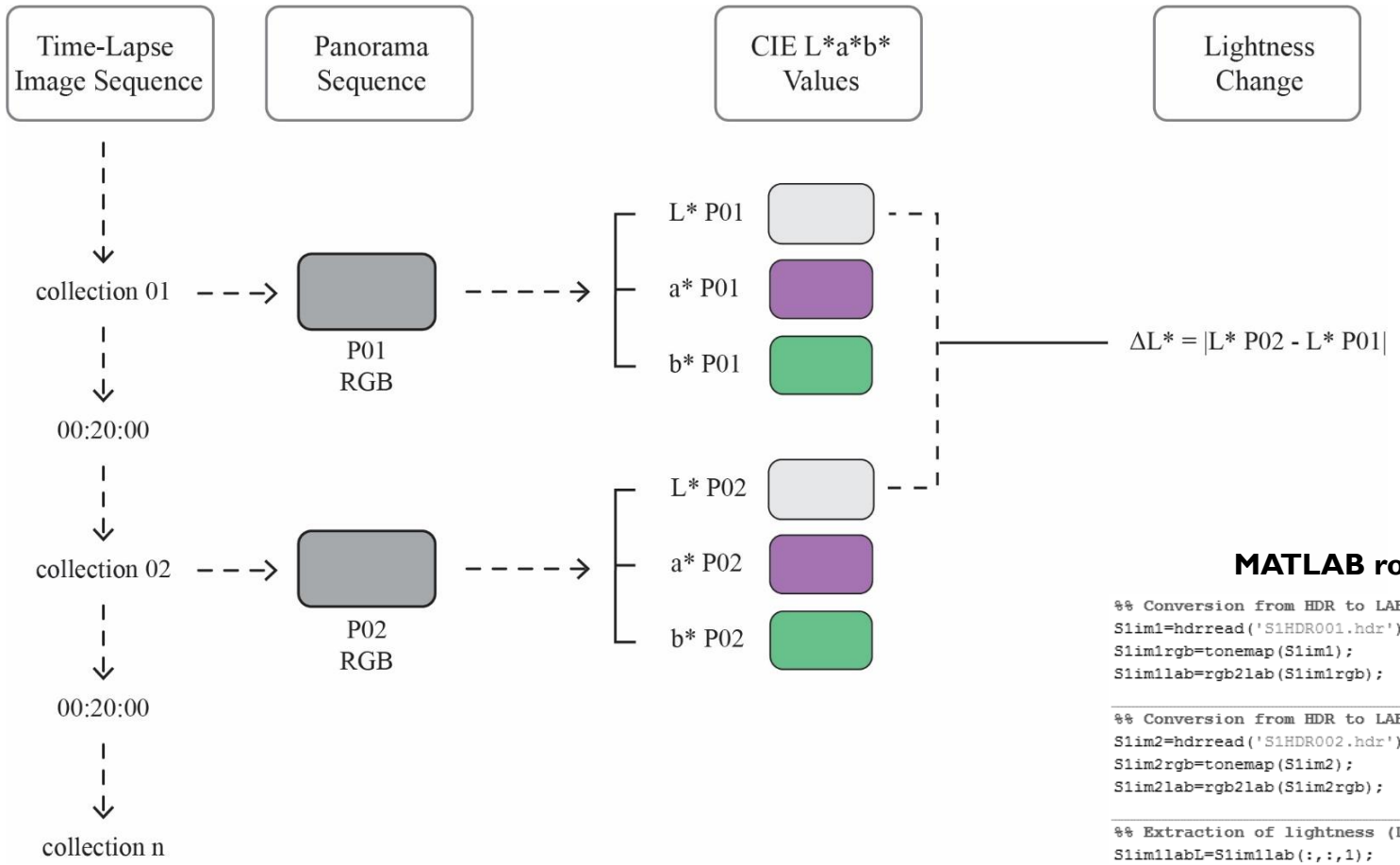


360° time-lapse videos

Environmental measures

Part 1: Procedures

b. COLLECTION



MATLAB routine CIE 2004

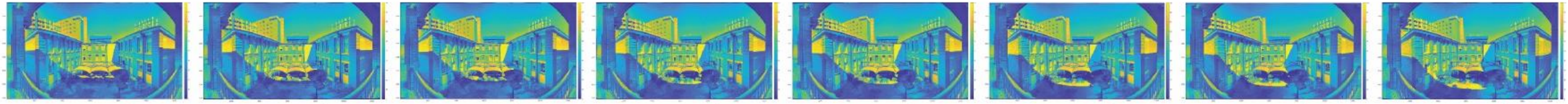
```
%% Conversion from HDR to LAB (Series 1 Image 1)
S1im1=hdrread('S1HDR001.hdr');
S1im1rgb=tonemap(S1im1);
S1im1lab=rgb2lab(S1im1rgb);

%% Conversion from HDR to LAB (Series 1 Image 2)
S1im2=hdrread('S1HDR002.hdr');
S1im2rgb=tonemap(S1im2);
S1im2lab=rgb2lab(S1im2rgb);

%% Extraction of lightness (L*) information (Series 1 Image 1)
S1im1labL=S1im1lab(:,:,1);
imagesc(S1im1labL)

%% Extraction of lightness (L*) information (Series 1 Image 2)
S1im2labL=S1im2lab(:,:,1);
imagesc(S1im2labL)

%% Absolute difference L* (Series 1 Image 2 and 1)
S1im2_1labL = abs(S1im2labL-S1im1labL);
imagesc(S1im2_1labL)
```

Canon EOS 5D Mark III on a panoramic head mount; Canon 50 mm f1:1.4 lens

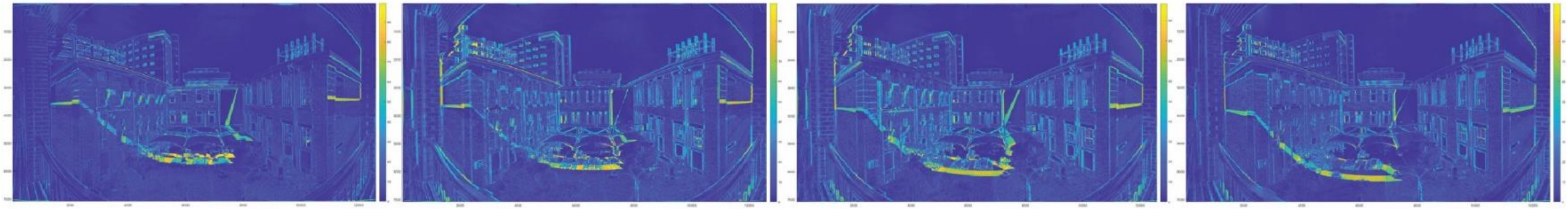
Part 1: Procedures

b. COLLECTION

P01 09:40 am | P02 10:00 am | P03 10:20 am | P04 10:40 am | P05 11:00 am



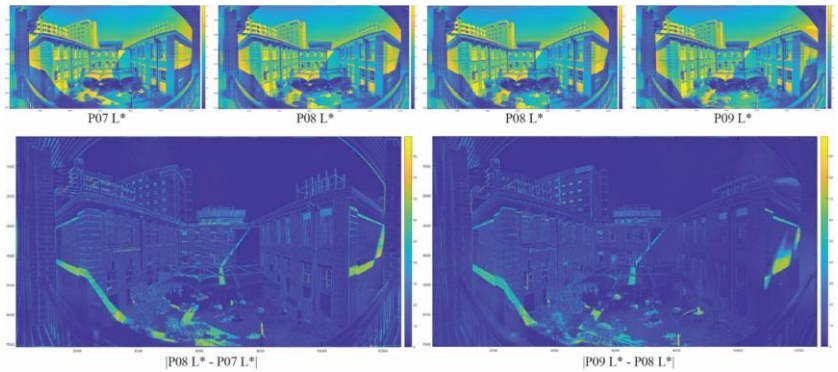
P01 L* | P02 L* | P02 L* | P03 L* | P03 L* | P04 L* | P04 L* | P05 L*



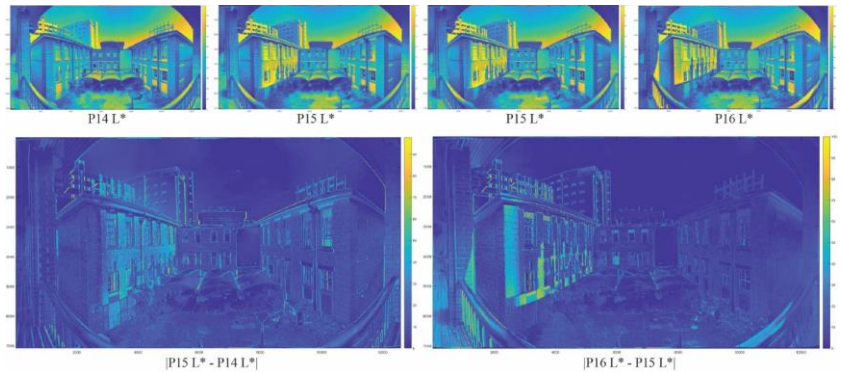
|P02 L* - P01 L*| | |P03 L* - P02 L*| | |P04 L* - P03 L*| | |P05 L* - P04 L*|

Part 1: Procedures

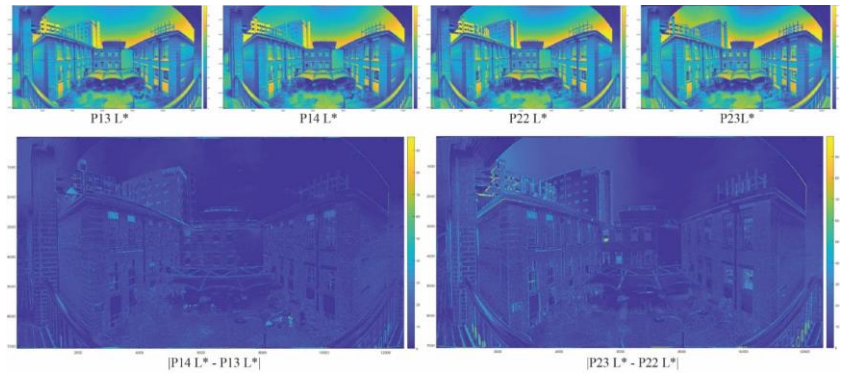
b. COLLECTION



Global Variation



Local Variation

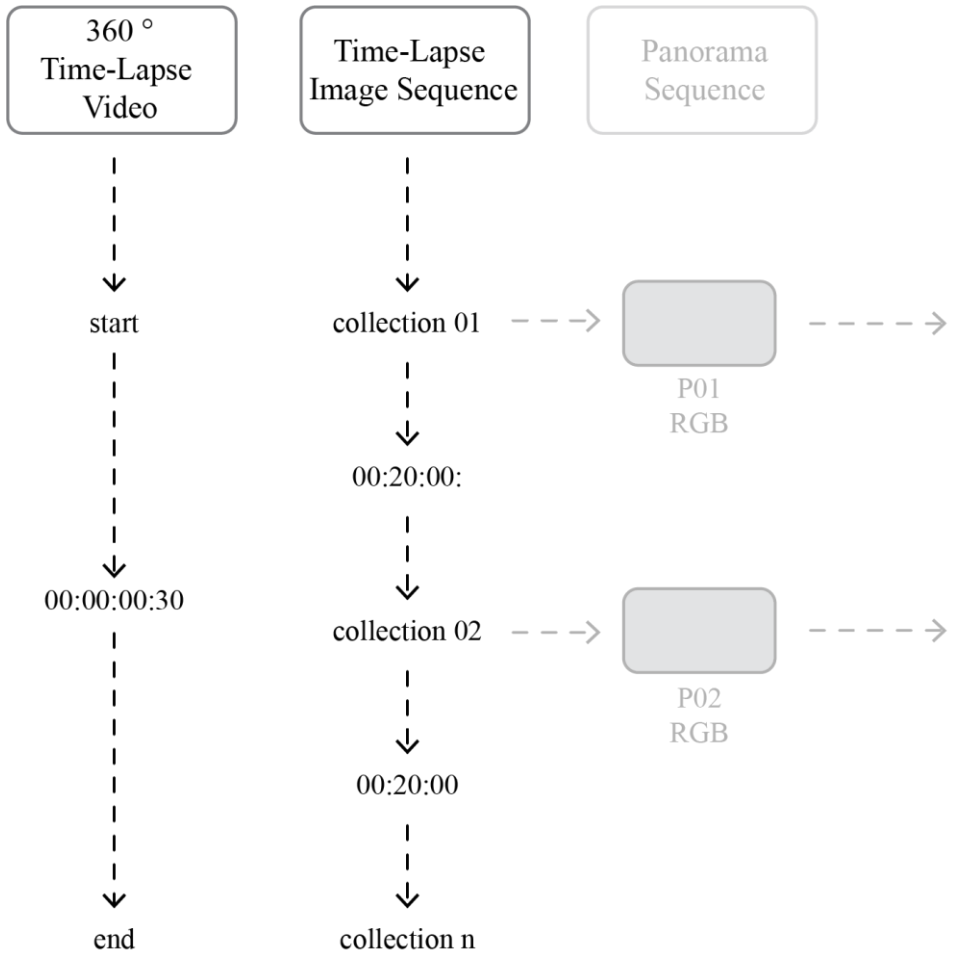


No Variation

Part 1: Procedures

b. COLLECTION

GARMIN Virb 360 Action camera
4K Video recording over a tripod



Part 1: Procedures

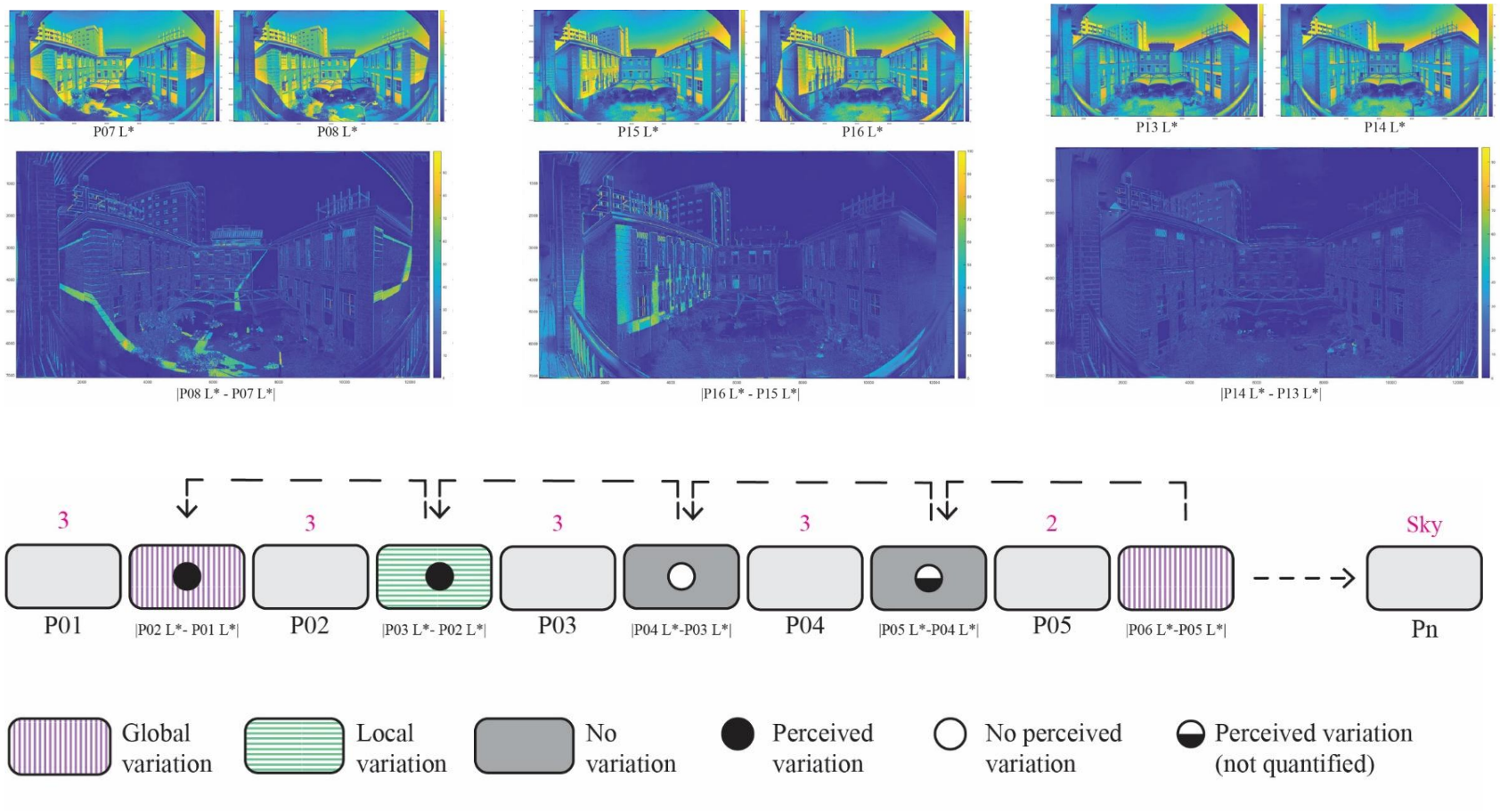
b. COLLECTION

- BF5 Sunshine Sensor
- Lighting Passport Pro AsenseTek ALP-01
- Hobo U12-012
- Canon EOS 5D Mark III camera fixed on a tripod, and a Sigma 8mm f3.5 EX DG

- Sky classification as control variable (Perez, Ineichen, Seals, Michalsky, & Stewart, 1990

- Photometric measures to examine predictors to luminous variation

Category	Date	Hour	Sun sensor				Lighting Passport		Data Logger	
			Total	Diffuse	Sky classification		CCT	V Illuminance	Temperature	RH
			W.m-2	W.m-2			K	Lux	C	%
VS1: Wall	20190514	9:40:00 AM	596.17	160.82	6	Clear Turbid	6183	3513	21.47	68.70
		10:00:00 AM	321.99	158.14	5	Intermediate	6390	3037	22.06	69.54
		10:20:00 AM	556.77	198.49	6	Clear Turbid	5343	8927	25.98	60.20
		10:40:00 AM	380.01	341.82	2	Overcast	5215	46125	29.34	50.23
		11:00:00 AM	309.78	286.65	2	Overcast	5644	5613	26.06	55.20
		11:20:00 AM	333.59	334.37	1	Overcast	5394	11939	24.16	60.81
		11:40:00 AM	487.4	384.6	3	Intermediate	5373	6795	24.62	59.80
		12:00:00 PM	481.25	382	3	Intermediate	5439	6406	26.26	55.54
		12:20:00 PM	323.37	270.72	2	Overcast	5341	7791	24.30	60.34
		12:40:00 PM	402.53	323.2	3	Intermediate	5494	6202	24.56	59.98
		1:00:00 PM	452.33	315.93	3	Intermediate	5137	2999	24.63	58.97
		1:20:00 PM	106.78	104.44	1	Overcast	5844	3279	24.13	58.51
		1:40:00 PM	114.92	109.29	1	Overcast	4810	1925	23.98	58.38
		2:00:00 PM	46.16	44.95	1	Overcast	5271	754	23.57	59.21
		2:20:00 PM	73.96	74.22	1	Overcast	5411	1571	23.35	58.84
		2:40:00 PM	108.77	109.29	1	Overcast	5320	1868	23.34	59.05
		3:00:00 PM	107.21	107.65	1	Overcast	5290	1679	23.38	59.27
		3:20:00 PM	107.47	107.91	1	Overcast	5372	1746	23.28	58.39
		3:40:00 PM	69.8	69.89	1	Overcast	5348	1282	23.23	59.19
		4:00:00 PM	63.13	63.39	1	Overcast	5600	1196	23.04	60.90
		4:20:00 PM	49.71	49.71	1	Overcast	5720	897	22.85	62.32
		4:40:00 PM	28.41	28.23	1	Overcast	6379	499	22.70	62.65
		5:00:00 PM	8.49	8.05	1	Overcast	6906	175	22.42	63.45



Lightness change as a function of different view types, view orientations, and heights.

PART I

PRELIMINARY DESCRIPTIVE SUMMARY

- View types: better depiction of luminous changes outdoors (in comparison to orientation or height of the vantage point).
- Vertical illuminance is a good predictor for luminous changes over time.

		|P02 L*-P01 L*|	|P03 L*-P02 L*|	|P04 L*-P03 L*|	|P05 L*-P04 L*|	|P06 L*-P05 L*|	|P07 L*-P06 L*|	|P08 L*-P07 L*|	|P09 L*-P08 L*|	|P10 L*-P09 L*|	|P11 L*-P10 L*|	|P12 L*-P11 L*|	|P13 L*-P12 L*|	|P14 L*-P13 L*|	|P15 L*-P14 L*|	|P16 L*-P15 L*|	|P17 L*-P16 L*|	|P18 L*-P17 L*|	|P19 L*-P18 L*|	|P20 L*-P19 L*|	|P21 L*-P20 L*|	|P22 L*-P21 L*|	|P23 L*-P22 L*|	Global Variation	Local Variation	No Variation	Total classified	% Global Variation	% Local Variation	% No Variation
Wall	VS 1				G			N			G		L	N	N	N	N	N	N	N	N	N	N	2	1	11				
	VS 2	G	G	G	G	G	G	L	G	G	G	G	G	G	G	G		G	L			G		16	2	0	**32**	**56**	**9**	**34**
Patio	VS 1	G	G	L	G	G	G	G	L	L	L	L	L	L	L	L	N		N		N			6	8	3				
	VS 2	G	G	G	G	G	G	G	G	G	G	G	L	N	L	L	G		G		G			14	3	1	**35**	**57**	**31**	**11**
Corridor	VS 1									G	G	N	N	L							N	N	N	2	1	5				
	VS 2		N	N	N	L	N	N	N			N	G	N	N	G	N	N	N	G	L	N		3	2	13	**26**	**19**	**12**	**69**
Roof	VS 1	G	G	N	G			G	G	L	G	G	L	G	G	G	G	G	G	N	N	N		13	2	4				
	VS 2	G		G				G		G			L						L					4	2	0	**25**	**68**	**16**	**16**

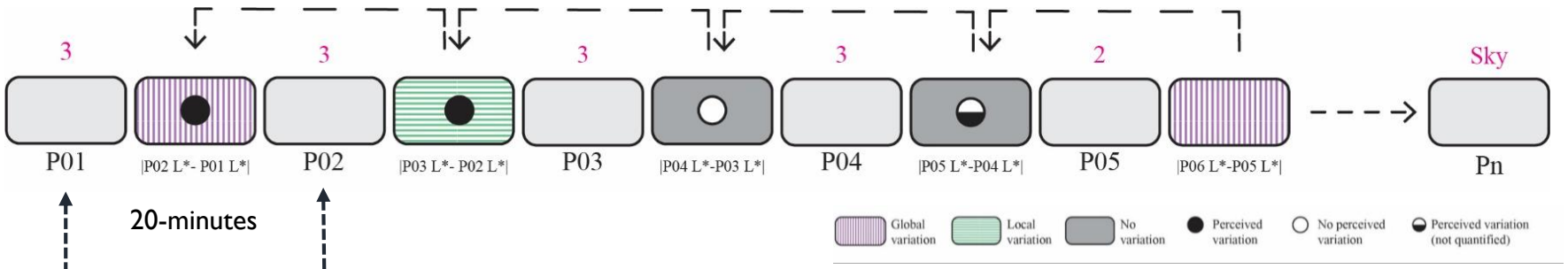
North	**NE109**				**G**			**N**			**G**		**L**	**N**	**N**	**N**	**N**	**N**	**N**	**N**	**N**	**N**	**N**	**2**	**1**	**11**				
	N351	G	G	N	G			G	G	L	G	G	L	G	G	G	G	G	G	N	N	N		13	2	4	**33**	**46**	**9**	**46**
South	S167	G	G	G	G	G	G	G	G	G	G	G	L	N	L	L	G		G		G			14	3	1				
	SW289		N	N	N	L	N	N	N			N	G	N	N	G	N	N	N	G	L	N		3	2	13	**36**	**47**	**14**	**39**
West	W289	G		G				G		G			L						L					3	2	13				
	W290	G	G	L	G	G	G	G	L	L	L	L	L	L	L	L	N		N		N			6	9	3	**36**	**25**	**31**	**44**

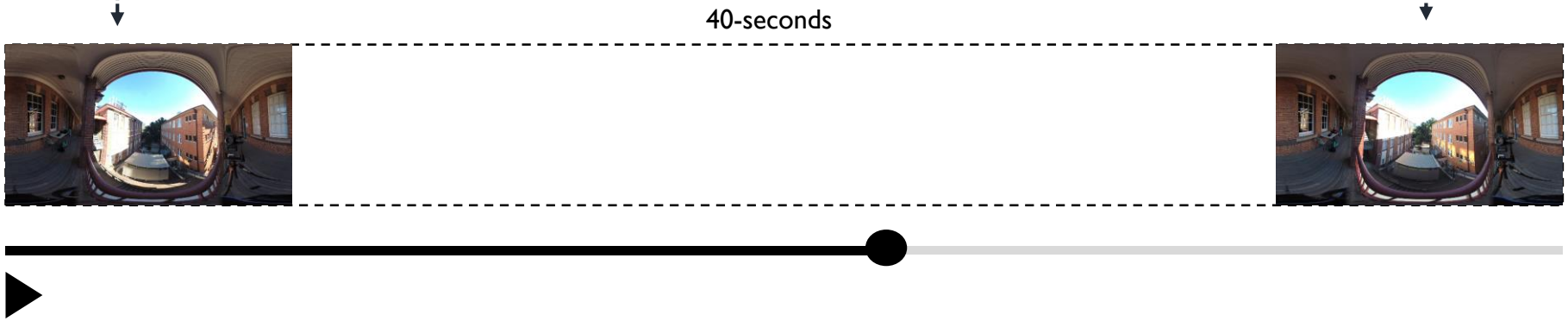
4 m	**4.30 m**				**G**			**N**			**G**		**L**	**N**	**N**	**N**	**N**	**N**	**N**	**N**	**N**	**N**	**N**	**2**	**1**	**11**				
	4.90 m	G	G	L	G	G	G	G	L	L	L	L	L	L	L	L	N		N		N			6	9	3	**32**	**25**	**31**	**44**
6 m	6.20 m	G	G	G	G	G	G	G	G	G	G	G	L	N	L	L	G		G		G			14	3	1				
	6.40 m		N	N	N	L	N	N	N			N	G	N	N	G	N	N	N	G	L	N		3	2	13	**36**	**47**	**14**	**39**
9 m	9.10 m									G	G	N	N	L							N	N	N	2	1	5				
	9.50 m	G	G	G	G	G	G	L	G	G	G	G	G	G	G	G		G	L			G		16	2	0	**26**	**69**	**12**	**19**
12 m	12.20 m	G	G	N	G			G	G	L	G	G	L	G	G	G	G	G	G	N	N	N		13	2	4				
	12.80 m	G		G				G		G			L						L					4	2	0	**25**	**68**	**16**	**16**

Part 2: Evaluation

Experimental design: Subjective assessment of views

Part 1. Quantitative assessment





Part 2. Subjective assessment

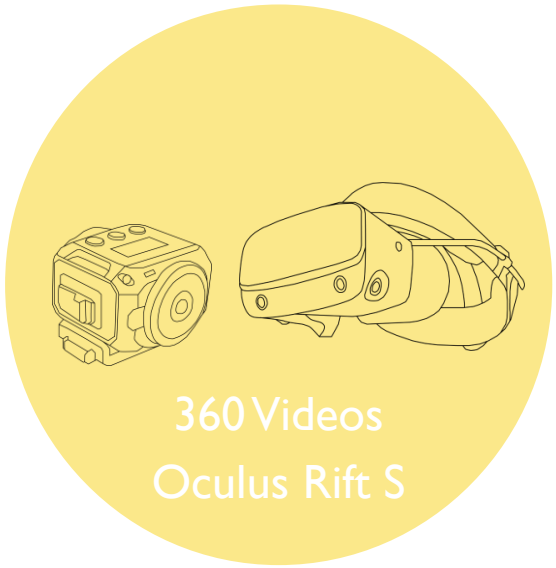
1. RATE
View preference

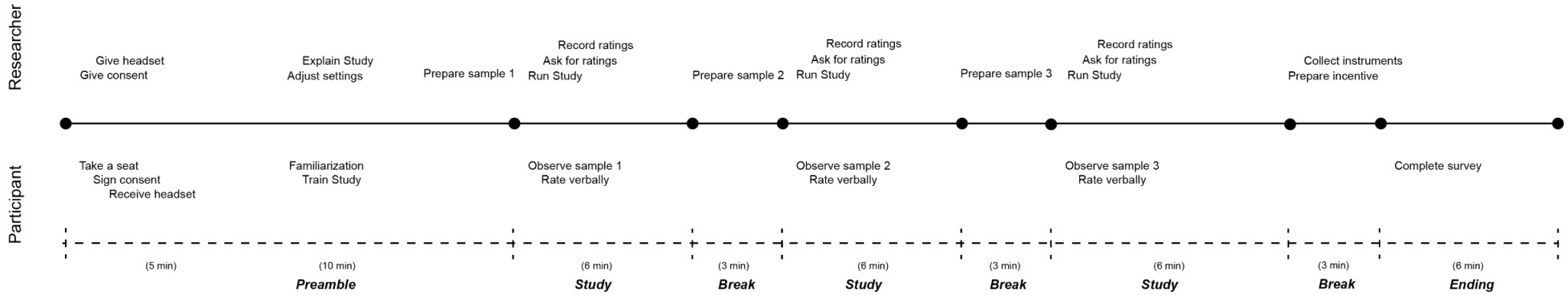
2. OBSERVE
40-seconds

3. RATE
Luminous changes
Time cues
View preference

Part 2: Evaluation

Experimental design: Instruments and Protocol





Immersive instruments

- ecological validity
  (de Kort, Meijnders, Sponselee & Ijsselsteijn, 2006)
- subjective assessment of light indoors
  (Chamilothori, Wienold, Andersen, 2017)

3 Randomized samples of 40 sec videos

Part 2: Evaluation

Experimental design – Testing – Next steps

Testers (n=9)

- Test Video speed (FPS) Ecological validity
- Exploration vs Forced perspective
- Randomization

Thank you!

Francisca Rodriguez
francisca.rodriguez@hdr.qut.edu.au
www.lumielab.com

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