

Supplementary Data

Thermal comfort in urban spaces: a cross-cultural study in the hot arid climate

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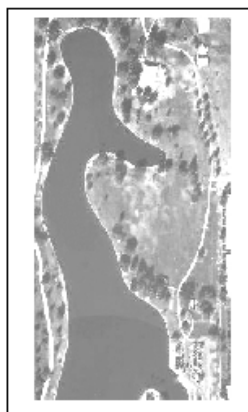
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Online Resource 1 Questionnaire form used in Chaparral Park

**University of Bath**  
**Department of Architecture & Civil Engineering**



Location: \_\_\_\_\_ Date: \_\_\_\_\_  
Start time: \_\_\_\_\_ No. ....



**- A -**

1. What is your sun preference at this moment?  
1.  Prefer more sun 2.  No change 3.  Prefer more shade 4.  N/A
2. How would you describe the wind situation at the moment?  
1.  Very windy 2.  3.  4.  5.  Calm
3. How would you prefer the wind situation to be at the moment?  
1.  Prefer more wind 2.  No change 3.  Prefer less wind
4. What do you think of the humidity at this moment?  
1.  Damp 2.  3.  4.  5.  Dry
5. At the moment, do you find the weather to be:  
1.  Cold 2.  Cool 3.  Neither cool nor warm 4.  Warm 5.  Hot
6. Would you like it to be:  
1.  Cooler 2.  No Change 3.  Warmer

7. With regard to the overall weather conditions here, do you feel comfortable at this moment?  
1.  Yes 2.  No

**- B -**

8. What would you do if it gets warmer/cooler? (Open question)  
1.  Change place 2.  Clothes on 3.  Clothes off 4.  Hot drink 5.  Cold drink 6.  Nothing/ Don't know 7.  Other.....
9. Did you live in an area with similar climate to this during your childhood?  
If no, what was the climate there?  1. Yes  2. No cooler/ colder  3. No warmer/hotter
10. Where do you spend most of your time during the weekdays?  
1.  Indoors 2.  Equally between both 3.  Outdoors
11. Do you think that today's weather is typical for this time of the year?  
1.  Yes 2.  No 3.  Don't know If no, what do you think it should be like? 1.  Cooler/colder 2.  Warmer/hotter
12. How often do you use this place? At least once  
1.  Every Day 2.  Every Week 3.  Every Month 4.  Rarely 5.  First time
13. Do you live or work in this area? 1.  No 2.  Yes, if yes where in the valley? .....
- For how long?** 1.  <1 year 2.  1 to 2 years 3.  2 to 3 years 4.  3 to 5 years 5.  5 to 10 years 6.  >10 years
14. What is the main reason for you to be in this place? (Open question)  
1.  Waiting 2.  Break 3.  Pass by 4.  Going out/ enjoying the place 5.  walking dog 6.  other.....
15. Why did you choose this specific place to be in? (Open question)  
1.  Sun 2.  Shade 3.  Accessibility 4.  Availability 5.  Landscape 6.  Other.....
16. How long ago did you arrive in this place? (Open question)  
1.  <15 min ago 2.  15-30 min 3.  30-45 min 4.  45-60 min 5.  60-90 min 6.  >90 min
17. For how long do think you will stay? (Open question)  
1.  <15 min 2.  15-30 min 3.  30-45 min 4.  45-60 min 5.  60-90 min 6.  >90 min

18. Where were you just before coming here? 1.  Indoors 2.  Outdoors

19. How long ago were you in an air-conditioned space (including vehicles)? (Open question)

1.  <15 min ago 2.  15-30 min 3.  30-45 min 4.  45-60 min 5.  60-90 min 6.  >90 min

20. How do you experience this place just now?

1.  Boring 2.  3.  4.  5.  Interesting

1.  Attractive 2.  3.  4.  5.  Unattractive

21. What do you like the most in this place? (Open question)

22. What do you not like the most in this place? (Open question)

23. Do you prefer to change your position in this place? 1.  Yes 2.  Doesn't matter 3.  No

If yes, what is the reason? (Open question)

- C -

24. What do you do for living? 1.  Highly skilled with Degree 2.  Skilled with degree 3.  Skilled without degree

4.  Non-skilled labour 5.  Student/ housewife/ retired 6.  No job Job's name .....

25. Your educational level is: 1.  Basic 2.  High school 3.  College 4.  University

26. How well would you say you are managing financially these days?

1.  Living comfortably 2.  Doing Alright 3.  Just about getting by 4.  Finding it quite difficult 5.  Finding it very difficult

End time:.....

- D -

Surface temperature: .....

Interviewee has been sitting in: 1.  Shade 2.  Sun 3.  Overcast

Gender: 1.  Male 2.  Female

Where is he/she sitting? 1.  Bench 2.  Ground 3.  Grass 4.  Other

Age group: 1.  <18 2.  18-24 3.  25-34 4.  35-44 5.  45-54 6.  55-60 7.  >60

Eating/ Drinking in the last 10 mins : 1.  Eating 2.  Hot drink 3.  Cold drink 4.  Nothing

Activity in the last 10 mins: 1.  Lying 2.  Seated 3.  Standing 4.  Walking 5.  Running

Interviewee: 1.  Alone 2.  With others

Clothing: 1. Trousers or 2. Skirt or 3. Dress (1. Long/ 2. Medium/ 3. Short), 4. Sweater or 5. Jacket (1. Thick/ 2. Light), 6. Coat (1. long/ 2. short),

7. Shirt or 8. T-shirt or 9. Vest (1. long/ 2. short/ 3. sleeveless)

Local dress: Men: 1.  Dishdasha 2.  Besht 3.  Tagla 4.  Ghutra

Women: 10.  Islamic Dress 20.  Abaya 30.  Head scarf 40.  Burqa

Footwear: 1.  Closed 2.  Open

Colour of clothes: 1.  Dark 2.  Mixed 3.  Light

Online Resource 2 Details of the meteorological sensors

Instrument	Commercial name	Manufacturer	Range	Accuracy
Anemometer (Cup Anemometer)	A100L2 Low Power Anemometer	Wind speed Limited (trading as Vector Instruments)	Measuring wind speed between 0-75 m/s	0.02 below 10m/s and above 56.5 m/s 0.01 between 10m/s and 56.5 m/s
Pyranometer	SKS 1110 Pyranometer	Skye Instruments Ltd	Measuring the incoming solar radiation- working range 0-5000 Wm <sup>-2</sup>	
Combined temperature/humidity probe.	HygroClip 2 HC2-S	ROTRONIC	Measuring relative humidity (0-100%) and temperature (-50 to +100 °C)	<±1% (RH) <±0.2°C (Ta)
Grey Globe thermometer (Thermocouple wire inside a 38mm grey table tense ball)			Measuring the globe temperature	<±0.3°C at 0 °C
Data logger	Squirrel 1001	Grant instruments		

Online Resource 3 Study sites in Marrakech and Phoenix



a-Al Koutoubia Garden



b-Al Koutoubia Plaza



c-Chaparral Park



d-Tempe Beach Lake



e-Tempe Market place

Online Resource 4 Dates and times of filed surveys (Aljawabra F, Nikolopoulou M (2010) Influence of hot arid climate on the use of outdoor urban spaces and thermal comfort: Do cultural and social backgrounds matter? Intelligent Buildings International 2:198-217)

city	season	site	date		time		
			month	days	morning	noon	late afternoon
Marrakech	winter	K. Park	Feb	01,03,05,07,	8:00-10:00 *	12:00-14:00	15:00-17:00
Marrakech	winter	K. Plaza	Feb	02,04,06,08,	8:00-10:00 *	12:00-14:00	15:00-17:00
Marrakech	summer	K. Park	Jul	22,24, ,25,	8:00-10:00	12:00-14:00	17:00 -20:00
			Aug	02			
Marrakech	summer	K. Plaza	Jul	22,24,25,	8:00-10:00 *	12:00-14:00	17:00 -20:00
			Aug	02			
Phoenix	winter	Ch. Park	Jan	11,12,13,20	8:00-10:00	12:00-14:00	15:00-17:30
Phoenix	winter	T. Lake	Jan	08,09,10	8:00-10:00	12:00-14:00	15:00-17:30
Phoenix	winter	T. Market	Jan	15,16,17	8:00-10:00 *	12:00-14:00	15:00-18:30
Phoenix	summer	Ch. Park	Jun	27,28,30	8:00-10:00	12:00-14:00	17:00-19:30
			Jul	01			
Phoenix	summer	T. Lake	Jul	<b>06,07,08,09</b>	8:00-10:00**	12:00-14:00**	17:00 -20:00
Phoenix	summer	T. Market	Jul	<b>06,08,09</b>	8:00-10:00 *	12:00-14:00	17:00 -20:00

-\* Most interviews were conducted after 12:00 as to the site was deserted before that.

-\*\* Most interviews were conducted in late afternoon session as to the site was deserted before that.

- Dates in bold italic represents **weekends**.

Online Resource 5 Percentage of age group and gender profiles in Marrakech and Phoenix sites

Age group	<18	18-24	25-34	35-44	45-54	55-65	>65
Marrakech (%)	4.3	30.03	33.00	14.9	10.9	4.0	3.0
Phoenix (%)	2.5	11.8	24.4	29.4	13.4	6.7	11.8

Gender	Female	Male
Marrakech (%)	16.8	83.2
Phoenix (%)	23.6	76.4

Online Resource 6 Means of measured microclimatic variables in Marrakech and Phoenix (Aljawabra F, Nikolopoulou M (2010) Influence of hot arid climate on the use of outdoor urban spaces and thermal comfort: Do cultural and social backgrounds matter? Intelligent Buildings International 2:198-217)

			Tg (°C)	Tair (°C)	RH %	Ws m/s	S W/m <sup>2</sup>
Marrakech	site 1	winter	22	23	32	0.7	258
		summer	36	37	24	1.0	307
	site 2	winter	23	24	26	0.9	263
		summer	35	36	26	1.2	309
Phoenix	site 3	winter	18	18	34	0.6	262
		summer	39	39	24	1.2	381
	site 4	winter	18	17	39	0.7	245
		summer	41	41	23	1.3	229
	site 5	winter	18	18	34	0.6	262
		summer	41	41	27	0.9	536

Online Resource 7 The t-tests of environmental variables in Marrakech and Phoenix (a) in winter and (b) in summer

**a- In winter**

variable	Marrakech		Phoenix		t-test	eta <sup>2</sup>
	mean	SD	mean	SD		
T <sub>air</sub> (°C)	22.4	3.60	22.5	6.90	-0.09	
S (W/m <sup>2</sup> )	206	194	384	267	<b>-4.84**</b>	<b>0.09</b>
Ws (m/s)	0.77	0.31	0.79	0.53	-0.17	
RH (%)	29	15.5	24	12.6	<b>2.39*</b>	<b>0.02</b>

\* p-value <0.05, \*\* p-value <0.01

**b- In summer**

variable	Marrakech		Phoenix		t-test	eta <sup>2</sup>
	mean	SD	mean	SD		
T <sub>air</sub> (°C)	35.93	2.7	38.9	2.8	<b>-6.93**</b>	<b>0.21</b>
S (W/m <sup>2</sup> )	148	209	108	162	1.322	
Ws (m/s)	0.962	0.5	1.397	0.85	<b>3.70**</b>	<b>0.07</b>
RH (%)	23.7	7.3	23.24	5.6	0.43	

\*\* p-value <0.01

Online Resource 8 Correlation analysis between ASV and other environmental and personal parameters in a. Marrakech and b. Phoenix

a)

	ASV	Tg	Tair	Rh	Ws
Pearson Correlation		.435**	.420**	-.333**	-.54*
Significance (2-tailed)		.000	.000	.000	.040
N	303	303	303	303	303

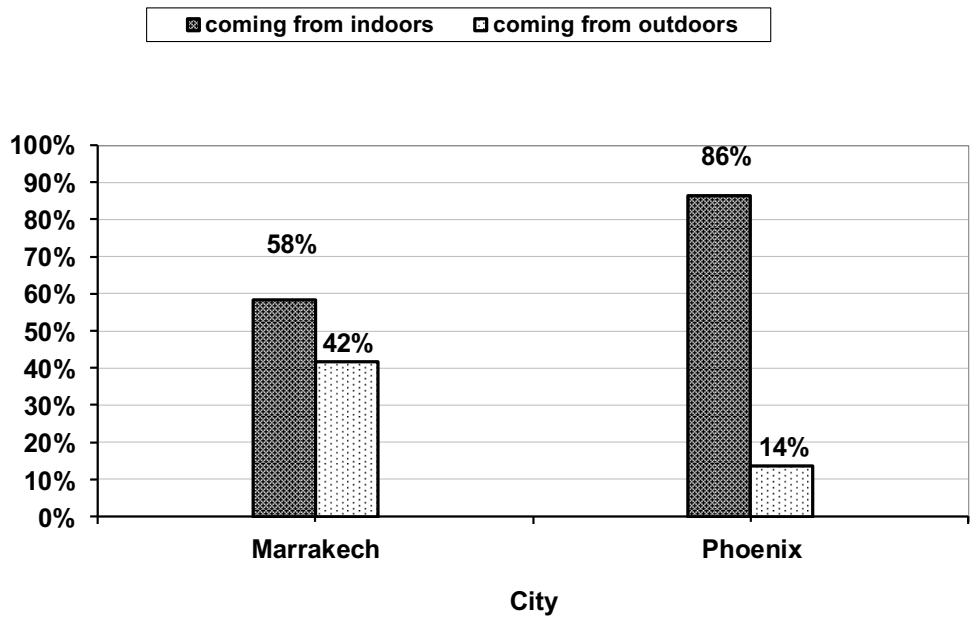
\*\* Correlation is significant at the 0.01 level (2 tailed).  
\* Correlation is significant at the 0.05 level (2 tailed).

b)

	ASV	Tg	Tair	Rh	Ws
Pearson Correlation		.725**	.740**	-.275**	.153*
Significance (2-tailed)		.000	.000	.002	.046
N	126	126	126	126	126

\*\* Correlation is significant at the 0.01 level (2 tailed).  
\* Correlation is significant at the 0.05 level (2 tailed).

Online Resource 9 Percentage of participants coming from indoors/outdoors just before the interview



Online Resource 10 Total number of people compared to the number of people in shade for different air temperatures in winter and summer

