Appendices for

Solar Shading Products and their effect on Overheating, Well-being, Productivity, and Sustainability in the UK Built Environment.

Zoe De Grussa

June 2021

A thesis submitted in partial fulfilment of the requirements of
London South Bank University for the degree of Doctor of Philosophy.

This research programme was carried out in collaboration with
The British Blind and Shutter Association.

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LIST OF APPENDICES

APPENDIX A. ETHICAL APPROVAL

London South Bank
University

Direct line: 0207 815 7492
E-mail: seethics@lsbu.ac.uk
Ref: 09Aug2016

Friday 07 October 2016

Dear Miss Zoe De Grussa

RE: The effect of Blinds and Shutters on Productivity in relation to Glare and Radiant Temperature within a working office.

Thank you for re-submitting this proposal and for your response to the reviewers' comments.

I am pleased to inform you that full Chair's Approval has been given by Dr. Daqing Chen, on behalf of the School Engineering.

I wish you every success with your research.

Yours sincerely,

Daqing Chen, PhD
Chair, Research Ethics Coordinator
School of Engineering

London South Bank University

Direct line: 0207 815 7492
E-mail: seethics@lsbu.ac.uk
Ref: Eng 09Aug2016

Friday 12 May 2017

Dear Miss Zoe De Grussa

RE: The effect of Blinds and Shutters on Productivity in relation to Glare and Radiant Temperature within a working office.

Thank you for submitting the amendment to the proposal (Ref: Eng 09Aug2016).

I am pleased to inform you that full Chair's Approval has been given by Dr. Daqing Chen, on behalf of the School Engineering.

I wish you every success with your research.

Yours sincerely,

Daqing Chen, PhD
Chair, Research Ethics Coordinator
School of Engineering

APPENDIX B. DEVELOPMENT OF STUDY DESIGN (PILOT STUDIES)

B1. Design Requirements

The initial design requirements for the test battery were:

- Could be issued remotely and accessed on various devices e.g. computers/ laptops.
- Able to present customisable questionnaires, neurobehavioral and cognitive tests.
- Log and record accurate time, date, participant ID's and responses to questionnaires and tests that could be exported for analysis.
- Logging of data had to be secure and only accessible to the research team.

Inquisit Web software fulfilled the requirements for the test battery. Inquisit is a precision psychological testing tool which offers an extensive library of psychological testing paradigms based on coded scripts that are bespoke to the software. The coded scripts are open access and were customised for the outcomes of the research questions.

B1.1. Pilot Studies

To ensure the efficiency of the produced test battery two pilot tests were conducted. The first pilot test was conducted so direct user feedback could be given and observations could be made by the researcher. Whilst the second pilot test was used to confirm whether testing could be conducted remotely and to check data collection.

B1.2. Pilot Study 1

10 PhD students and academics at London South Bank University were recruited to trial the four isomorphic variations and so the base line test could be trialled twice. Seven of the ten participants could attend a group testing session conducted in a computer lab at London South Bank University. The remaining three participants were unavailable, so alternative times were arranged to complete the pilot on a 1:1 basis.

Before the participants started the test, they were given a participant number and briefed on the reasons for the pilot test. They were asked to read and follow the installation instructions for the Inquisit software to run and once completed they were asked to raise their hand and wait. Once the instruction sheet was issued the researcher noted any issues raised during the installation procedure and the time taken for the first and last participant to complete the installation process. When everyone had successfully installed the software, the participants were then asked to start the test and were reminded to read the

on-screen instructions fully before starting each test. The researcher recorded any issues/questions raised during the session, the time taken for the first and last participant to complete the test battery and made observations whilst the participants carried out the tasks. The subsequent 1:1 session was run in the same format but on different days and in differing locations.

The initial pilot study identified:

- Test instructions and the amount of text that participants were required to read needed to be reduced/improved, particularly before the Data Checking, Choice Reaction, Stroop and Working Memory Tests.
- Timings of the page transitions needed refinement.
- Data Checking task failed in testing due to a timing/transition error.
- Clothing questionnaire options were missing 'leggings' as an option.
- Confusion about of the term 'Eyes Smarting' within the health and well-being questionnaire
- Participants accidently skipped a 'page' of questions during the questionnaire.
- Presentation of the mood questionnaire meant that people missed/ forgot to answer the question in full.
- Conflict and clarity with the instructions for the Plus and Minus Task was needed. It was felt quite difficult because data needed to be written in the Work booklet and entered on the computer.
- On-screen page numbers didn't correspond with the booklet

Post testing the researcher reviewed the feedback from the participants and addressed the issues and concerns of the participants. A key change in the design of the test battery was to use animated images rather than texts to inform participants of how to carry out the tests.

B1.3. Pilot Study 2

This pilot was issued to 5 participants remotely and the participants conducted the test without the presence of the researcher in the room. This trialled the method that the test battery would be given to participants within the actual study and tested the improvements/changes made to the test battery including the incorporation of informative gifs.

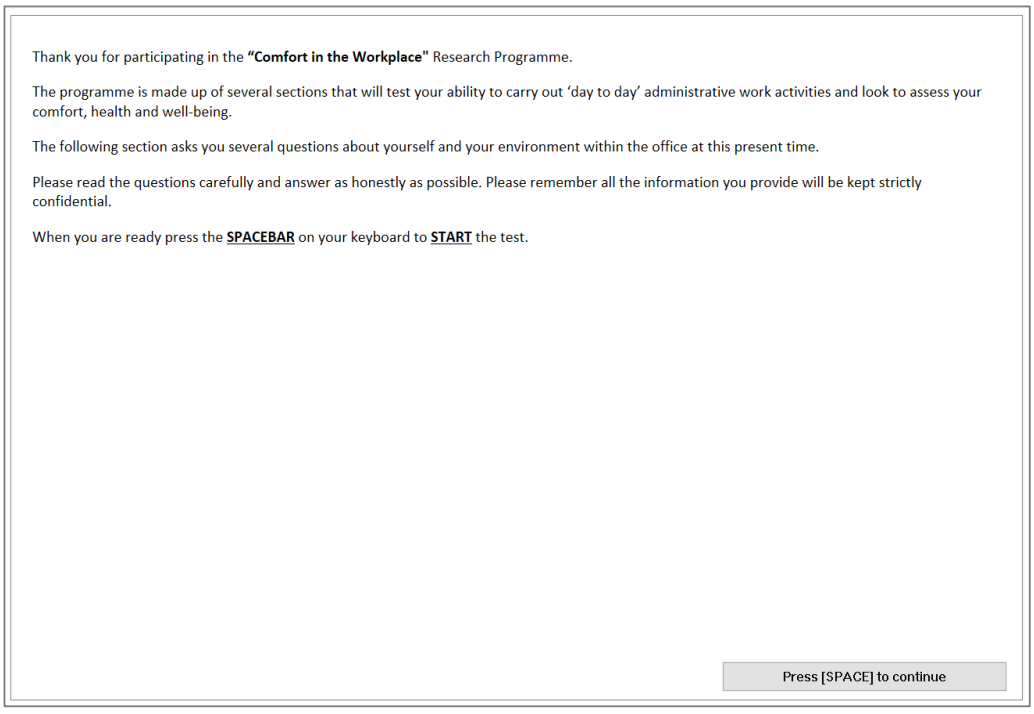
The key feedback given from the participants within the initial pilot study was the following:

- Font Size varied throughout the test battery.

- Spelling Errors.
- Number Search Test – On-screen timer was distracting whilst conducting the task.
- Inquisit did not record answers correctly for the Grammar Task.
- Didn't understand one of the Health and Well-being questions.

All the comments made were corrected or improved upon within the final version of the Test Battery. The final design of the on-screen test battery and booklet is presented in 0.

C1. Test Battery



1). At this time, how would you rate your overall comfort at your desk location?

Very Comfortable -3	Moderately Comfortable -2	Slightly Comfortable -1	Neutral 0	Slightly Uncomfortable +1	Moderately Uncomfortable +2	Very Uncomfortable +3

2). For a moment consider the environment you are working in, taking into account the lighting, temperature, air quality and level of sound you are experiencing at this time.

To what extent do you believe the environment is impacting your work productivity at this moment?

Not at All 0	Slightly +1	Moderately +2	Extensively +3

3). Are there any issues outside of work that may be affecting your productivity level at this moment?

○ Yes ○ Maybe ○ No

Continue

4). What clothing are you wearing today? (Select as many as appropriate)

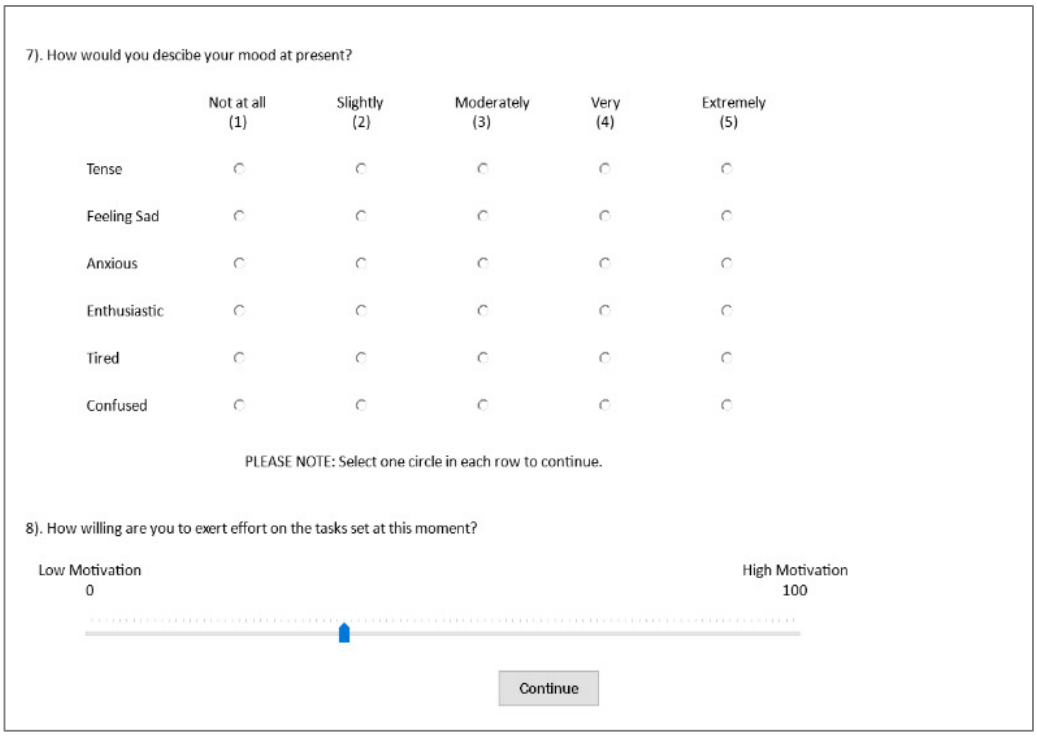
- ☐ Jeans
- ☐ Shorts
- ☐ Light Trousers/ Leggings
- ☐ Skirt
- ☐ Summer Dress
- ☐ T-Shirt
- ☐ Long Sleeved - Shirt
- ☐ Long Sleeved -Blouse
- ☐ Vest
- ☐ Jacket
- ☐ Jumper
- ☐ Cardigan
- ☐ Sandals/ Flip-Flops
- ☐ Trainers
- ☐ Shoes
- ☐ Socks

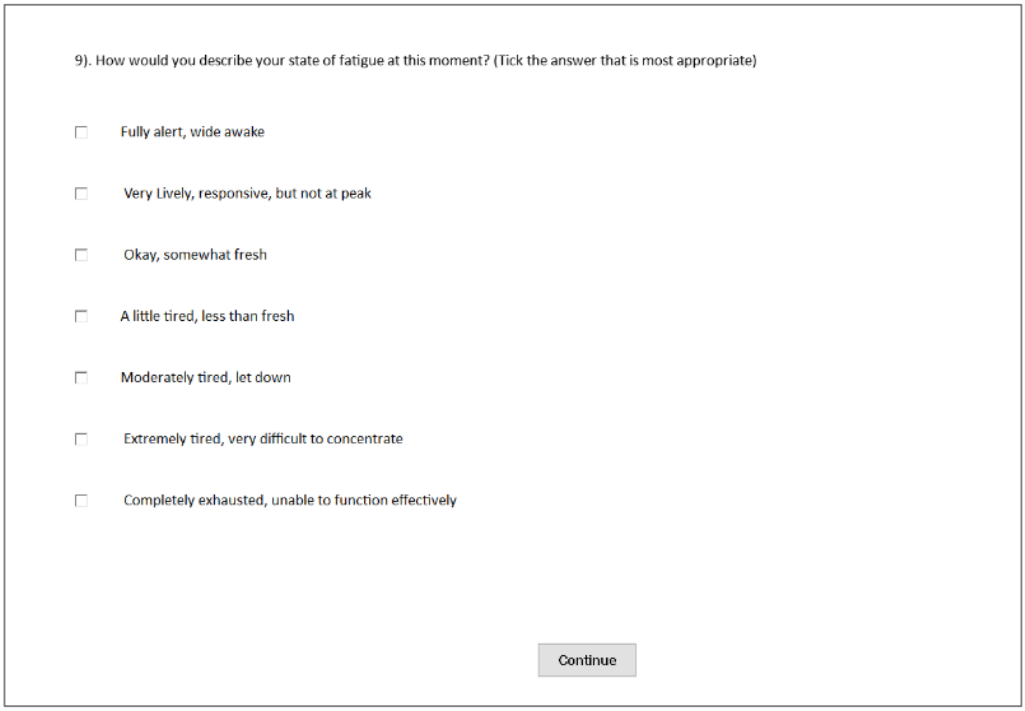
5). Are you wearing/using glasses or contact lenses?

○ Yes ○ No

6). How long have you been sitting at your desk location prior to starting the test?

○ Less than 10 Minutes ○ 10 - 30 Minutes ○ 31 - 60 Minutes


7). How would you descibe your mood at present?
Not at all (1)
Slightly (2)
Moderately (3)
Very (4)
Extremely (5)
Tense
Feeling Sad
Anxious
Enthusiastic
Tired
Confused
PLEASE NOTE: Select one circle in each row to continue.
8). How willing are you to exert effort on the tasks set at this moment?
Low Motivation
0
High Motivation
100
Continue


9). How would you describe your state of fatigue at this moment? (Tick the answer that is most appropriate)
Fully alert, wide awake
Very Lively, responsive, but not at peak
Okay, somewhat fresh
A little tired, less than fresh
Moderately tired, let down
Extremely tired, very difficult to concentrate
Completely exhausted, unable to function effectively
Continue

The following section includes three tests that replicate day to day activities. These include:

- Text Typing Test
- Arithmetic Test
- Data Entry/Checking Test

In order to complete the next tasks **YOU WILL NEED A PEN** and a **"Comfort in the Workplace" booklet**

Please now read the front of the booklet and complete the front page with your Participant Number and Location ID.

When you are ready, press the **SPACEBAR** on your keyboard to **START** the test.

Press [SPACE] to continue

Text Typing Test

The following task assesses your typing speed and accuracy. You will be asked to type up a section of text which is presented on Page 1 of the "Comfort in the Workplace" Booklet for one minute.

At the end of one minute the task will end.

Your performance will be assessed on the number of words that you accurately type within 1 minute. Try to type as quickly and accurately as you can.

Please be aware that you may not complete typing the paragraph within the time frame.

When you are ready **TURN** to **PAGE 1** of the booklet and **PREPARE** to type. Press the **SPACEBAR** on the keyboard to **START** the test.

Press [SPACE] to continue

00:59

Please type the text presented on Page 1 of the 'Comfort in the Workplace' Booklet in the box below.

If you finish before the time is up, please press the 'Finished Test' button:

Finished Test

Arithmetic Test

In the next test you will have to complete some addition and subtraction questions. There are 15 Questions on each page.

Follow these steps:

Step 6:
Click the **PAGE COMPLETE** button on-screen

Please write your answers in pen in the booklet.

When you are ready, press the **SPACEBAR** on your keyboard to **START** the test and turn to **PAGE 2** of your booklet.

Press [SPACE] to continue

Turn to Page 2 and answer the questions as quickly as possible.

When you have finished use your mouse to click the button below.

PAGE COMPLETE!

Turn to Page 3 and answer the questions as quickly as possible.

When you have finished use your mouse to click the button below.

PAGE COMPLETE!

Turn to Page 4 and answer the questions as quickly as possible.

When you have finished use your mouse to click the button below.

PAGE COMPLETE!

Data Entry Task

You will have three and a half minutes to complete 20 questions

Your task is to find any differences between the two lists presented in the "Comfort in the Workplace" Booklet – these are errors. You will compare the original list on the left hand-side to the list on the right within the "Comfort in the Workplace Booklet", checking that it has been transferred correctly from left to right.

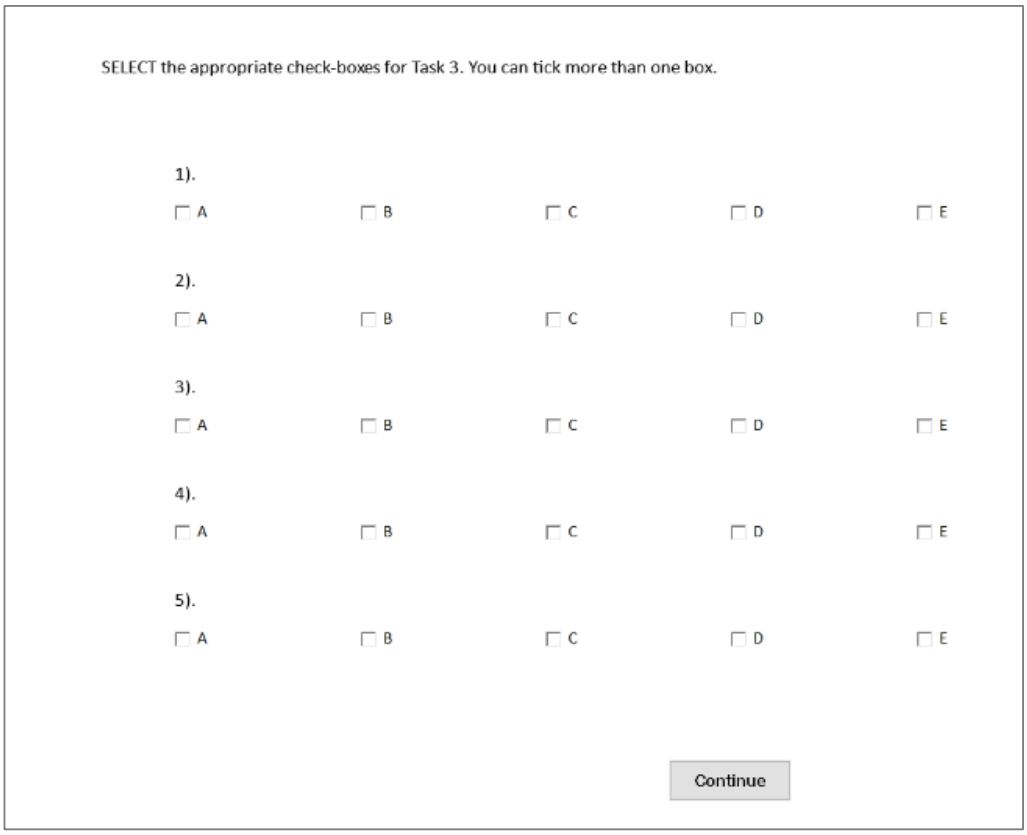
DO NOT mark the booklet but fill in the appropriate checkboxes on-screen according to the rules described at the top of the right hand page in the booklet.

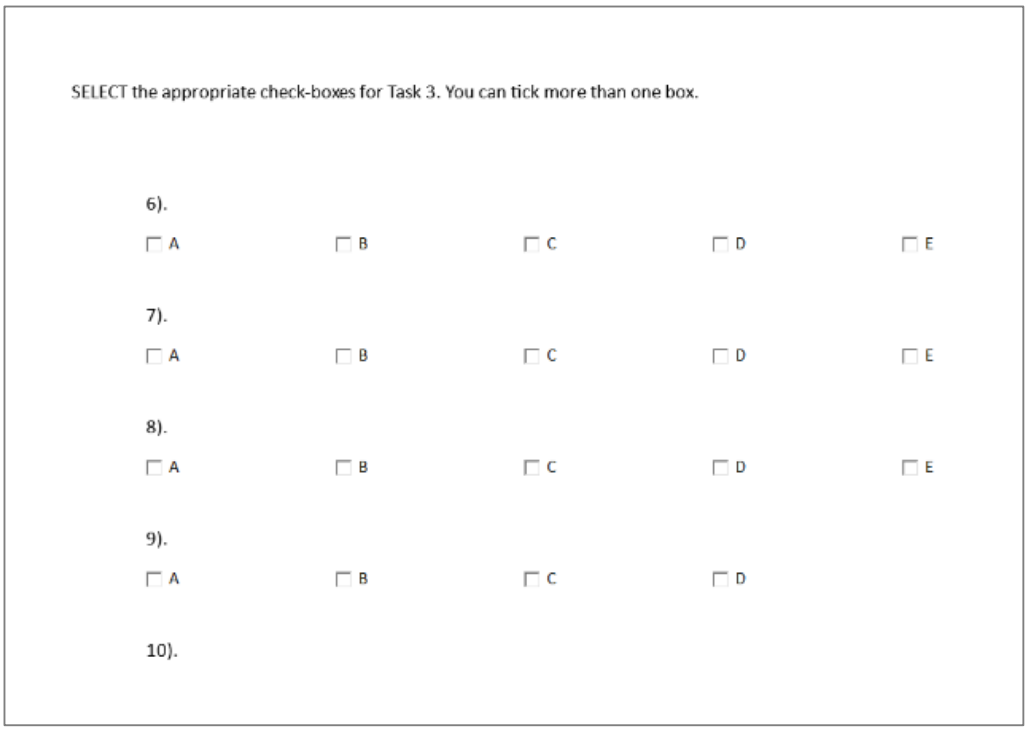
At the end of the three and half minutes the task will end and you will continue onto the next task. You may not finish all of the questions, but please try and complete as many as possible in the time given.

TURN to **PAGE 6 (Example)** to review an example of the activity before continuing.

When you have read the example, return to the on-screen instructions. Press the **SPACEBAR** and turn to **PAGE 8** to **START** the test.

Press [SPACE] to continue


SELECT the appropriate check-boxes for Task 3. You can tick more than one box.
1).
A
B
C
D
E
2).
A
B
C
D
E
3).
A
B
C
D
E
4).
A
B
C
D
E
5).
A
B
C
D
E
Continue


SELECT the appropriate check-boxes for Task 3. You can tick more than one box.
6).
A
B
C
D
E
7).
A
B
C
D
E
8).
A
B
C
D
E
9).
A
B
C
D
10).

SELECT the appropriate check-boxes for Task 3. You can tick more than one box.

11).

☐ A ☐ B ☐ C ☐ D ☐ E

12).

☐ A ☐ B ☐ C ☐ D ☐ E

13).

☐ A ☐ B ☐ C ☐ D ☐ E

14).

☐ A ☐ B ☐ C ☐ D ☐ E

15).

SELECT the appropriate check-boxes for Task 3. You can tick more than one box.

16).

☐ A ☐ B ☐ C ☐ D ☐ E

17).

☐ A ☐ B ☐ C ☐ D ☐ E

18).

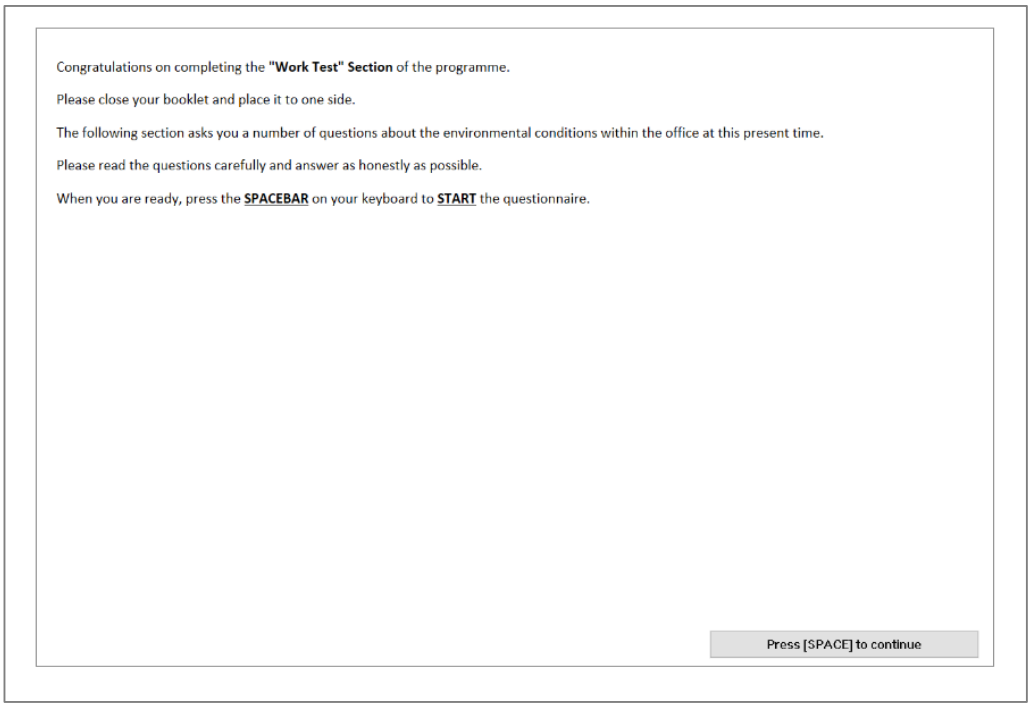
☐ A ☐ B ☐ C ☐ D ☐ E

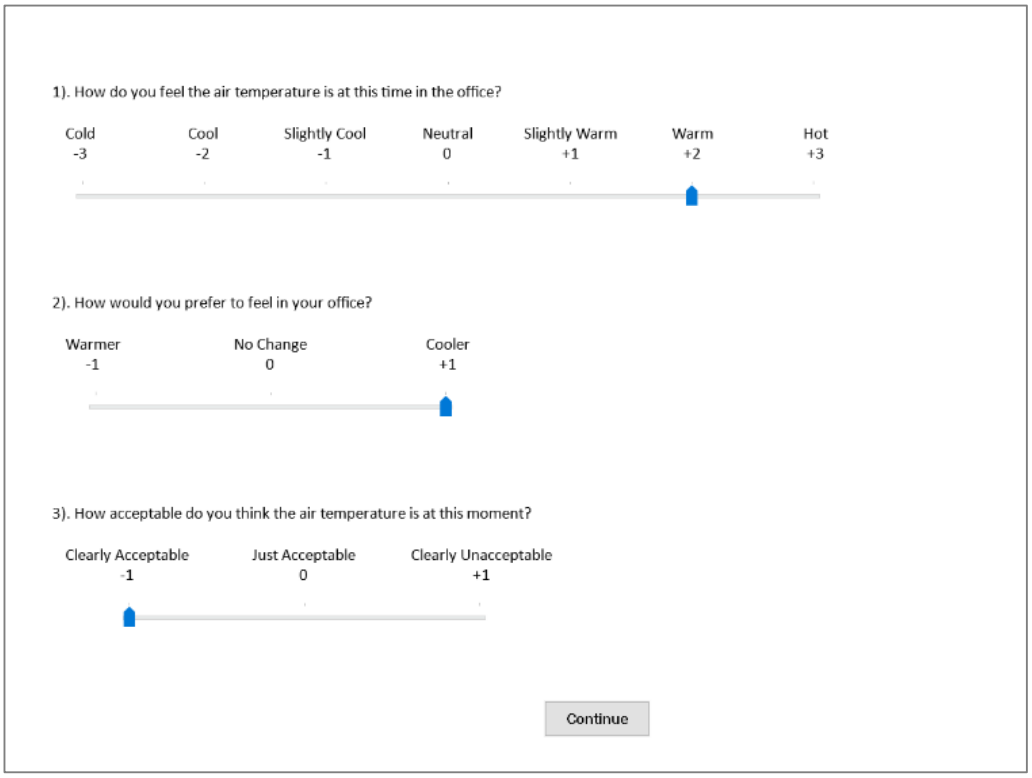
19).

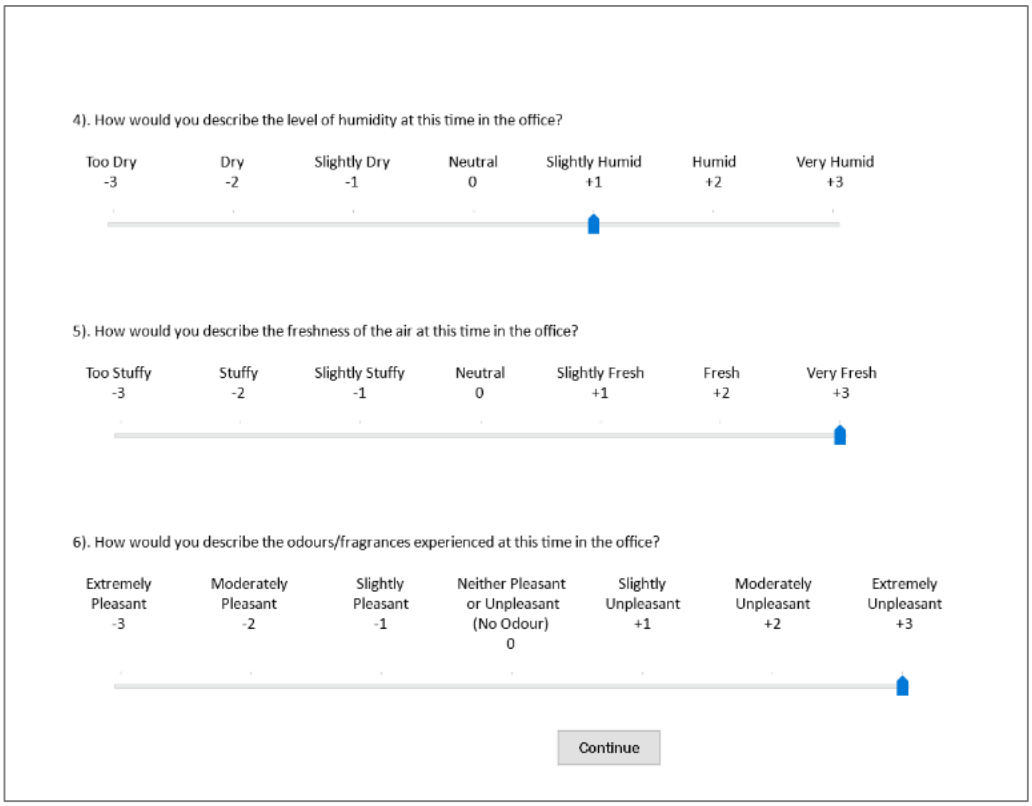
☐ A ☐ B ☐ C ☐ D ☐ E

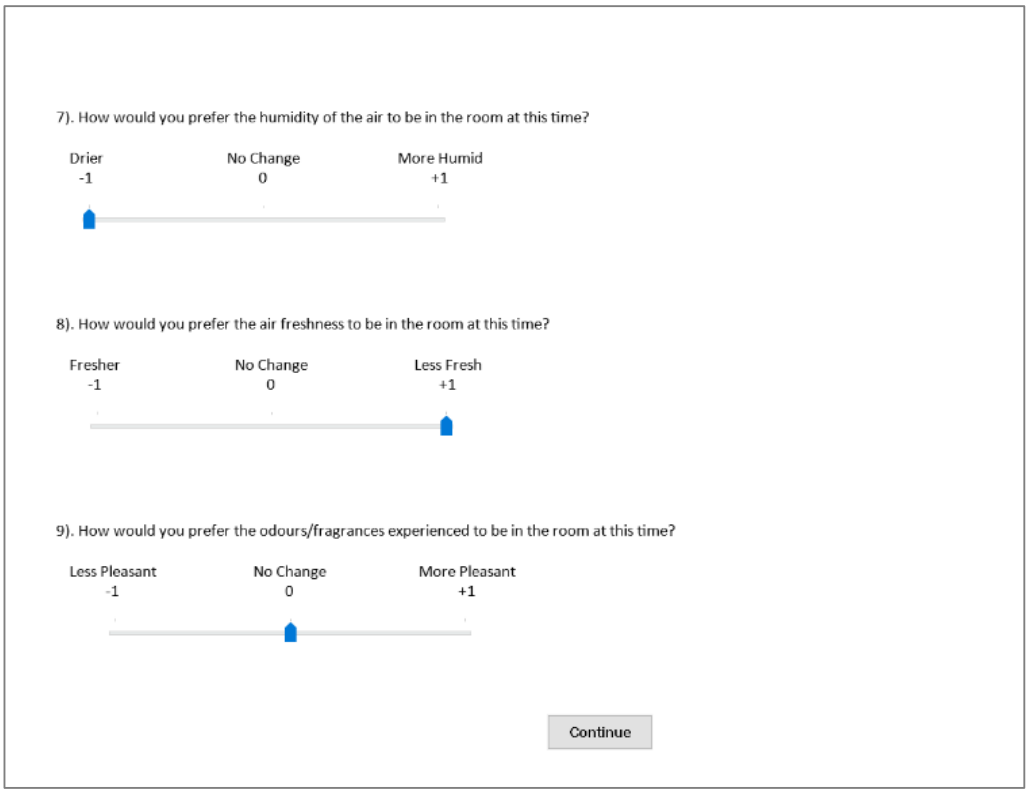
20).

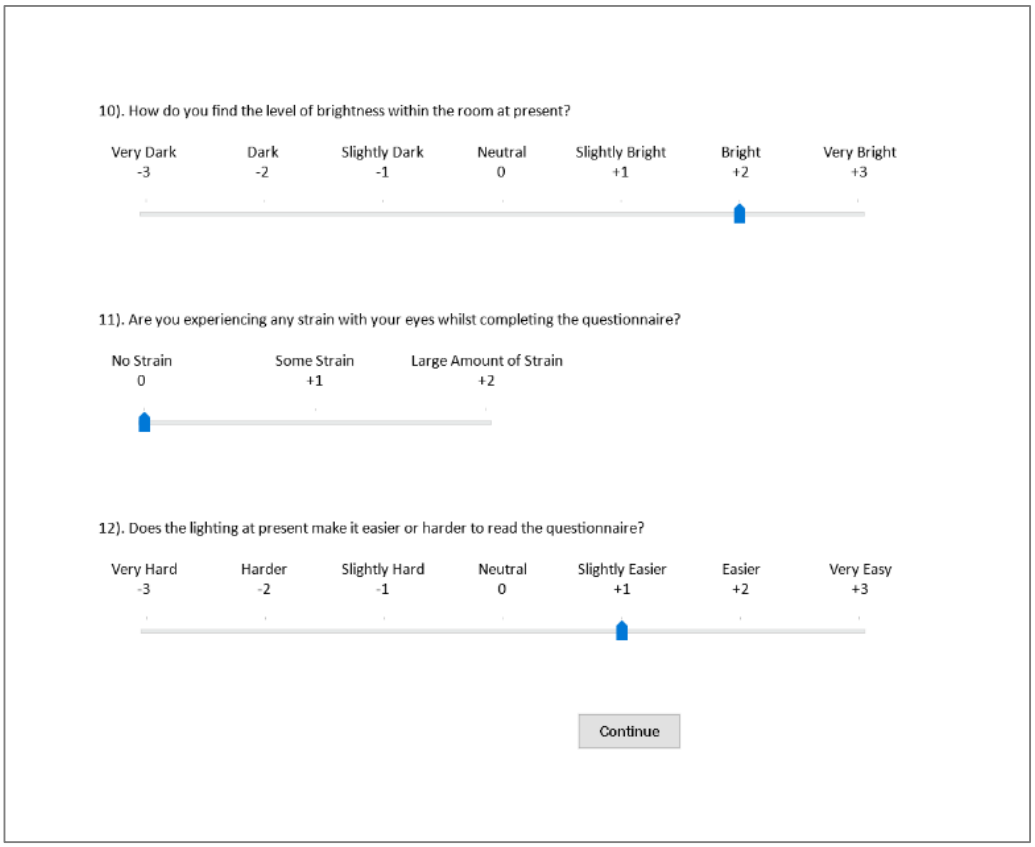
☐ A ☐ B ☐ C ☐ D ☐ E

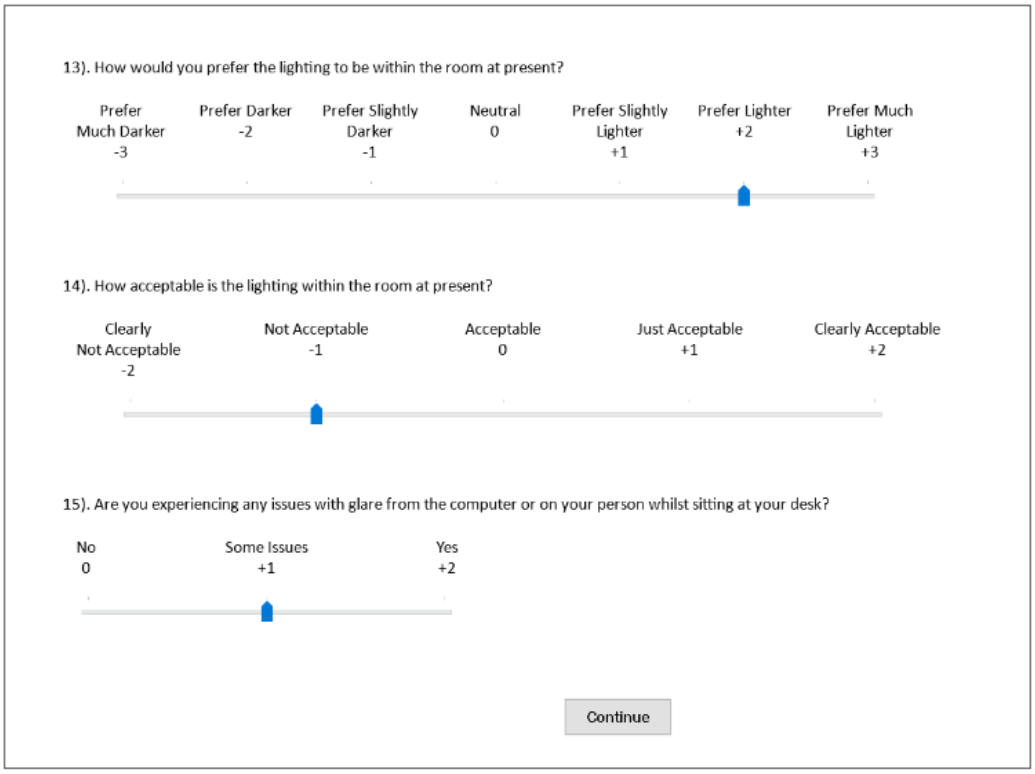

Congratulations on completing the "Work Test" Section of the programme.
Please close your booklet and place it to one side.
The following section asks you a number of questions about the environmental conditions within the office at this present time.
Please read the questions carefully and answer as honestly as possible.
When you are ready, press the SPACEBAR on your keyboard to START the questionnaire.
Press [SPACE] to continue

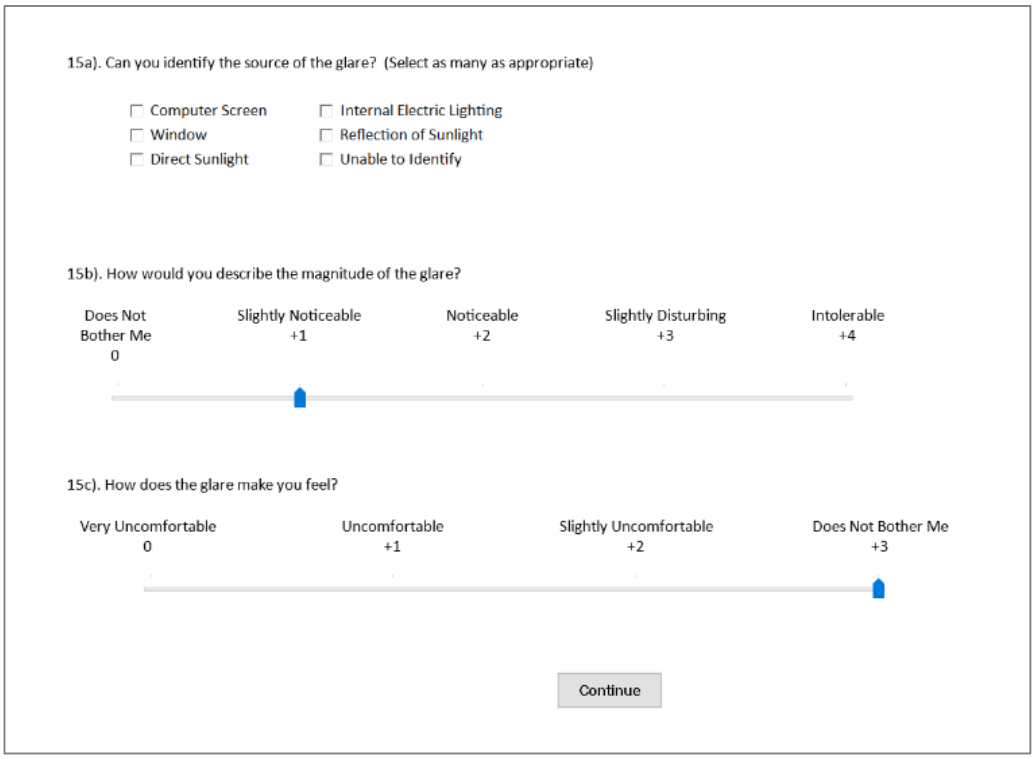

1). How do you feel the air temperature is at this time in the office?
Cold -3
Cool -2
Slightly Cool -1
Neutral 0
Slightly Warm +1
Warm +2
Hot +3
2). How would you prefer to feel in your office?
Warmer -1
No Change 0
Cooler +1
3). How acceptable do you think the air temperature is at this moment?
Clearly Acceptable -1
Just Acceptable 0
Clearly Unacceptable +1
Continue

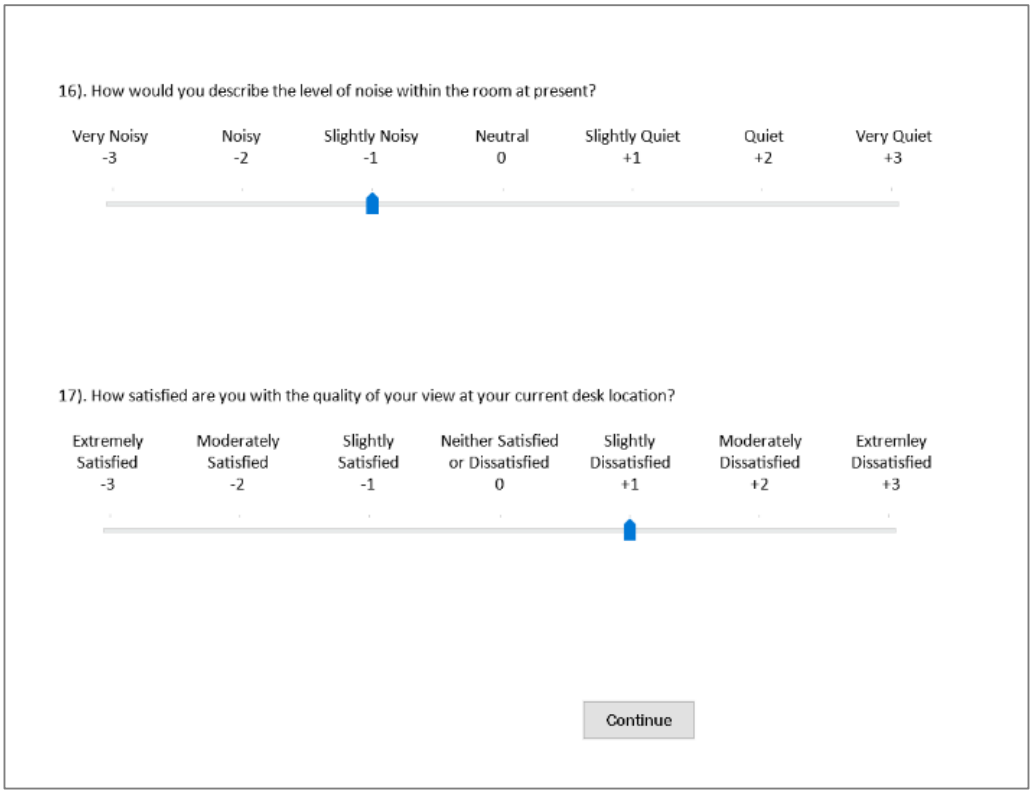

4). How would you describe the level of humidity at this time in the office?
Too Dry -3
Dry -2
Slightly Dry -1
Neutral 0
Slightly Humid +1
Humid +2
Very Humid +3
5). How would you describe the freshness of the air at this time in the office?
Too Stuffy -3
Stuffy -2
Slightly Stuffy -1
Neutral 0
Slightly Fresh +1
Fresh +2
Very Fresh +3
6). How would you describe the odours/fragrances experienced at this time in the office?
Extremely Pleasant -3
Moderately Pleasant -2
Slightly Pleasant -1
Neither Pleasant or Unpleasant (No Odour) 0
Slightly Unpleasant +1
Moderately Unpleasant +2
Extremely Unpleasant +3
Continue

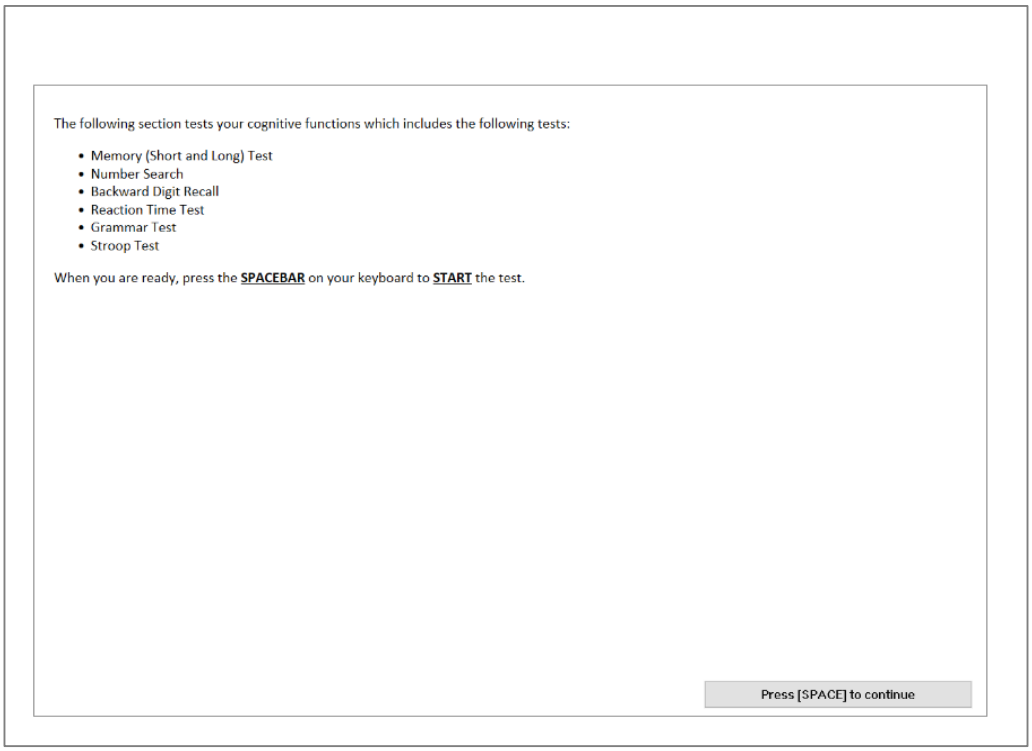

7). How would you prefer the humidity of the air to be in the room at this time?
Drier -1
No Change 0
More Humid +1
8). How would you prefer the air freshness to be in the room at this time?
Fresher -1
No Change 0
Less Fresh +1
9). How would you prefer the odours/fragrances experienced to be in the room at this time?
Less Pleasant -1
No Change 0
More Pleasant +1
Continue

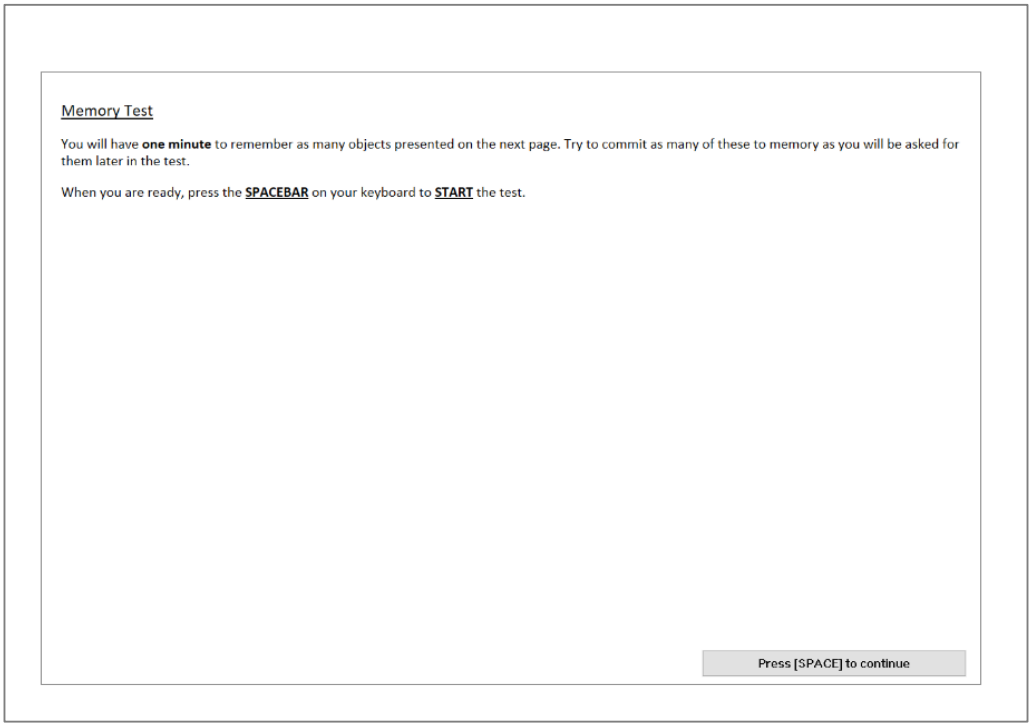

10). How do you find the level of brightness within the room at present?
Very Dark -3
Dark -2
Slightly Dark -1
Neutral 0
Slightly Bright +1
Bright +2
Very Bright +3
11). Are you experiencing any strain with your eyes whilst completing the questionnaire?
No Strain 0
Some Strain +1
Large Amount of Strain +2
12). Does the lighting at present make it easier or harder to read the questionnaire?
Very Hard -3
Harder -2
Slightly Hard -1
Neutral 0
Slightly Easier +1
Easier +2
Very Easy +3
Continue

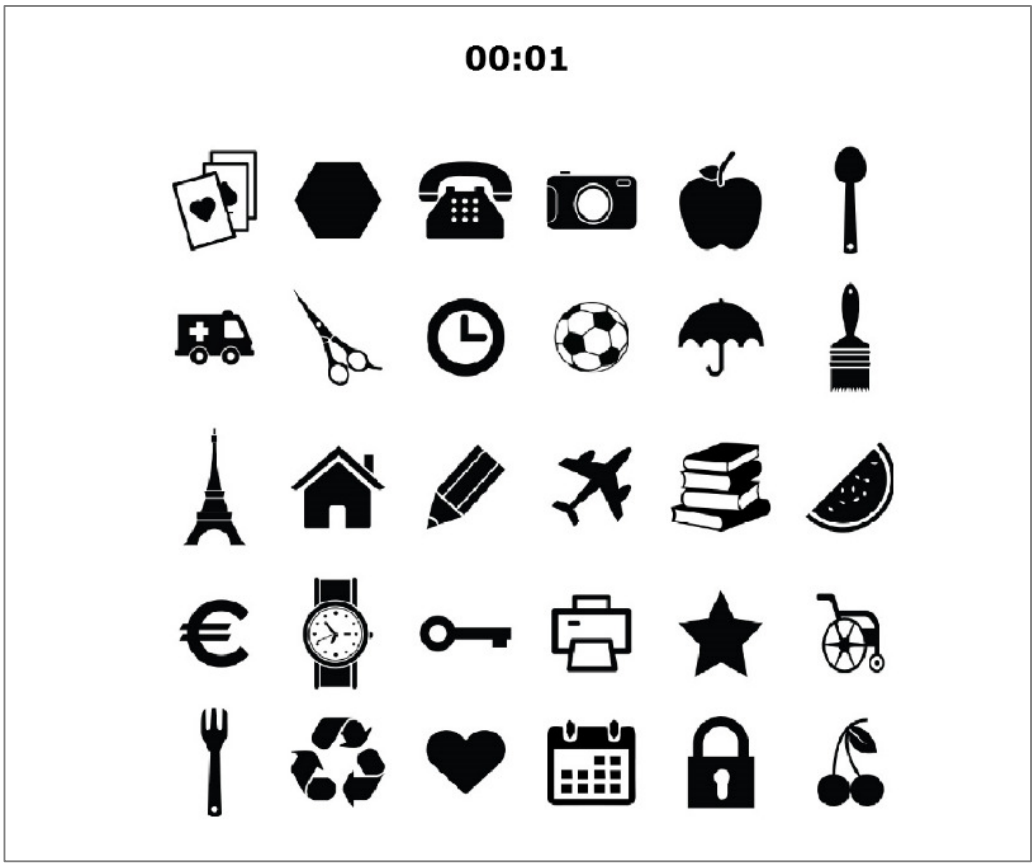

13). How would you prefer the lighting to be within the room at present?
Prefer Much Darker -3
Prefer Darker -2
Prefer Slightly Darker -1
Neutral 0
Prefer Slightly Lighter +1
Prefer Lighter +2
Prefer Much Lighter +3
14). How acceptable is the lighting within the room at present?
Clearly Not Acceptable -2
Not Acceptable -1
Acceptable 0
Just Acceptable +1
Clearly Acceptable +2
15). Are you experiencing any issues with glare from the computer or on your person whilst sitting at your desk?
No 0
Some Issues +1
Yes +2
Continue

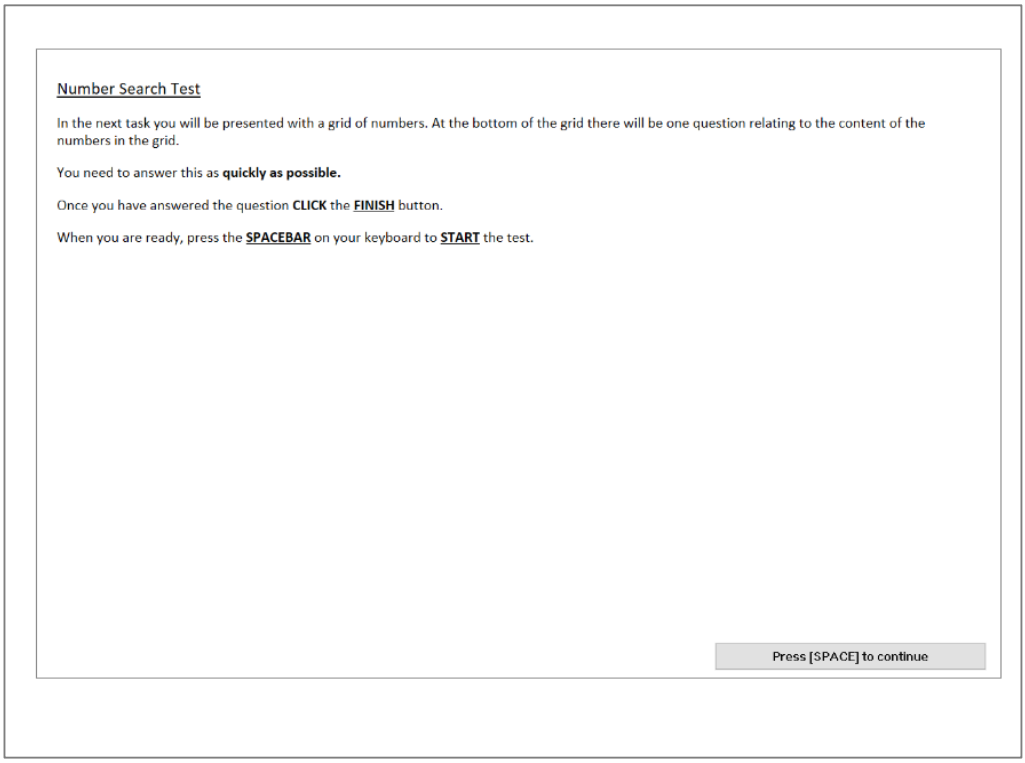

15a). Can you identify the source of the glare? (Select as many as appropriate)
Computer Screen
Window
Direct Sunlight
Internal Electric Lighting
Reflection of Sunlight
Unable to Identify
15b). How would you describe the magnitude of the glare?
Does Not Bother Me 0
Slightly Noticeable +1
Noticeable +2
Slightly Disturbing +3
Intolerable +4
15c). How does the glare make you feel?
Very Uncomfortable 0
Uncomfortable +1
Slightly Uncomfortable +2
Does Not Bother Me +3
Continue


16). How would you describe the level of noise within the room at present?
Very Noisy -3
Noisy -2
Slightly Noisy -1
Neutral 0
Slightly Quiet +1
Quiet +2
Very Quiet +3
17). How satisfied are you with the quality of your view at your current desk location?
Extremely Satisfied -3
Moderately Satisfied -2
Slightly Satisfied -1
Neither Satisfied or Dissatisfied 0
Slightly Dissatisfied +1
Moderately Dissatisfied +2
Extremley Dissatisfied +3
Continue


The following section tests your cognitive functions which includes the following tests:
• Memory (Short and Long) Test
• Number Search
• Backward Digit Recall
• Reaction Time Test
• Grammar Test
• Stroop Test
When you are ready, press the SPACEBAR on your keyboard to START the test.
Press [SPACE] to continue


Memory Test
You will have one minute to remember as many objects presented on the next page. Try to commit as many of these to memory as you will be asked for them later in the test.
When you are ready, press the SPACEBAR on your keyboard to START the test.
Press [SPACE] to continue


00:01


Number Search Test
In the next task you will be presented with a grid of numbers. At the bottom of the grid there will be one question relating to the content of the numbers in the grid.
You need to answer this as quickly as possible.
Once you have answered the question CLICK the FINISH button.
When you are ready, press the SPACEBAR on your keyboard to START the test.
Press [SPACE] to continue

Answer the question below as quickly as you can!

9	5	4	5	9	7	1	3
5	6	5	3	8	9	6	8
7	4	8	6	5	4	7	6
9	3	9	1	3	5	3	3
8	6	3	9	2	7	5	6
3	9	1	8	1	2	1	7
1	2	5	7	6	5	4	3
7	4	7	9	2	1	5	8

1). How many 9s are in the grid above?

Click to FINISH

Reaction Test

On the next screen you will see 4 black boxes in a row, after a short time one of the boxes will turn red. Your task is to press the corresponding key as quickly as possible.

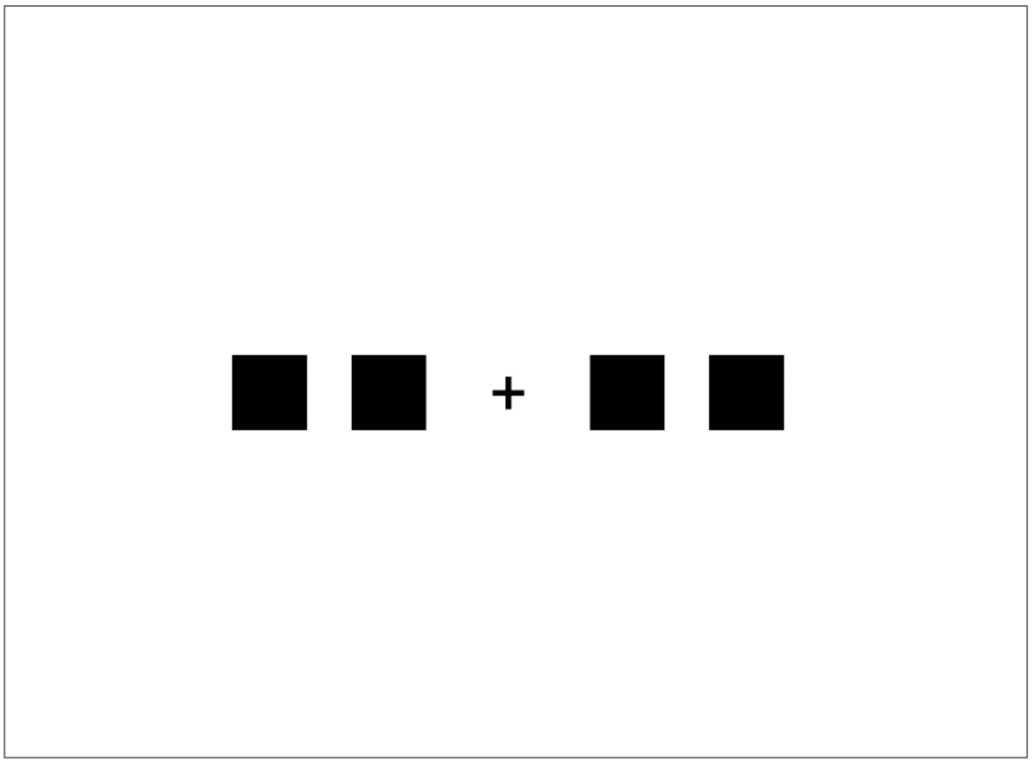
It is **IMPORTANT** that you place your MIDDLE AND INDEX fingers over the correct keys before the square changes colour.

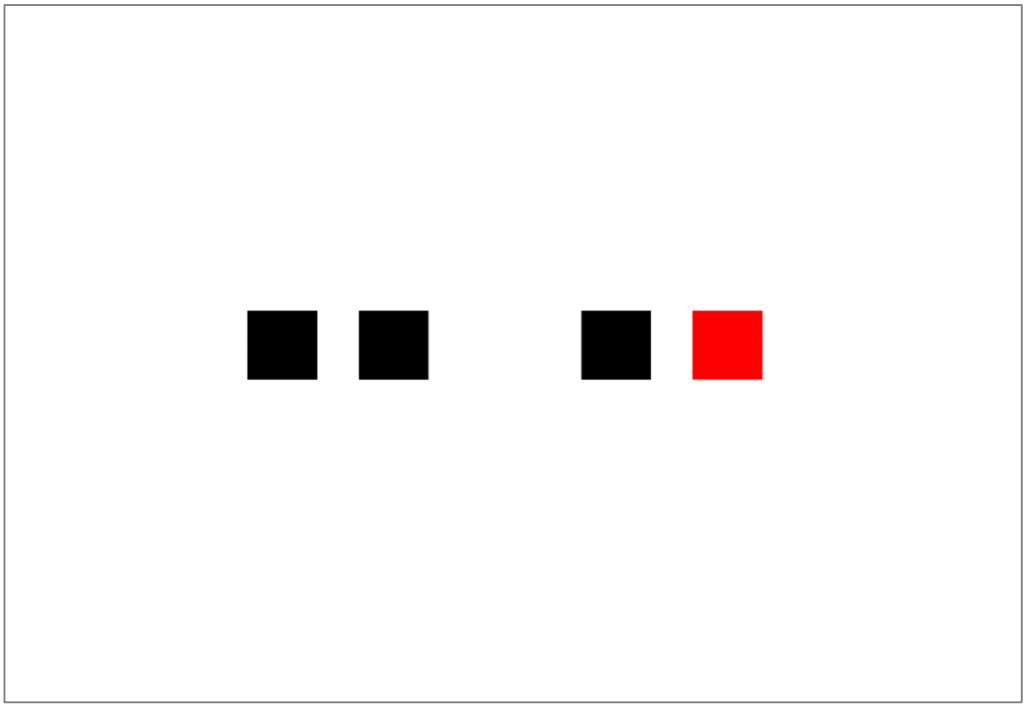
PRESS 2 when the box SECOND FROM LEFT turns RED.

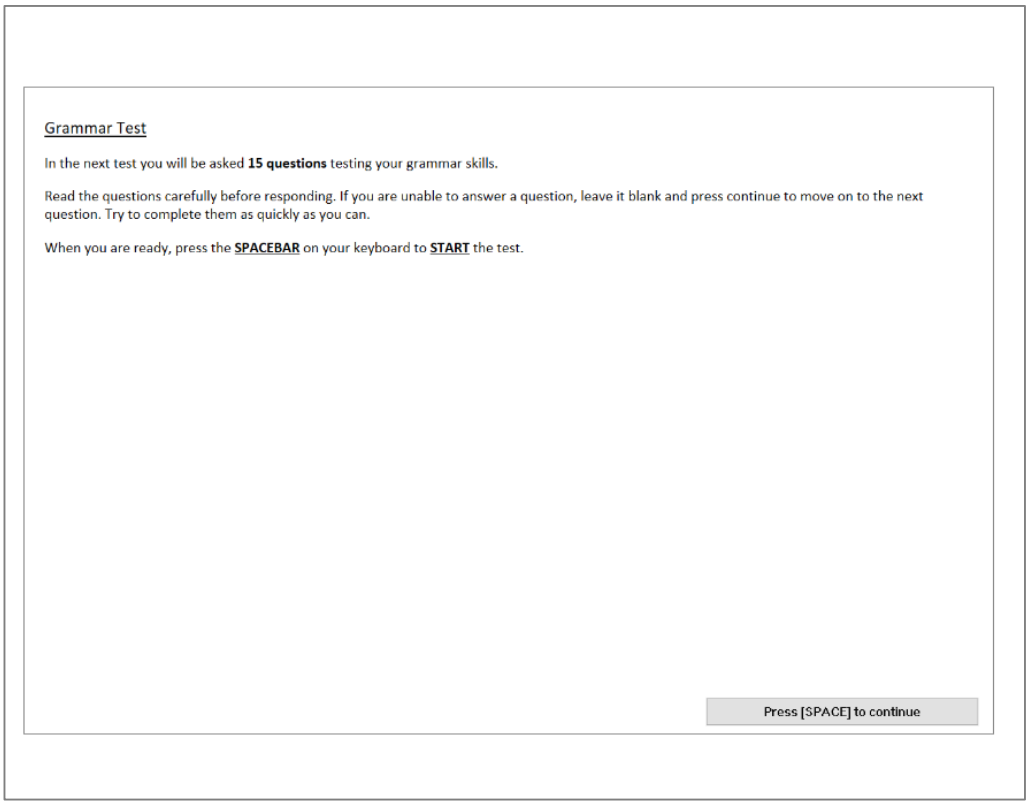
It is recorded as an **ERROR** if you press a key before the box turns red or if you hit the wrong key.

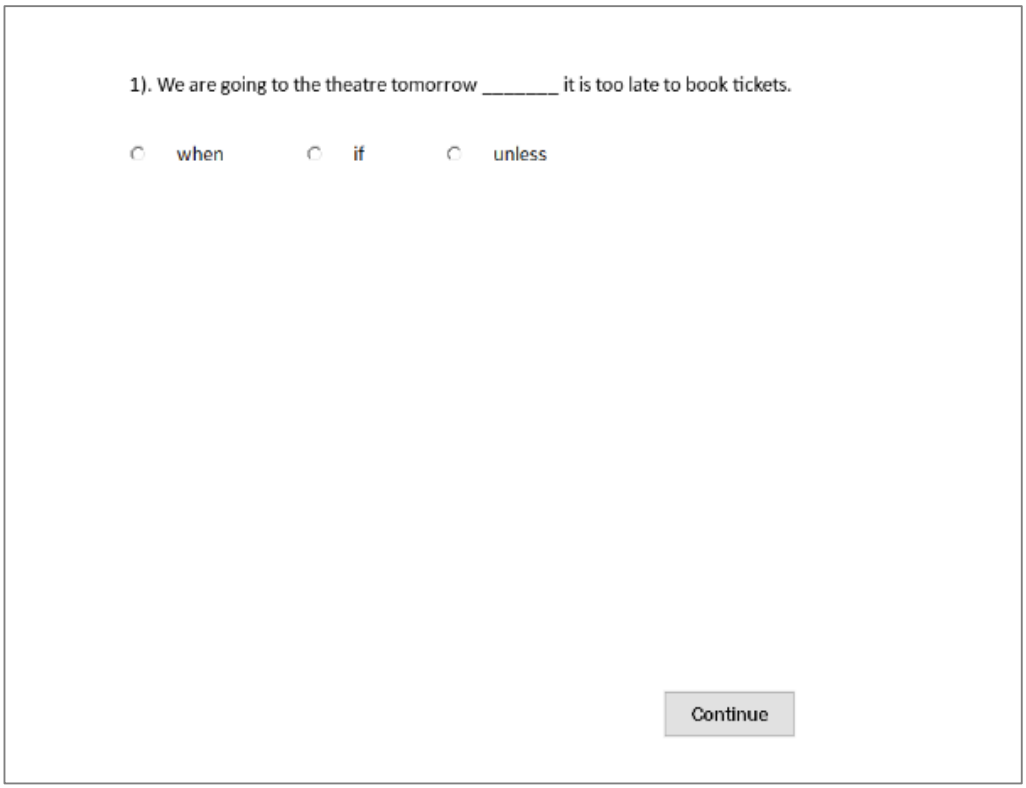
Try to respond as quickly as possible. When you are ready, press the **SPACEBAR** on your keyboard to **START** the test.

Press [SPACE] to continue






Grammar Test
In the next test you will be asked 15 questions testing your grammar skills.
Read the questions carefully before responding. If you are unable to answer a question, leave it blank and press continue to move on to the next question. Try to complete them as quickly as you can.
When you are ready, press the SPACEBAR on your keyboard to START the test.
Press [SPACE] to continue


1). We are going to the theatre tomorrow _____ it is too late to book tickets.
when
if
unless
Continue

2). I'm sorry, I _____ to get to change that money for you, I was too busy.

○ couldn't ○ didn't manage ○ weren't able

Continue

3). That's such a nice piece of furniture. I wish it _____ fit in my apartment.

○ was able ○ would ○ might

Continue

4). Your horse is _____ than ours.

○ much bigger ○ more bigger ○ so bigger

Continue

5). She _____ me Steve had lost his job.

○ said ○ told ○ say to

Continue

6). We used to meet at the bus stop because we weren't _____ to go to town on our own.

made allowed let

Continue

7). You _____ told me! I wouldn't have written to her if I'd known!

should've must've would've

Continue

8). You'll get overweight if you _____ so many snacks in the day!

○ ate ○ eaten ○ eat

Continue

9). _____ Pyrinees Mountain range separates France and Spain.

○ A ○ The ○ Them

Continue

10). I'm looking forward to my holiday! I _____ to spend the whole week on a boat!

○ will ○ 'm going ○ 'll go

Continue

11). I could talk to him but he doesn't come here often, _____ he?

○ does ○ doesn't ○ do

Continue

12). "That was a near miss." What part of speech is "near"?

- Noun
- Adjective
- Verb
- Adverb

Continue

13). What is the modal verb in this sentence?

"It might be a good idea to ring up and check what time it starts."

- ring
- might
- starts
- check

Continue

14). What is the progressive past tense of 'it drizzles'?

- It drizzled
- It has drizzled
- It had drizzled
- It was drizzling

Continue

15). "This is nowhere near good enough." What part of speech is "nowhere"?

- adjective
- adverb qualifying an adjective
- adverb qualify an adverb
- adverb

Continue

Stroop Test

In the following test you will see words and shapes presented in different colours. Your task is to indicate the **COLOUR** in which each word or shape is presented in while ignoring what the words actually say and what the shape is.

Indicate the colour of the word or shape by pressing either of the following:

Press 2 when the WORD or SHAPE is GREEN

Example: If you see the word **RED** printed in the colour **BLUE**, press '9' for blue regardless of the meaning of the word.

Try to respond as quickly and accurately as you can, because you will be timed.

Position your fingers above the appropriate keys on the keyboard. When you are ready, press the **SPACEBAR** on your keyboard to **START** the test.

Press [SPACE] to continue

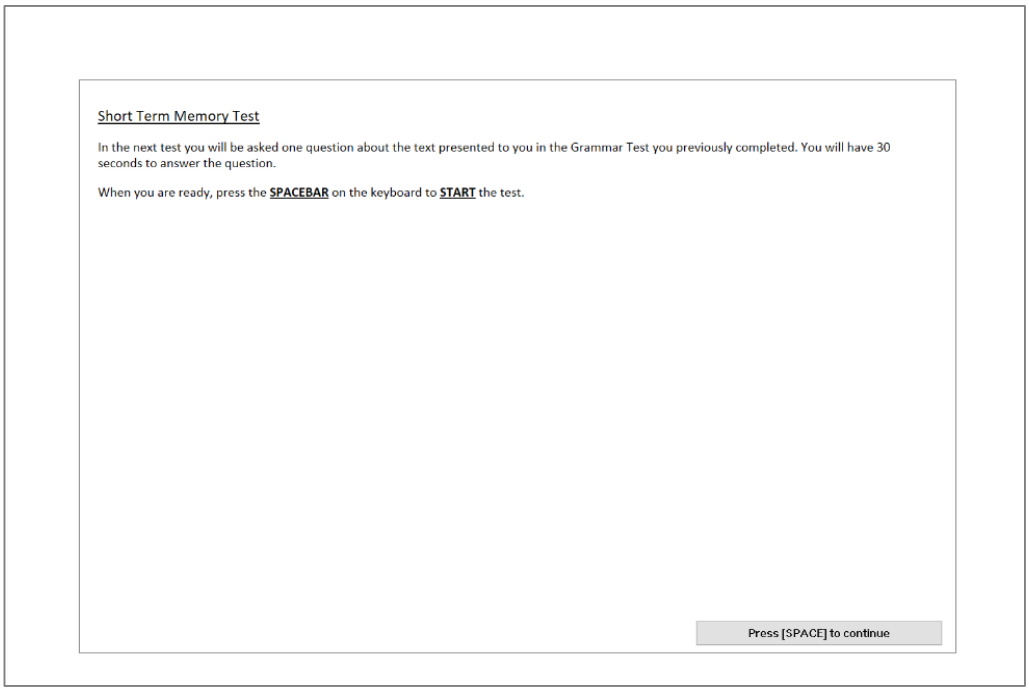
1 = red 2 = green 9 = blue 0 = black

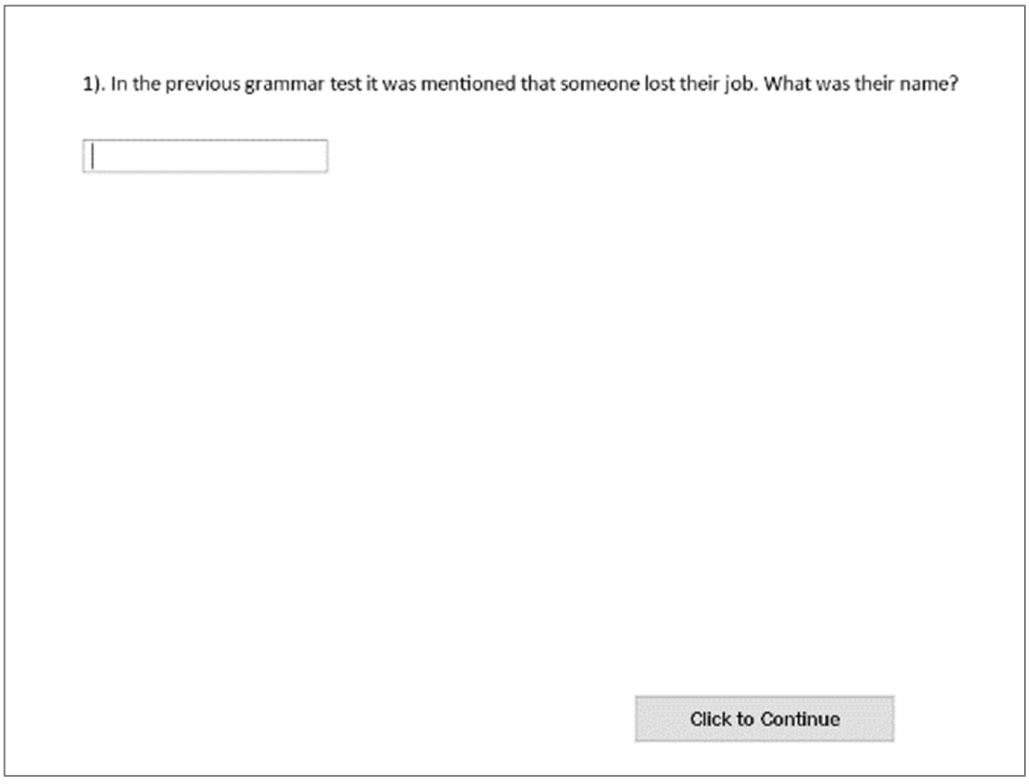
1 = red 2 = green 9 = blue 0 = black

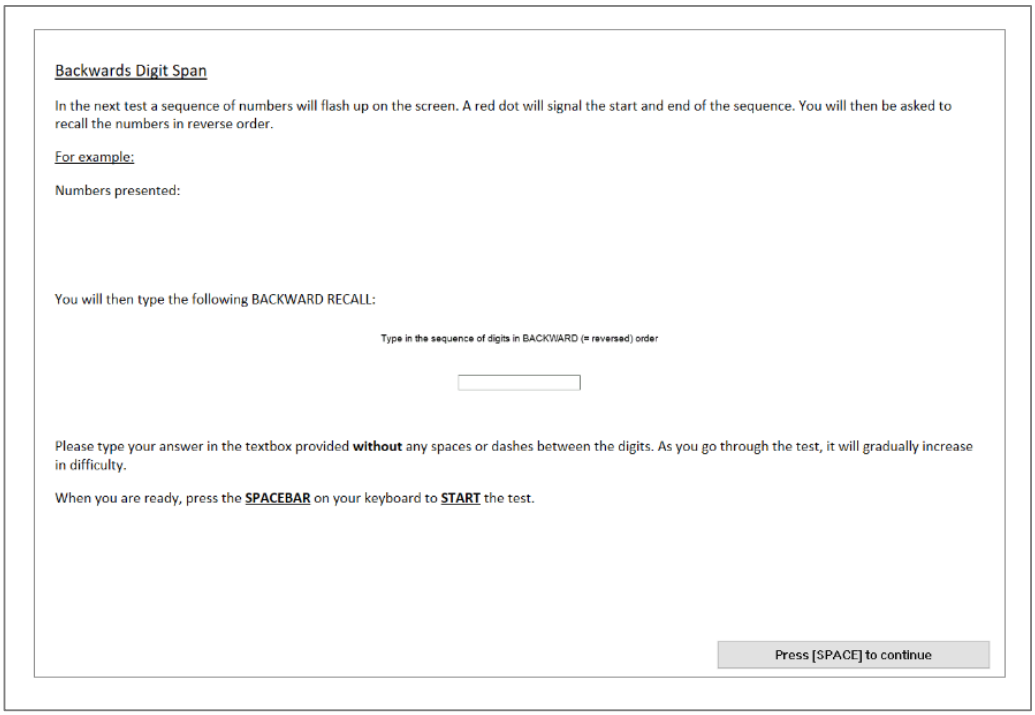
black

1 = red 2 = green 9 = blue 0 = black

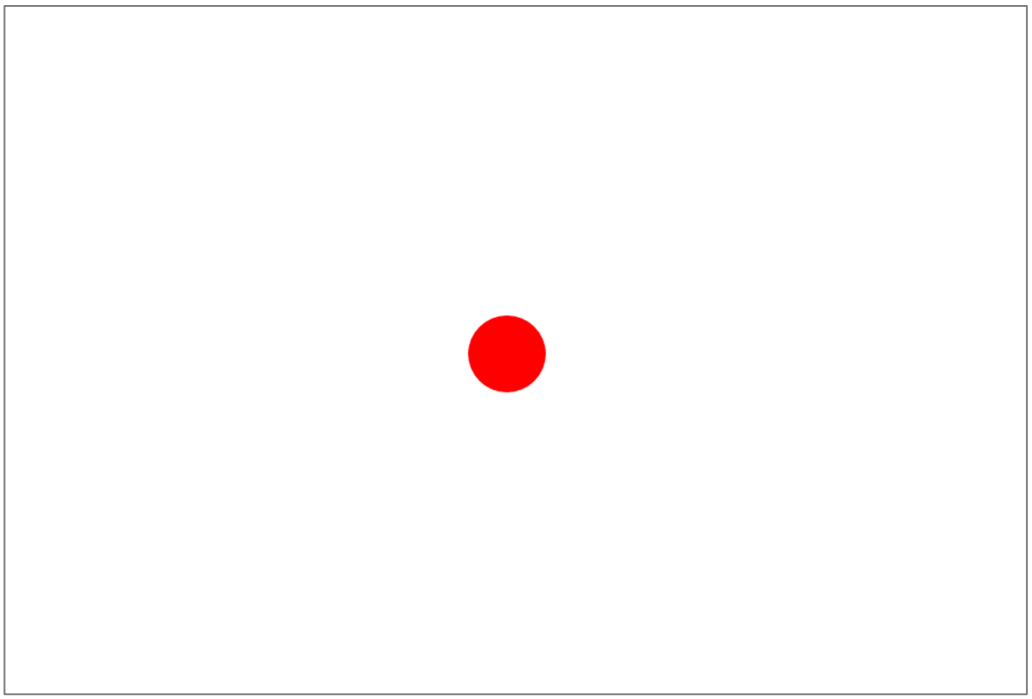
red


Short Term Memory Test
In the next test you will be asked one question about the text presented to you in the Grammar Test you previously completed. You will have 30 seconds to answer the question.
When you are ready, press the SPACEBAR on the keyboard to START the test.
Press [SPACE] to continue


1). In the previous grammar test it was mentioned that someone lost their job. What was their name?
Click to Continue


Backwards Digit Span
In the next test a sequence of numbers will flash up on the screen. A red dot will signal the start and end of the sequence. You will then be asked to recall the numbers in reverse order.
For example:
Numbers presented:
You will then type the following BACKWARD RECALL:
Type in the sequence of digits in BACKWARD (= reversed) order
Please type your answer in the textbox provided without any spaces or dashes between the digits. As you go through the test, it will gradually increase in difficulty.
When you are ready, press the SPACEBAR on your keyboard to START the test.
Press [SPACE] to continue

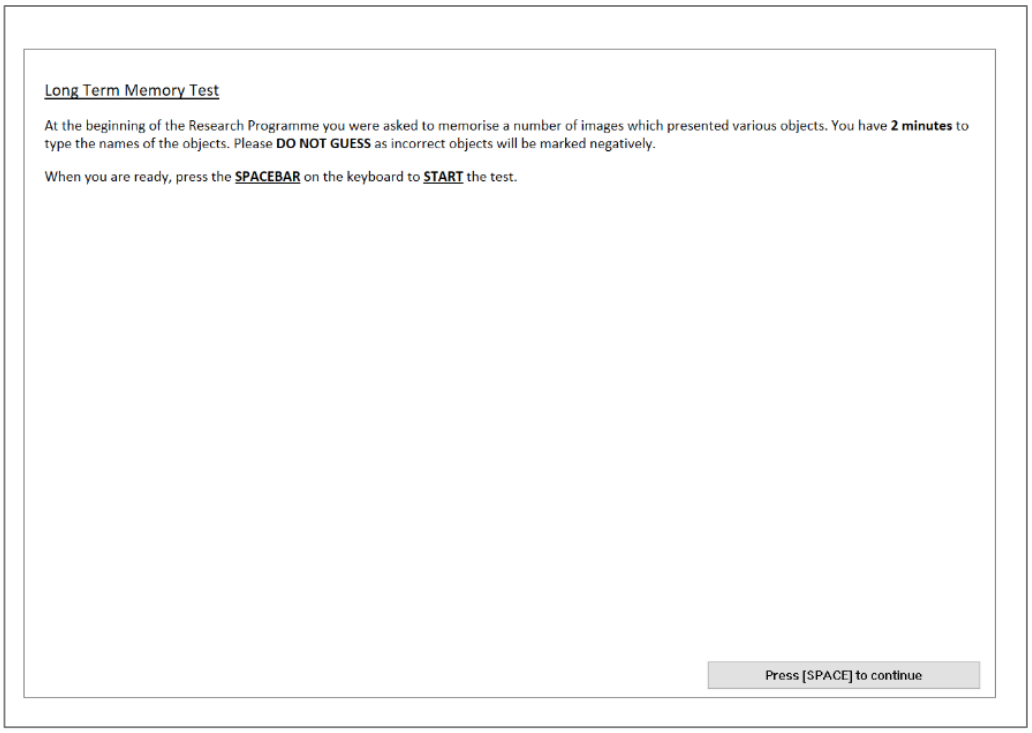

4

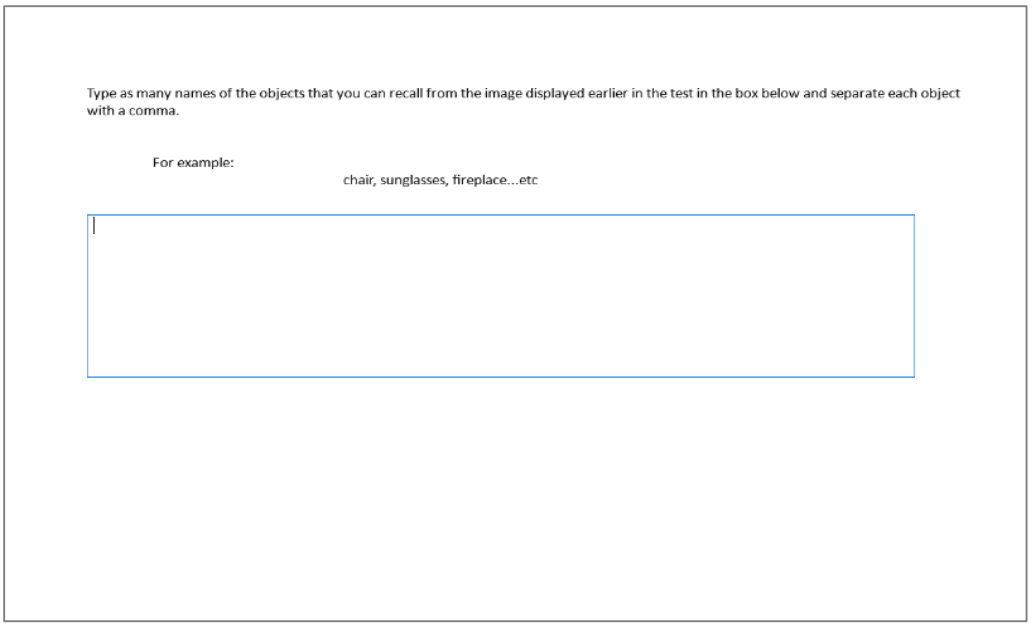


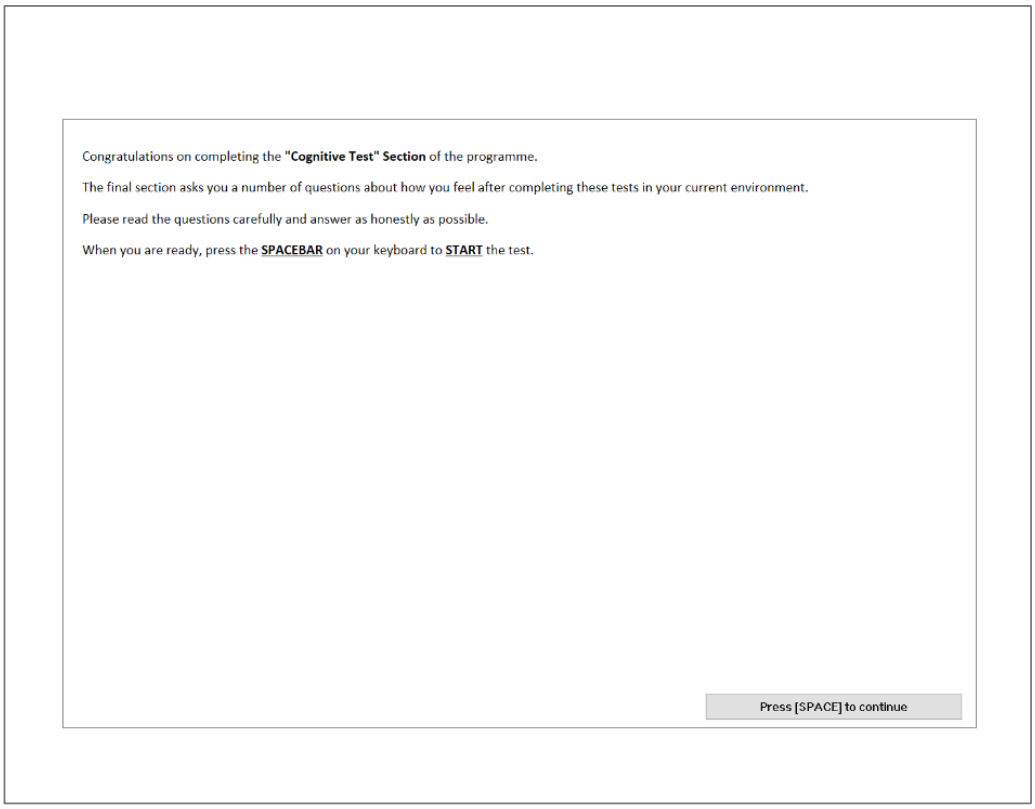
You have reached the end of the Backward Digit Span Test.

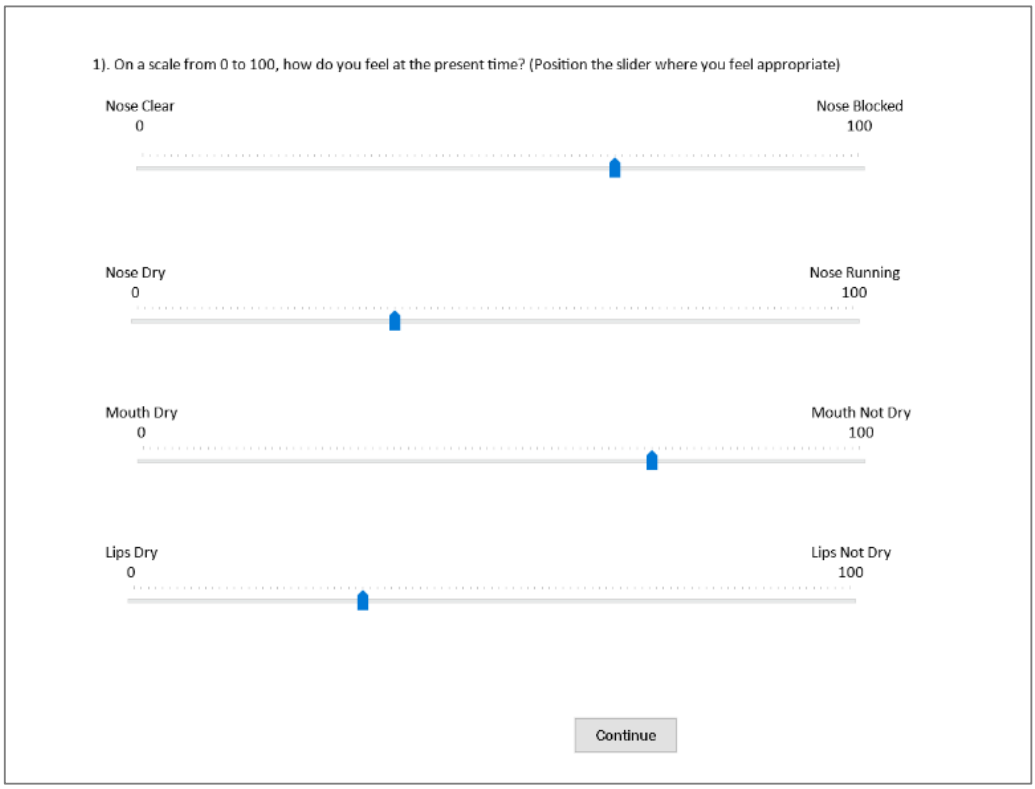
You recalled 0 digits correctly.

The next test will start shortly.

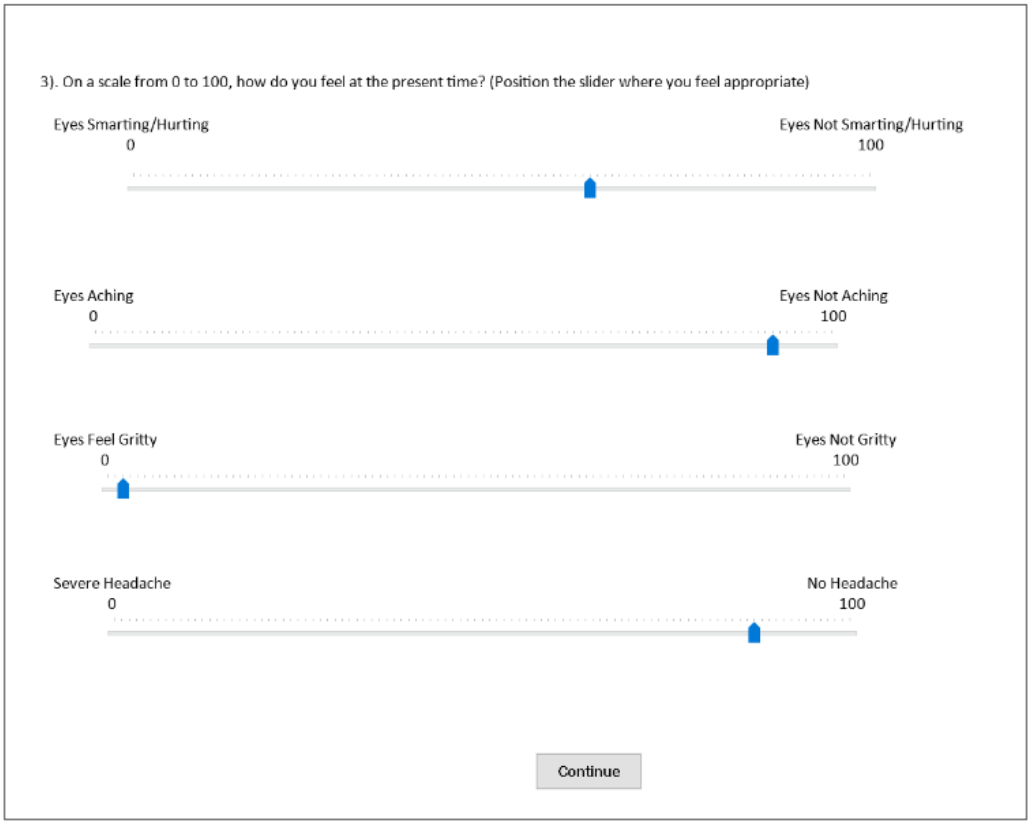

Long Term Memory Test
At the beginning of the Research Programme you were asked to memorise a number of images which presented various objects. You have **2 minutes** to type the names of the objects. Please **DO NOT GUESS** as incorrect objects will be marked negatively.
When you are ready, press the **SPACEBAR** on the keyboard to **START** the test.
Press [SPACE] to continue

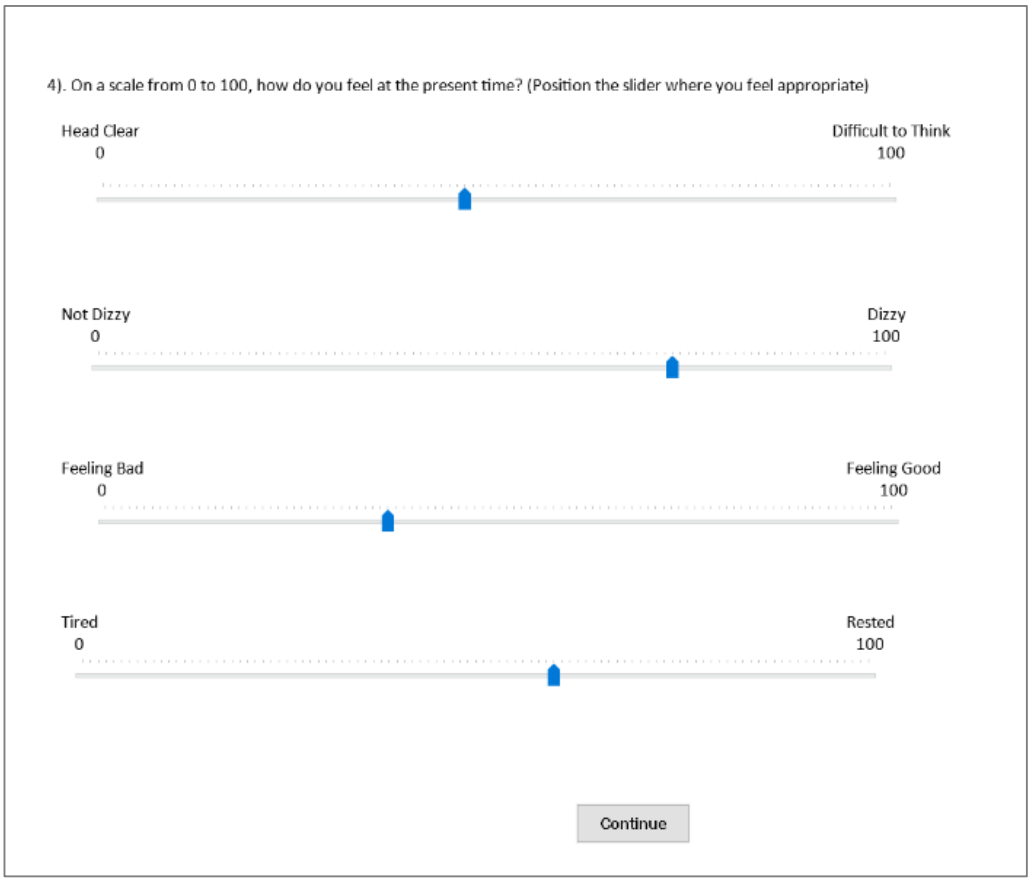

Type as many names of the objects that you can recall from the image displayed earlier in the test in the box below and separate each object with a comma.
For example:
chair, sunglasses, fireplace...etc

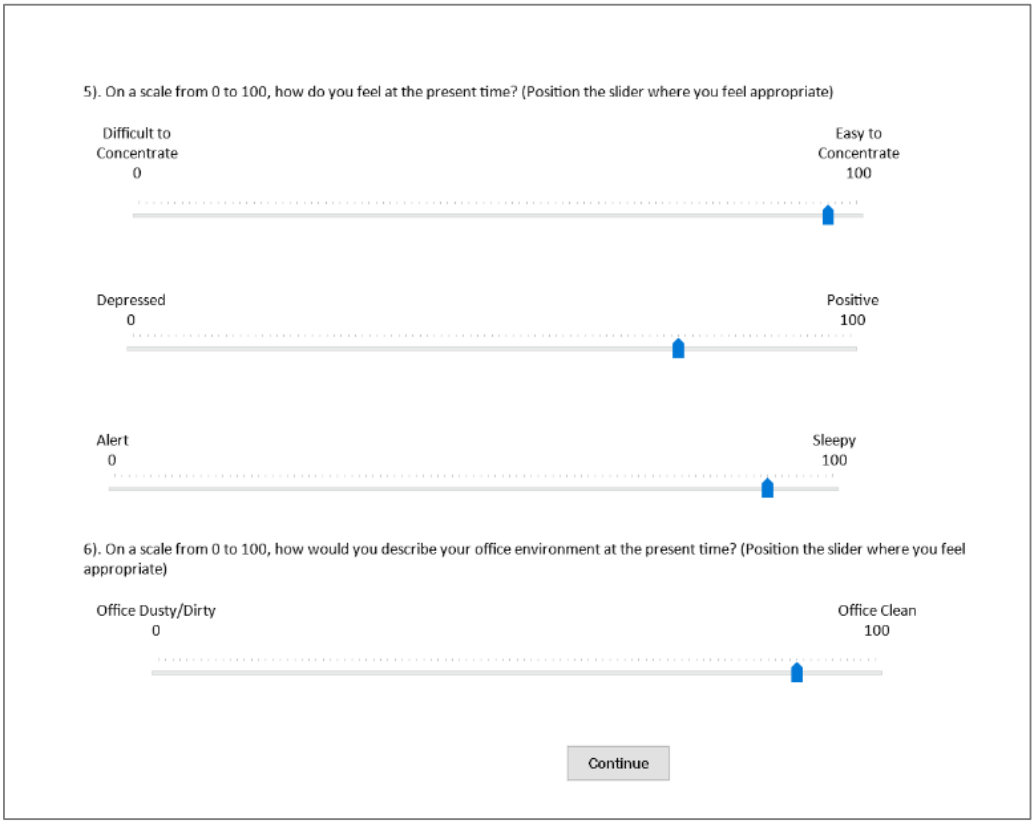

Congratulations on completing the "Cognitive Test" Section of the programme.
The final section asks you a number of questions about how you feel after completing these tests in your current environment.
Please read the questions carefully and answer as honestly as possible.
When you are ready, press the SPACEBAR on your keyboard to START the test.
Press [SPACE] to continue

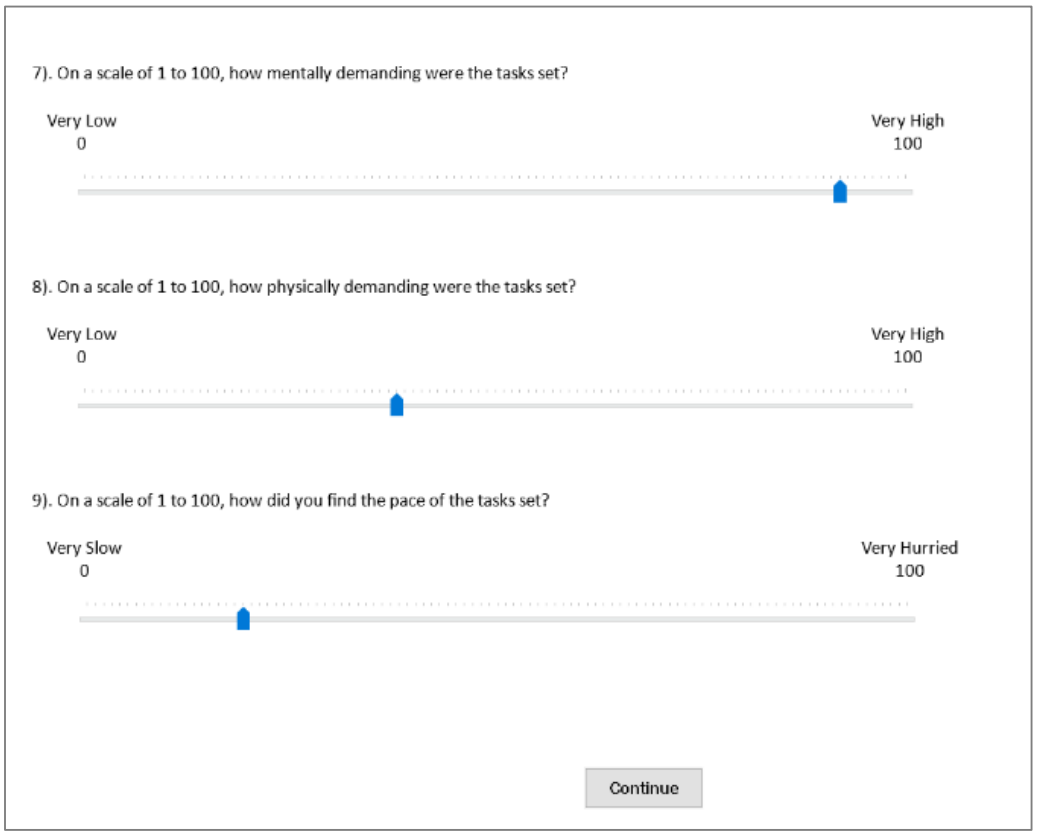

1). On a scale from 0 to 100, how do you feel at the present time? (Position the slider where you feel appropriate)
Nose Clear
0
Nose Blocked
100
Nose Dry
0
Nose Running
100
Mouth Dry
0
Mouth Not Dry
100
Lips Dry
0
Lips Not Dry
100
Continue

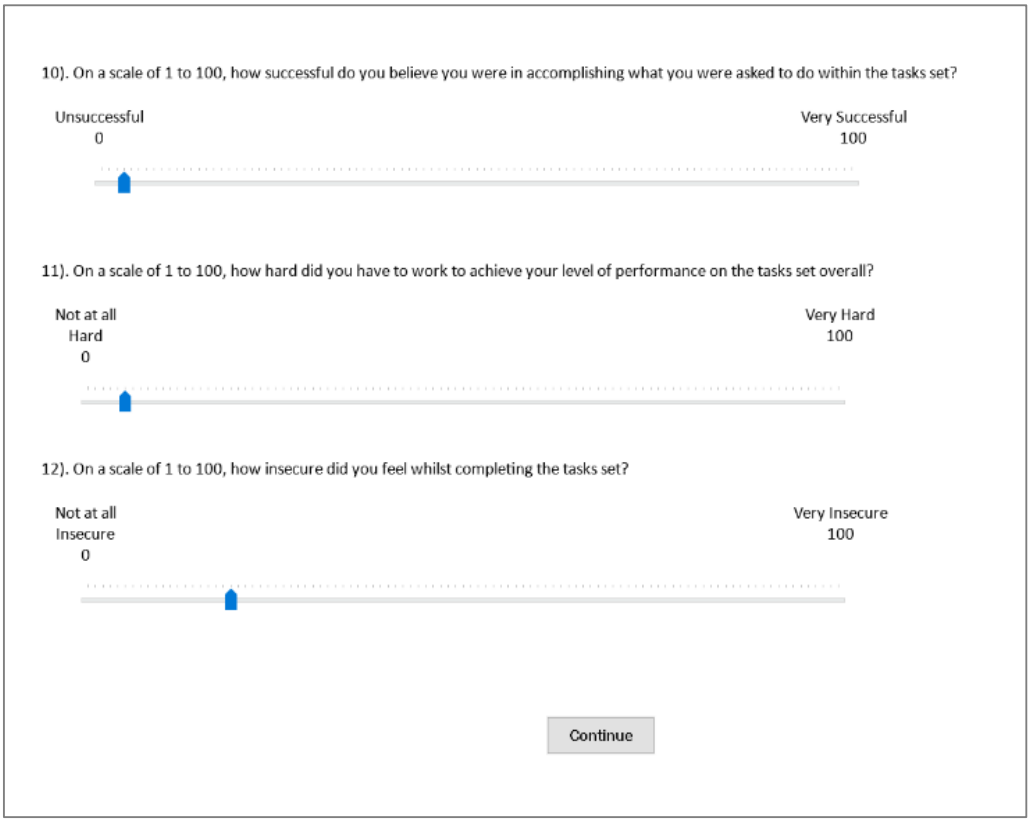

2). On a scale from 0 to 100, how do you feel at the present time? (Position the slider where you feel appropriate)
Skin Dry
0
Skin Moist
100
Hair
Dry/Brittle
0
Hair Not
Dry/Brittle
100
Nails Brittle
0
Nails Supple
100
Eyes Dry
0
Eyes Not Dry
100
Continue

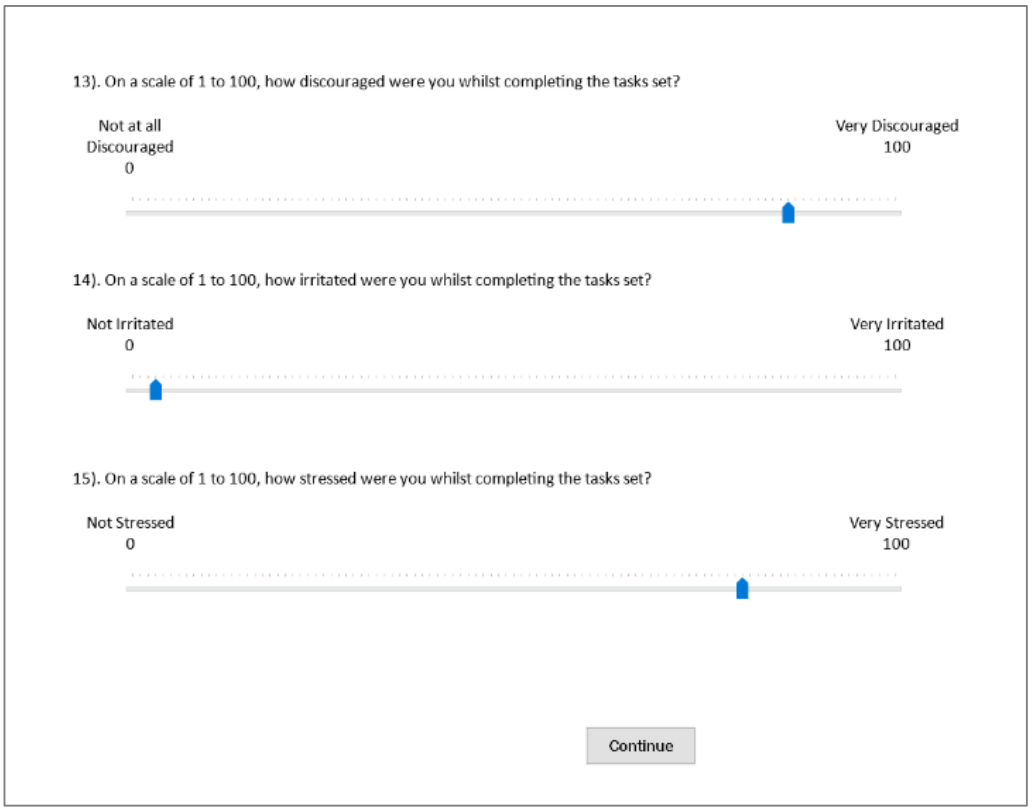

3). On a scale from 0 to 100, how do you feel at the present time? (Position the slider where you feel appropriate)
Eyes Smarting/Hurting
0
Eyes Not Smarting/Hurting
100
Eyes Aching
0
Eyes Not Aching
100
Eyes Feel Gritty
0
Eyes Not Gritty
100
Severe Headache
0
No Headache
100
Continue

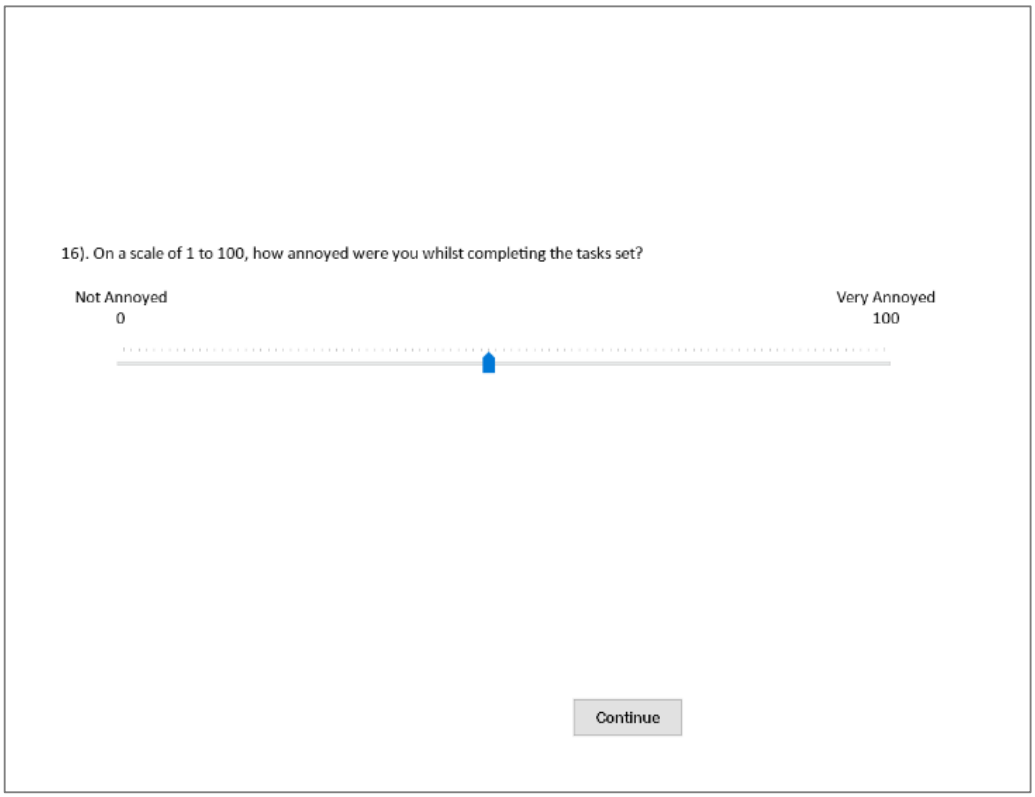

4). On a scale from 0 to 100, how do you feel at the present time? (Position the slider where you feel appropriate)
Head Clear
0
Difficult to Think
100
Not Dizzy
0
Dizzy
100
Feeling Bad
0
Feeling Good
100
Tired
0
Rested
100
Continue


5). On a scale from 0 to 100, how do you feel at the present time? (Position the slider where you feel appropriate)
Difficult to Concentrate
0
Easy to Concentrate
100
Depressed
0
Positive
100
Alert
0
Sleepy
100
6). On a scale from 0 to 100, how would you describe your office environment at the present time? (Position the slider where you feel appropriate)
Office Dusty/Dirty
0
Office Clean
100
Continue


7). On a scale of 1 to 100, how mentally demanding were the tasks set?
Very Low
0
Very High
100
8). On a scale of 1 to 100, how physically demanding were the tasks set?
Very Low
0
Very High
100
9). On a scale of 1 to 100, how did you find the pace of the tasks set?
Very Slow
0
Very Hurried
100
Continue


10). On a scale of 1 to 100, how successful do you believe you were in accomplishing what you were asked to do within the tasks set?
Unsuccessful
0
Very Successful
100
11). On a scale of 1 to 100, how hard did you have to work to achieve your level of performance on the tasks set overall?
Not at all
Hard
0
Very Hard
100
12). On a scale of 1 to 100, how insecure did you feel whilst completing the tasks set?
Not at all
Insecure
0
Very Insecure
100
Continue


13). On a scale of 1 to 100, how discouraged were you whilst completing the tasks set?
Not at all Discouraged
0
Very Discouraged
100
14). On a scale of 1 to 100, how irritated were you whilst completing the tasks set?
Not Irritated
0
Very Irritated
100
15). On a scale of 1 to 100, how stressed were you whilst completing the tasks set?
Not Stressed
0
Very Stressed
100
Continue


16). On a scale of 1 to 100, how annoyed were you whilst completing the tasks set?
Not Annoyed
0
Very Annoyed
100
Continue

Thank you for your participation in the "Comfort in the Workplace" Research Programme. We greatly appreciate your co-operation.

Please **keep noise to a minimum** whilst your colleagues finish the test.

Please **check** you have completed the front of the booklet appropriately and place your answer booklet in the tray provided in your office. The researcher will come and collect them before the end of the day.

The programme will close down shortly. **Once everyone has completed the test you will be sent an email. At which point you will be free to to do the following:**

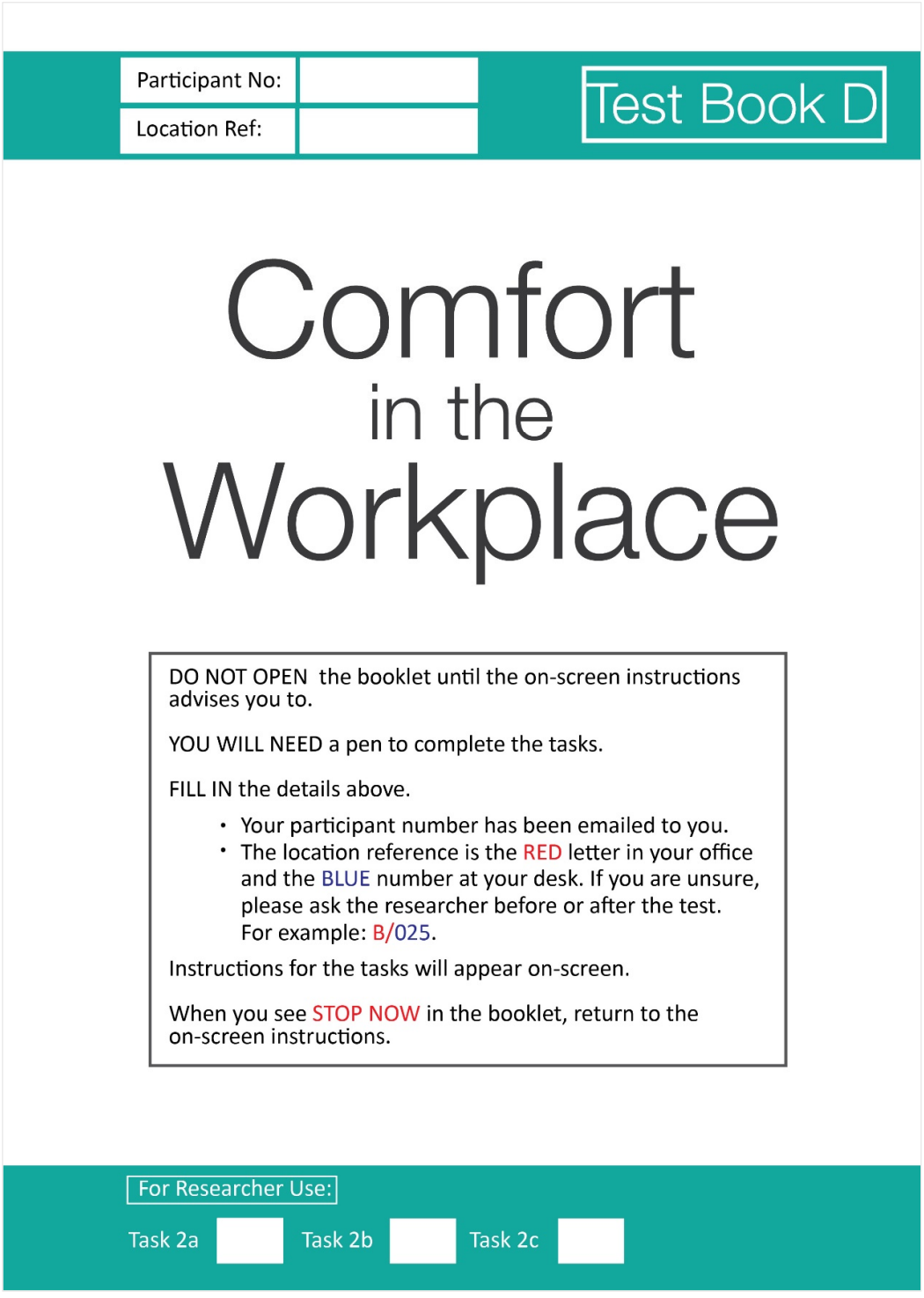
- Adjust the blinds, window or lighting settings/positions for your comfort
- Adjust your clothing so you are comfortable
- Drink plenty of water and take regular screen breaks for the rest of the day
- Switch on any electric fans
- Enjoy the rest of your day!!

As a reminder, if at any point you are unhappy with continuing the study or would like to withdraw, please contact the researcher immediately.

Zoe De Grussa - Email: degrussz@lsbu.ac.uk - Tel: +44 (0)20 7815 7529

C2. Test Booklet

One of the four versions of the test booklet used.



Task 1 Text Typing

In the morning we went up to the village and bought a wire rattrap and fetched it down, and unstopped the best rat-hole, and in about an hour we had fifteen of the bulliest kind of ones; and then we took it and put it in a safe place under Aunt Sally's bed. But while we was gone for spiders little Thomas Franklin Benjamin Jefferson Elexander Phelps found it there, and opened the door of it to see if the rats would come out, and they did; and Aunt Sally she come in, and when we got back she was a-standing on top of the bed raising Cain, and the rats was doing what they could to keep off the dull times for her. So she took and dusted us both with the hickory, and we was as much as two hours catching another fifteen or sixteen, drat that meddlesome cub, and they warn't the likeliest, nuther, because the first haul was the pick of the flock. I never see a likelier lot of rats than what that first haul was.

STOP NOW

RETURN TO THE ON-SCREEN INSTRUCTIONS.

Task 2 Arithmetic

ADD 3 to each two-digit number and **WRITE** your answer on the dotted line.
Once completed **turn to Page 3.**

Example	32 +3 35	
Q1	66	
Q2	39	
Q3	74	
Q4	36	
Q5	78	
Q6	16	
Q7	71	
Q8	64	
Q9	39	
Q10	26	
Q11	41	
Q12	28	
Q13	49	
Q14	77	
Q15	53	

STOP NOW

1. Go to PC SCREEN
2. Click **'PAGE COMPLETE'**
3. Turn the page and continue with test.

Task 2 Arithmetic

SUBTRACT 3 from each two-digit number and **WRITE** your answer on the dotted line.
Once completed **turn to Page 4.**

Example	21 (-3)	18
Q16	18	.....
Q17	49	.....
Q18	22	.....
Q19	93	.....
Q20	24	.....
Q21	51	.....
Q22	46	.....
Q23	35	.....
Q24	69	.....
Q25	82	.....
Q26	63	.....
Q27	77	.....
Q28	61	.....
Q29	72	.....
Q30	46	.....

STOP NOW

1. Go to PC SCREEN
2. Click **'PAGE COMPLETE'**
3. Turn the page and continue with test.

Task 2 Arithmetic

Alternate between **ADDING 3** and **SUBTRACTING 3** from each two-digit number and **WRITE** your answer on the dotted line. Once completed press the PAGE COMPLETE button on-screen.

Example

Ex.1 32 +3 35

Ex.2 42 -3 39

Ex.3 36 +3 39 etc.

Q31 58 .....

Q32 26 .....

Q33 52 .....

Q34 29 .....

Q35 38 .....

Q36 75 .....

Q37 13 .....

Q38 42 .....

Q39 36 .....

Q40 81 .....

Q41 43 .....

Q42 98 .....

Q43 70 .....

Q44 32 .....

Q45 73 .....

STOP NOW

1. Go to PC SCREEN
2. Click **'PAGE COMPLETE'**
3. Turn the page and continue with test.

Task 3 Data Entry Example

INSTRUCTIONS:

- Your task is to find any **differences** between the two lists on this page and the page opposite.
- **DO NOT MARK** this booklet, but fill in the appropiate tick boxes on the screen according to the rules on the opposite page.
- **READ** the Example, Rules and Tips before clicking **CONTINUE** on-screen.

EXAMPLE:

All of the information is about office equipment required for rental by different companies. Each line of information is for one company, for which the following details are given in columns:

	Ref No.	Name	Dates	Telephone System	Computer	Photocopier	Hot Drinks Machine	Furniture
1	*G15*	*Roberts*	*22/9 - 05/12*	✓	✓	✓		✓
2	*L26*	*Camden Ltd*	*15/2 - 20/3*	✓			✓	
3	*R71*	*Joseph*	*7/11 - 16/9*	✓		✓		✓
4	*S34*	*A1 Machines*	*3/10 - 13/12*	✓	✓			
5	*T89*	*Maynard Sons*	*29/8 - 18/11*			✓	✓	✓

Ref No. The reference number of the company. *In Example 1 it is* ***G15***.

Name The name of the company. *In Example 1 is* ***Roberts***.

Dates The period over which the equipment is required. In *Example 1* the dates are ***22/9 - 5/12***.

Office Equipment Telephone system, computer, photocopier, hot drinks machine, and furniture. In the original list these are represented by ticks where on the opposite page they are shown as symbols. In *Example 1* these are ***telephone system, computer, photocopier and furniture***.

RULES FOR FILLING IN ANSWERS:

If there is an *error* in the **Reference Number:**	fill in tick box **A** on the screen.
If there is an *error* in the **Name:**	fill in tick box **B** on the screen.
If there is an *error* in the **Dates:**	fill in tick box **C** on the screen.
If there is an *error* in the **Office Equipment:**	fill in tick box **D** on the screen.
If there are ***no errors*** at all in the line:	fill in tick box **E** on the screen.

There may be more than one error in the line, so you may have to fill in more than one tick box.

EXAMPLE:

Office Equipment Symbol Key:

Telephone System  Computer  Hot Drinks Machine  Photocopier  Furniture 

	Ref No.	Name	Dates	Office Equipment
1	*G15*	*Roberts*	*22/9 - 05/12*	
2	*L26*	*Camden Ltd*	*15/2 - 20/3*	
3	*R71*	*Joseph*	*7/11 - 16/9*	
4	*S34*	*A1 Machines*	*3/10 - 13/12*	
5	*T89*	*Maynard*	*29/8 - 18/11*	

TIPS TO REMEMBER

- Work across the page, completing each question (line) on-screen before moving on.
- The rules and the symbols are given on each task.
- Make sure that the correct tick box or tick boxes are selected on-screen.
- Check that you are putting each answer next to the correct number on-screen.
- If you want to change an answer, you can click the back button on-screen & double-click a tick-box to deselect an answer.
- Work as quickly and as accurately as you can. If you are not sure of an answer, mark your best choice, but avoid wild guessing.

STOP NOW - END OF EXAMPLE

PRESS CONTINUE ON-SCREEN THEN TURN THE PAGE TO START THE TASK.

Task 3 Data Entry Task

TIPS:

- Work across the page, completing each question (line) on-screen before moving on.
- Check that you are putting each answer next to the correct number on-screen.
- If you want to change an answer, you can click the back button on-screen & double-click a tick-box to deselect an answer.
- If you are not sure of answer, mark your best choice, but avoid wild guessing.

	Ref No.	Name	Dates	Priority Boarding	Inflight Meal	Window Seat	Hand Luggage	Suitcase
1	AY548	Gothenburg	18:45 16-Sep	✓				
2	EI888	Bucharest	11:45 07-Feb	✓		✓		
3	AF368	Ekaterinburg	08:20 18-Nov			✓	✓	
4	KL618	Chicago	12:40 04-Sep				✓	
5	AA106	Malta	16:30 21-Aug		✓	✓		
6	BA151	Naples	10:10 13-Jan	✓				✓
7	IB422	Dubai	17:30 13-May	✓	✓	✓		
8	MH941	Oslo	06:40 01-Mar		✓		✓	✓
9	DL437	Verona	11:25 25-Feb		✓	✓		
10	VS046	Goa	12:15 06-Jun					✓
11	AA640	Orlando	13:35 15-Apr	✓	✓			
12	AT551	Barcelona	08:25 15-Oct		✓			✓
13	EI881	Belize	15:10 17-May	✓		✓		
14	IB767	Milan	05:45 03-Jun				✓	
15	AF366	Edinburgh	18:15 20-Jan	✓			✓	✓
16	BA172	Toulouse	06:25 19-Apr		✓	✓	✓	
17	EI8872	Marrakech	12:20 21-Feb	✓	✓	✓		
18	KL6101	Lanzarote	17:30 23-Jun	✓			✓	
19	AA6618	Krakov	20:55 09-Sep		✓	✓		✓
20	BA1385	Almaty	16:25 21-Jul		✓			

APPENDIX D. CALIBRATION & POST PROCESSING

D1. Lux Sensors

Using differing data loggers in Office A (DT500) and B (DT80) meant that a data correction was required to ensure the data output from the two loggers was accurate and consistent between loggers and offices. This was caused by the difference in the input voltage that the two loggers could receive. The logger situated in Office A (DT500) was specified to receive input voltages of ±25 mV where the Office B logger could tolerate voltages of ±30 mV which is equal to the output voltage of the EKO-ML-020S-O lux sensors that operated within (0-30mv on a scale of 0-150,000 lux). Therefore, the data collected by the lux sensors connected to the Office A (DT500) datalogger was recording on a different scale to the data collected in Office B (DT80).

A calibration procedure was conducted pre-test phase to produce a polynomial formula that could be applied to the data collected on the Office A datalogger during the test period. Each of the four lux sensors connected to the Office A (DT500) logger were checked for accuracy against an externally calibrated data logger and lux sensor (data logger and sensor) the SKL/310 (lux sensor) and Datahog2 (logger).

The calibration was carried out by positioning the externally calibrated lux sensor next to the lux sensors located in Office A under varying lighting conditions whilst the output data was recorded on their corresponding data loggers. The calibrated sensor was set to output lux values and the sensors to be placed in the test office were set to output mV. A variation of illuminance conditions was created using both electric lighting and daylight. The sensors located on the north façade of the building were tested under illuminance spans of 0 ≈ 750 lux and spans of 0 ≈ 1040 lux were created on the south side of the building. This process was carried out in the testing offices once all sensors had been set up to ensure each lux sensor was exposed to similar lighting conditions that would occur within the test period.

Multiple readings were taken for each sensor for a period of 2 minutes with a logging interval set to 10 seconds. This data was then plotted on a graph and a polynomial equation was calculated between the mV and lux data for each of the four sensors.

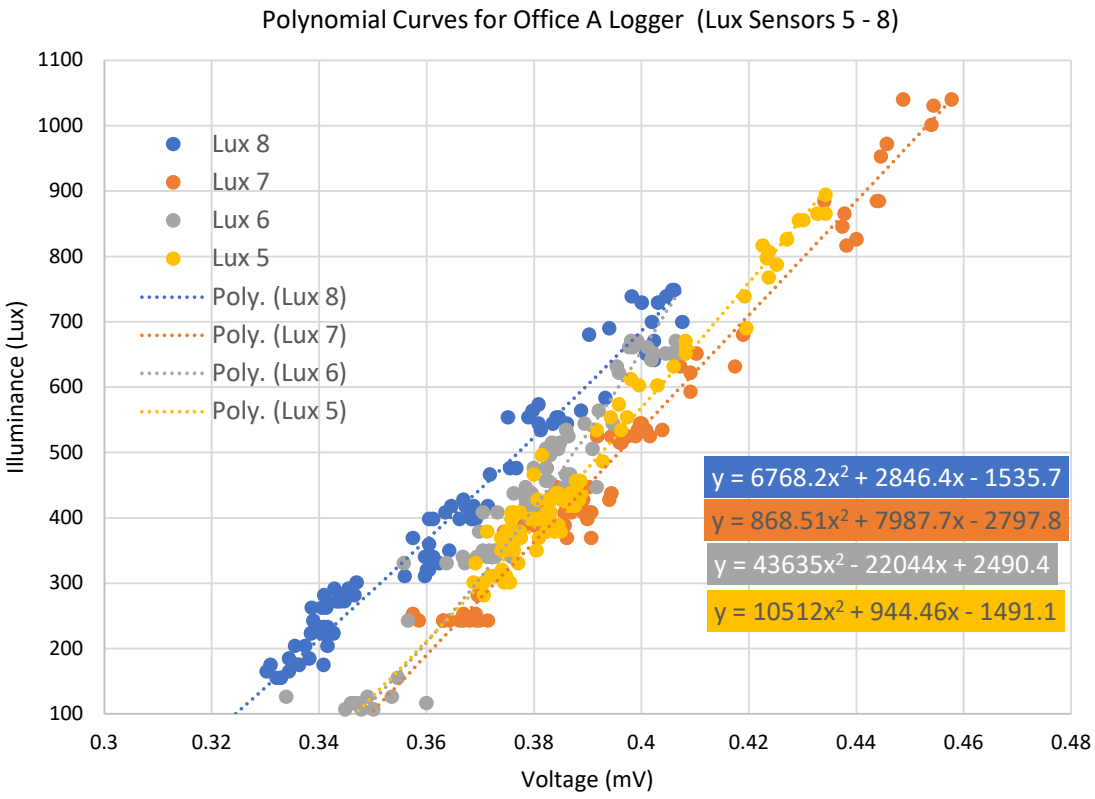


Figure 114. Polynomial Curves applied to Room A Sensors (Lux Sensors 5 -8)

Figure 114 shows the polynomial curves produced between the mV volt output and the calibrated sensors lux value for each lux sensor in Office A. This was then applied to the mV output data received from the logger during post processing.

The logger that was used in Office B was able to process the 30mV output signal from the EKO-ML-020S-O lux sensors therefore a scaling factor was applied to the DT80 logger to convert the readings from the sensors 30mV range to be equivalent to the 0 – 150,000 lux scale.

Once calibrated an accuracy test was then conducted with the polynomial formulae applied to the corresponding lux sensor data. The calibrated lux sensor was again positioned next to the testing lux sensor for a 2-minute period and measurements were taken every 10 seconds whilst varying lighting conditions were recreated. The lux values were then compared for accuracy. This found that Office A sensors had an accuracy of ±50 lux and in Office B accuracy of ±100 lux, over a range of 0 – 1500 lux. This was found to be a reasonable difference considering the lux sensors were not positioned in the exact same position but side by side during calibration.

Air Temperature, Relative Humidity and CO_2 :

Pre-installation the two GS-CO2-RHT-1001 sensors which measured air temperature, RH and CO_2 were compared for accuracy before the test phase. The sensors were setup side by side in a laboratory environment and measurements were logged for 30 minutes at a frequency of 60 seconds. When comparisons of the air temperature and RH (Figure 115) were carried out the two sensors differed by an average of 0.48% RH and 1.27°C. The RH reading was within the accuracy threshold given for the sensor (±3% RH), but the air temperature was above the accuracy thresholds (± 0.5°C).

An adjustment of 1.27°C was applied to the air temperature data collected by the Office B data logger to account for this difference.

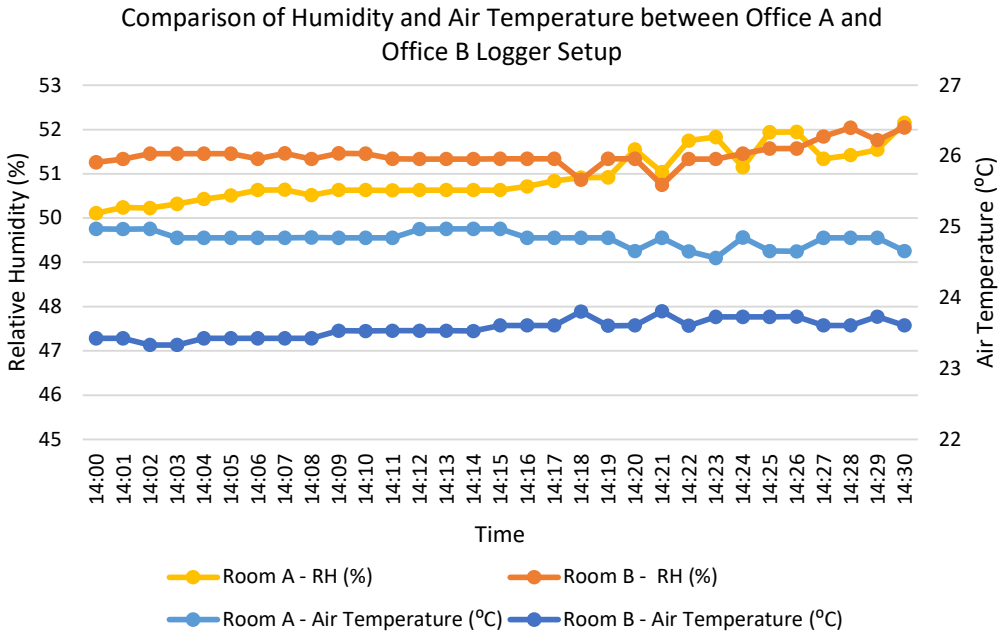


Figure 115. Comparison between Logger Set-Ups of Relative Humidity and Air Temperature.

Further to this a comparison was made between the two sensors and an externally calibrated Testo 435-2 Indoor Air Quality Sensor to compare the CO_2 measurements. The average temperature within the room was recorded at 26°C with a RH of 50%. Measurements were logged every 60 seconds for comparison for a 30-minute period. Figure 116 identifies that the sensor set up for Office A sensor logs data within the accuracy tolerance of ±50ppm ±3% of scale. However, Office B records a PPM of between 129 - 165ppm greater than the calibrated sensor which exceeded the accuracy tolerance.

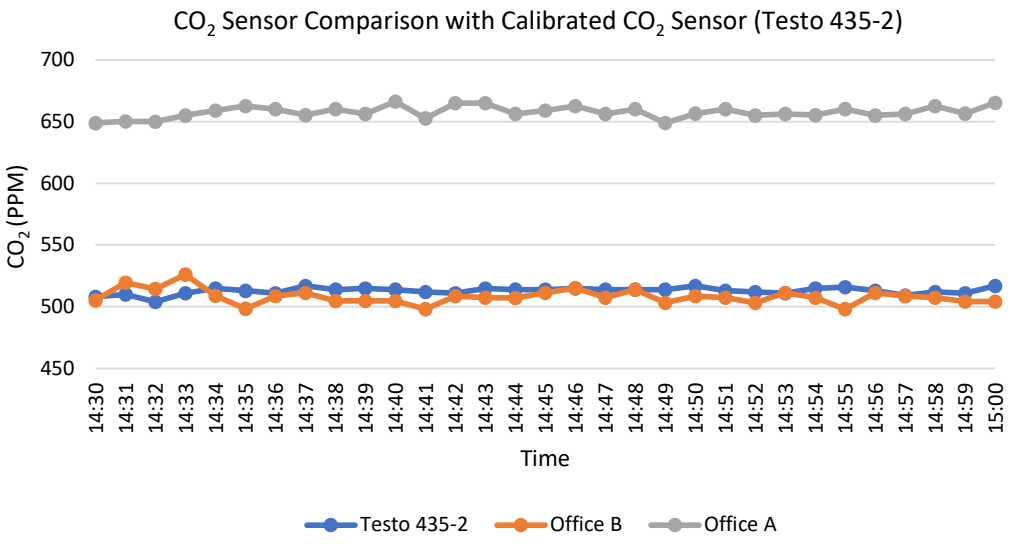


Figure 116. CO_2 Comparison between Logger Set-Ups and with Testo 435-2 Calibrated Sensor.

Considering this difference, the Office B sensor was replaced with a CO_2 sensor provided by the Managing Air for Green Inner Cities (MAGIC) project and calibrated by the MAGIC team. The sensor was a Sense Air K33 which has an accuracy of ±15ppm.

Globe Temperature:

After the test phase, a calibration was carried out on the globe temperature sensors to check the accuracy of the sensors between the differing logging systems. The Office A logger (DT500) and the Office B logger (DT80) were both connected to six globe temperature sensors during testing. The same sensors and related loggers were setup side by side in an environmental chamber alongside two globe temperature sensors that use a mercury thermometer as a temperature probe. These sensors require the temperature to be read of the thermometer and noted down to take a reading.

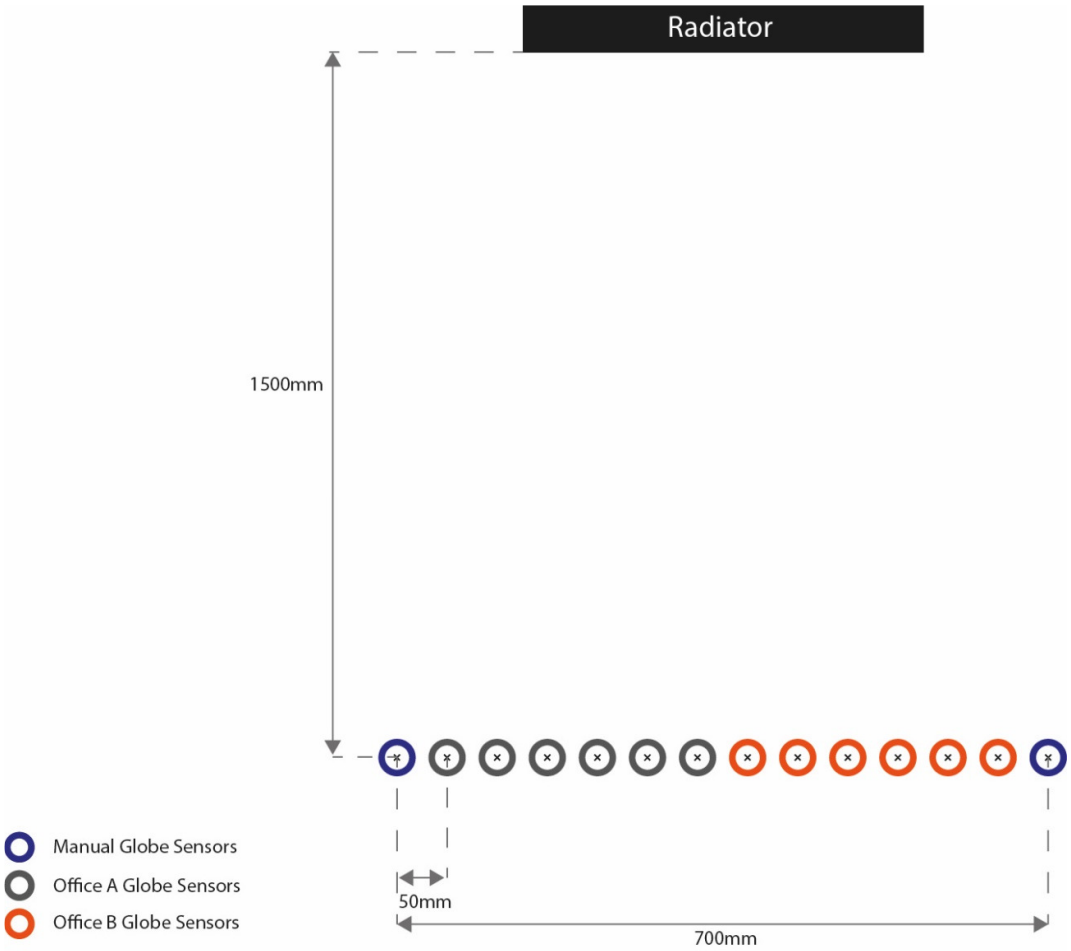


Figure 117. Sensor Setup for Globe Temperature Calibration

The sensors were setup as shown in Figure 117. An electric radiator was positioned within the chamber 1.5m away from the sensor setup and each sensor was positioned an equal distance away from the radiator and equal from each other.

At 15-minute intervals over a period of 5 hours the manual globe temperatures were monitored by entering the room, reading the temperature of the two mercury sensors then leaving the room (and closing the door). During the 5 hours the radiator thermostat temperature was gradually increased until the mercury globe temperature probe reached 42°C which exceeded the maximum temperature recorded within the test phase.

The readings from the two mercury sensors were compared for temperature variation between the two sensors and maximum of a 1°C difference was found. The difference between the six sensors connected to the dataloggers was less than 0.5°C. The results of the 6 sensors for each logger were averaged and the two globe temperature sensors were

also averaged. The averaged measurements taken are presented in Figure 118. It was evident that the average mercury globe temperatures and the Office A Logger were logging correctly whereas there was a difference between the Office A Logger and the averaged globe measures taken by the Office B Logger.

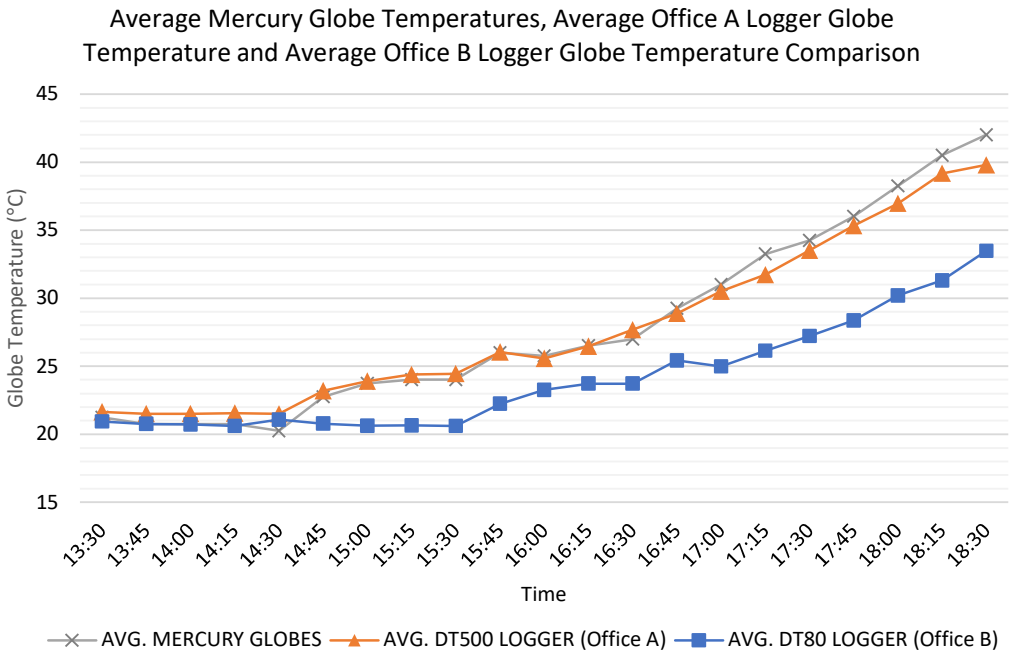


Figure 118. Average Globe Temperatures of Manual Sensors (X), Office A Sensors/Logger (Δ), and the Office B Sensors/Logger (□).

The difference between these values increased as the temperature rose resulting in a maximum difference of 7.87°C between the Office A logger and Office B and 9.20°C between the mercury globe temperature averages and the Office B logger.

A polynomial equation was then derived from the temperature difference between logger A and logger B and the logger B measurements collected. This equation was then applied to the data collected in the test phase to correct the scale of the Office B globe temperature, so it matched with the scale of the Office A Logger. Figure 119 represents the polynomial that was derived and applied to the globe temperature sensor data for Office B (DT80 Logger).

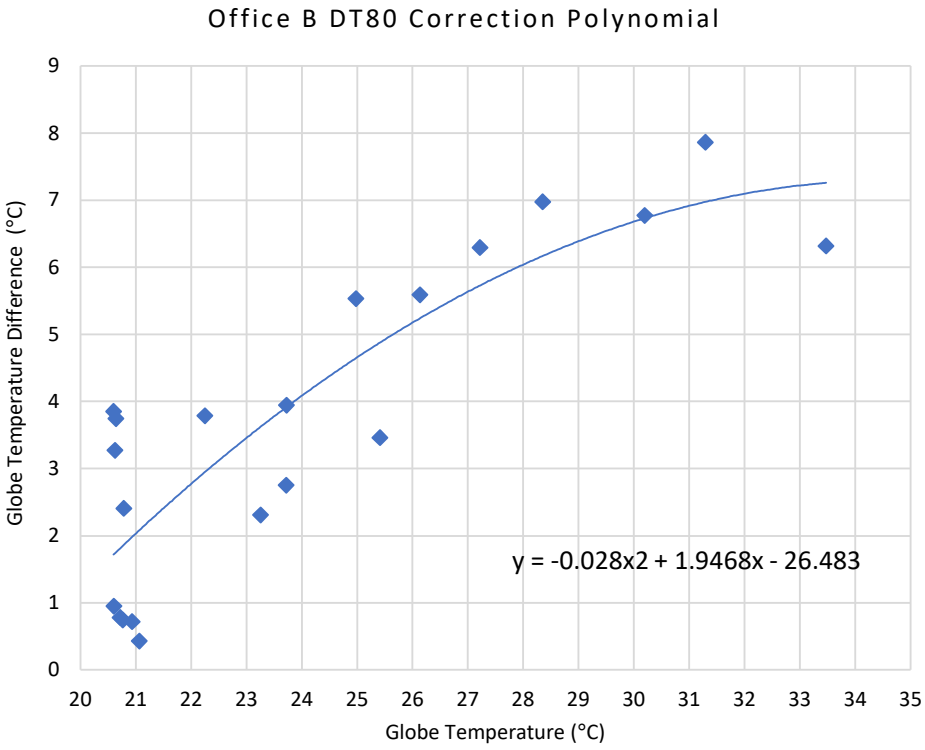


Figure 119. Average difference in Globe Temperature between Office A and Office B Datalogger

D2. Post Processing

The process differed for each type of data collected and the actions taken to amend the original data collected are explained below. All other data was used as collected.

D2.1. Internal Objective Environment Data

Lux Values, Air Temperatures, Relative Humidity and CO_2 Data:

Due to the close frequency of logging (every 10 seconds) a high volume of noise was present in the data. The decision was made to exponentially smooth the data to improve the legibility of the data during the two-hour period. Exponential smoothing was carried using Equation D1.

$$S_t = \alpha \cdot \chi_t + (1 - \alpha) S_{t-1} \quad \text{(Equation D1)}$$

S_t = Smoothed Statistic

α = Smoothing (weighting) constant = 0.01

x_t = Weighted Average of the Current Observation

S_{t-1} = Actual measure in the period

Operative Temperature:

Box Plots were used to identify extreme outliers and removed from the dataset. The data was then exponentially smoothed as per Equation D1, and a cumulative moving average was applied using the following Equation D2 to replace any missing data points.

$$CMA_n = \frac{A_{n-1} + A_n + A_{n+1}}{3} \qquad \text{(Equation D2)}$$

CMA_n = Cumulative Moving Average

A_{n-1} = Actual measure in the previous period

A_n = Actual measure

A_{n+1} = Actual measure in the following period

D3. Test Battery Data

Data collected from occupants through the test battery was additional amended from data gathered from the focus group, this resulted in one participants' scores for the Working Memory Test being removed from the dataset[1].

[1] During the focus group one participant admitted to cheating when carrying out the Working Memory Test (See Appendix F, Line 151 – 167). As this data was identifiable it was removed from the objective productivity dataset for the relevant participant.

APPENDIX E. DATA COLLECTION ERROR

During data collection of the internal objective environment data a number of issues arose that meant the number of measures collected for each internal environment measure differed (see Table 31, p. 166). This was caused by:

- The loss of all internal environment data for Test Day 14 in Office B.
- A malfunctioning CO_2 sensor in Office B.
- Differences in the layout of operative temperature sensors resulted in two participants in Office B not being assigned operative temperature data in post-processing.

Internal environment data had to be offloaded at the end of each Test Day or the logger would reach capacity and overwrite the data collected. Unfortunately on Test Day 14 this event occured due to human error.

The desk positions for two participants in Office B meant that two participants were at a greater distance from the operative temperature sensors than the rest of the participants in Office A and B. Therefore, operative temperature data for these participants were not assigned to these participants in the data post-processing to ensure the method of collecting operative data remained consistent for all participants.

CO_2 data, the malfunctioning sensor caused all CO_2 measurements in office B to be considered unreliable. However, in parallel to this study a separate research project co-ordinated by Managing Air for Green Inner Cities (MAGIC) (University of Cambridge Centre for Mathematical Studies, no date) was simultaneously monitoring and collecting CO_2 data amongst other air quality measurements in the same Office B. The project co-ordinator of the MAGIC project was happy to share their data with the researcher of this study. The MAGIC dataset provided CO_2 data for all but one Test Day in Office B. Even though the CO_2 dataset was not complete a large proportion of the CO_2 data was available and therefore the decision was made to include the data within the analysis.

APPENDIX F. INTERNAL OBJECTIVE ENVIRONMENT BETWEEN TEST DAYS

The box plots in Figure 120 - Figure 125 display the variation in internal measures across the test days. The box plots also display the recommended comfort thresholds in reference to the values provided in Table 4 of the Literature Review relating to offices for all measures expect for operative temperature and air temperature.

The operative temperature comfort threshold is presented by the Θ_{max} and Θ_{upp} which defines the adaptive comfort threshold and the absolute maximum threshold as described in BS EN 15251 and CIBSE TM52 (BSI, 2015; CIBSE, 2013).

To calculate the Θ_{max} and Θ_{upp} the external air temperatures were further analysed to identify the maximum acceptable adaptive comfort threshold (Θ_{max})[2] for occupants in relation to Category II[3] in BS EN 15251 which considers the exponentially weighted daily external air temperatures (T_{rm}). External daily mean air temperatures were calculated from data collected every 30 minutes between 9am and 8.30am the following day. Daily mean air temperatures of the days in between the test days were also calculated in order to calculate the T_{rm} and the Θ_{max} for each test day. The Θ_{max} ranged between 27 °C and 29°C throughout the test days. Internal operative temperatures that exceeded the Θ_{max} threshold are likely to be found uncomfortably warm for occupants.

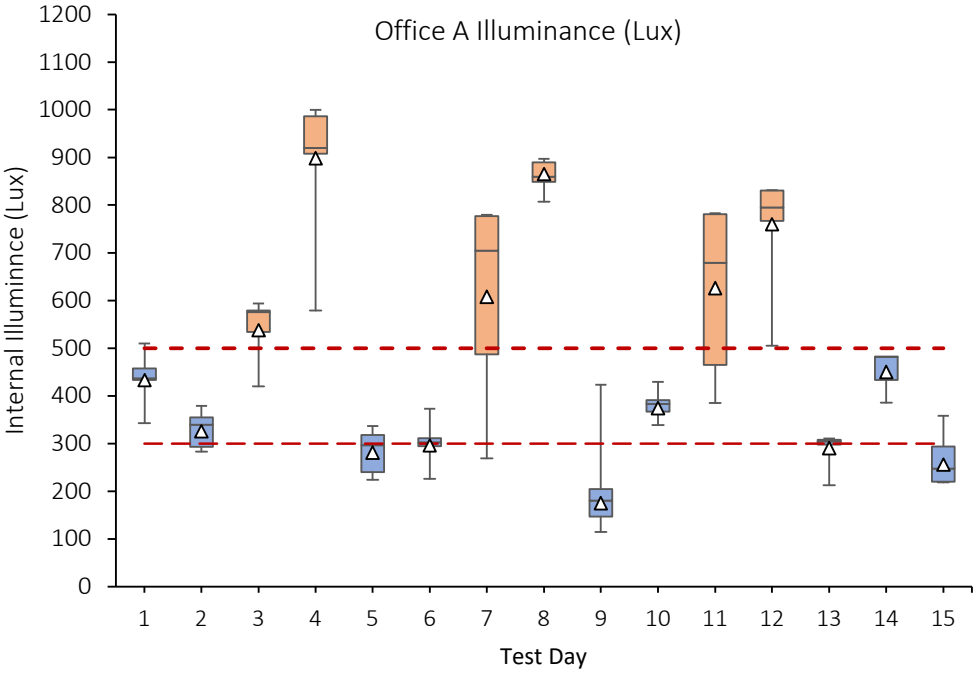
The results relating to the test days are presented in Table F1.

[2] CIBSE TM52 definition of Θ_{max} is derived from the exponentially weighted running mean outdoor air temperature (T_{rm}) and the suggested acceptable temperature range that occupants can tolerate (K), see Equation 3 (p. 75) for calculation methodology.

[3] Category II refers to a normal expectation of an occupant for new builds or renovations. See Section 3.4.2 (p. 75) for further detail.

Table F1. T_{rm} and Θ_{max} (Category II) as per BS EN 15251 (BSI, 2015)

Date	Test Day	Daily Average External Air Temperature (°C)	T_{rm} (°C)	Θ_{max} (°C)
13/07/2017	Pre-Test	19.25	19.94	28.38
18/07/2017	Test Day 1	21.66	19.90	28.37
20/07/2017	Test Day 2	17.03	20.62	28.60
25/07/2017	Test Day 3	18.84	17.01	27.41
27/07/2017	Test Day 4	16.95	17.28	27.50
31/07/2017	Test Day 5	18.35	17.59	27.60
03/08/2017	Test Day 6	18.50	17.99	27.74
08/08/2017	Test Day 7	15.53	17.88	27.70
10/08/2017	Test Day 8	16.18	16.37	27.20
15/08/2017	Test Day 9	19.24	18.35	27.85
17/08/2017	Test Day 10	19.50	19.05	28.09
22/08/2017	Test Day 11	19.78	17.52	27.58
24/08/2017	Test Day 12	18.27	18.13	27.78
29/08/2017	Test Day 13	19.74	21.21	28.80
31/08/2017	Test Day 14	16.53	18.96	28.06



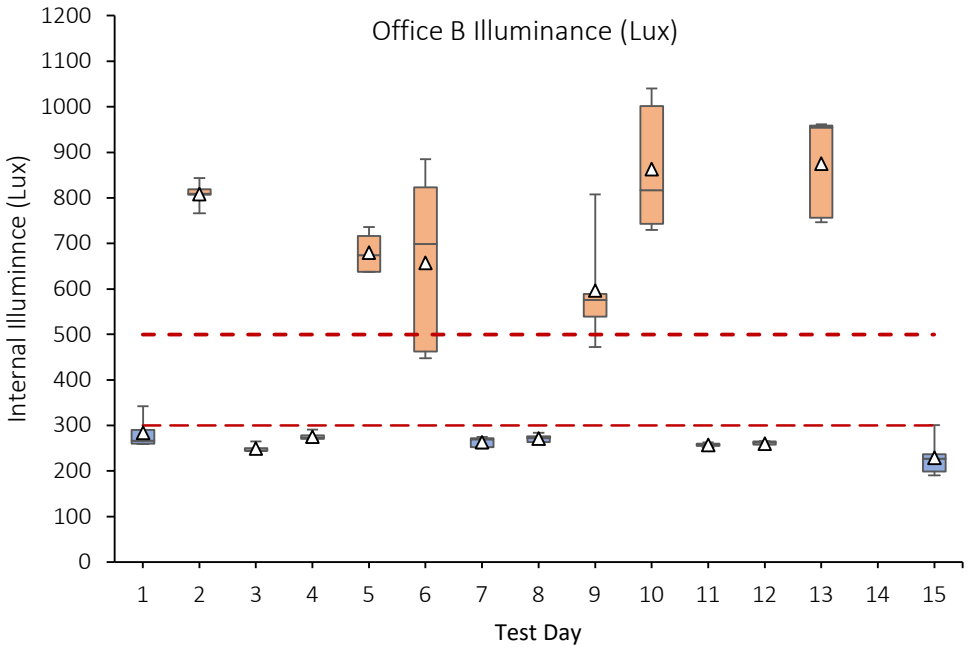


Figure 120. Office A and Office B Average Illuminance during across test days Open (Orange) and Closed (Blue) Blind Conditions (300 - 500 Lux = dashed line, Δ = Mean).

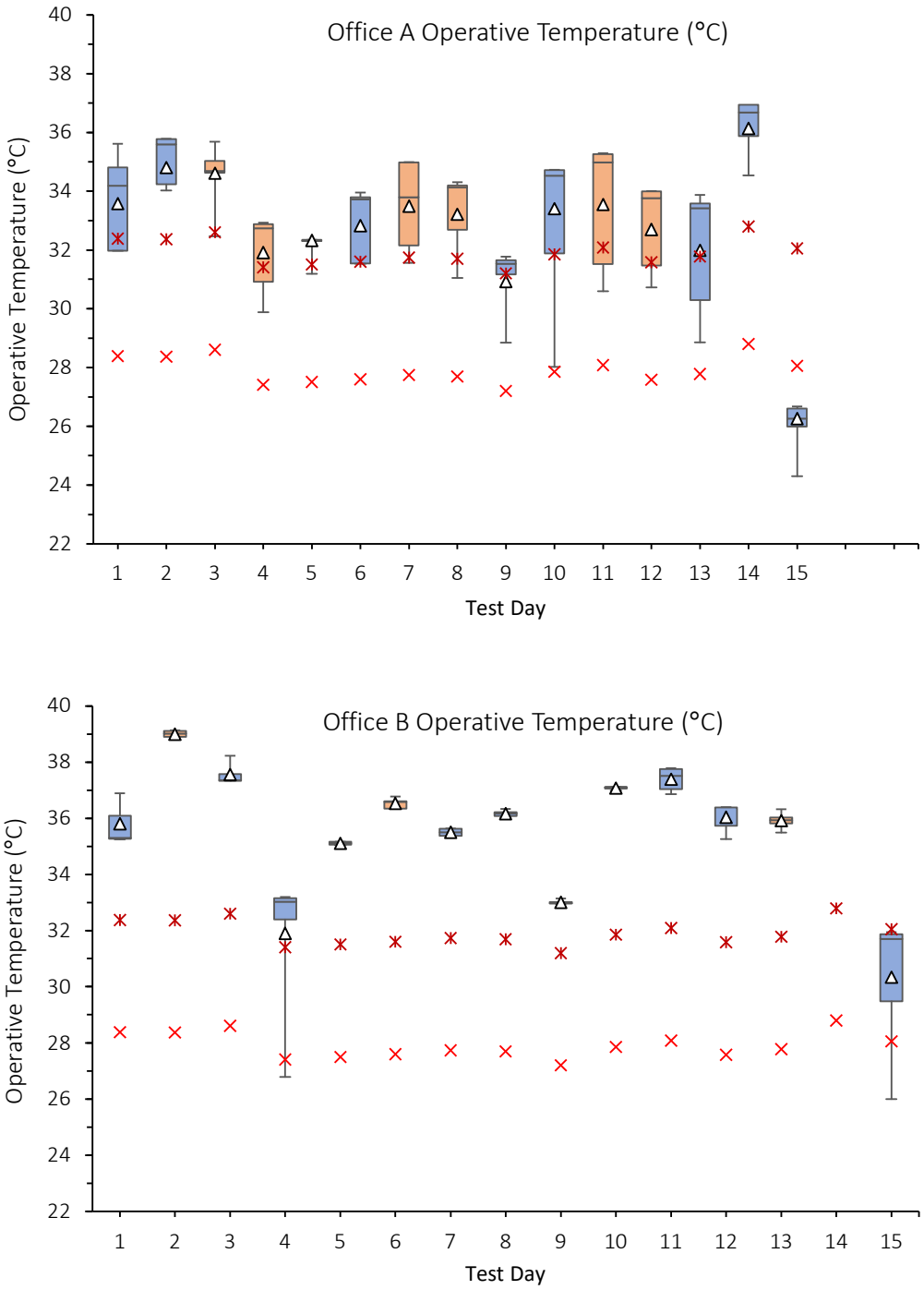


Figure 121. Office A and Office B Average Operative Temperatures across test days in Open (Orange) and Closed (Blue) Blind Conditions (Tmax = X, Tupp = *, Δ = Mean).

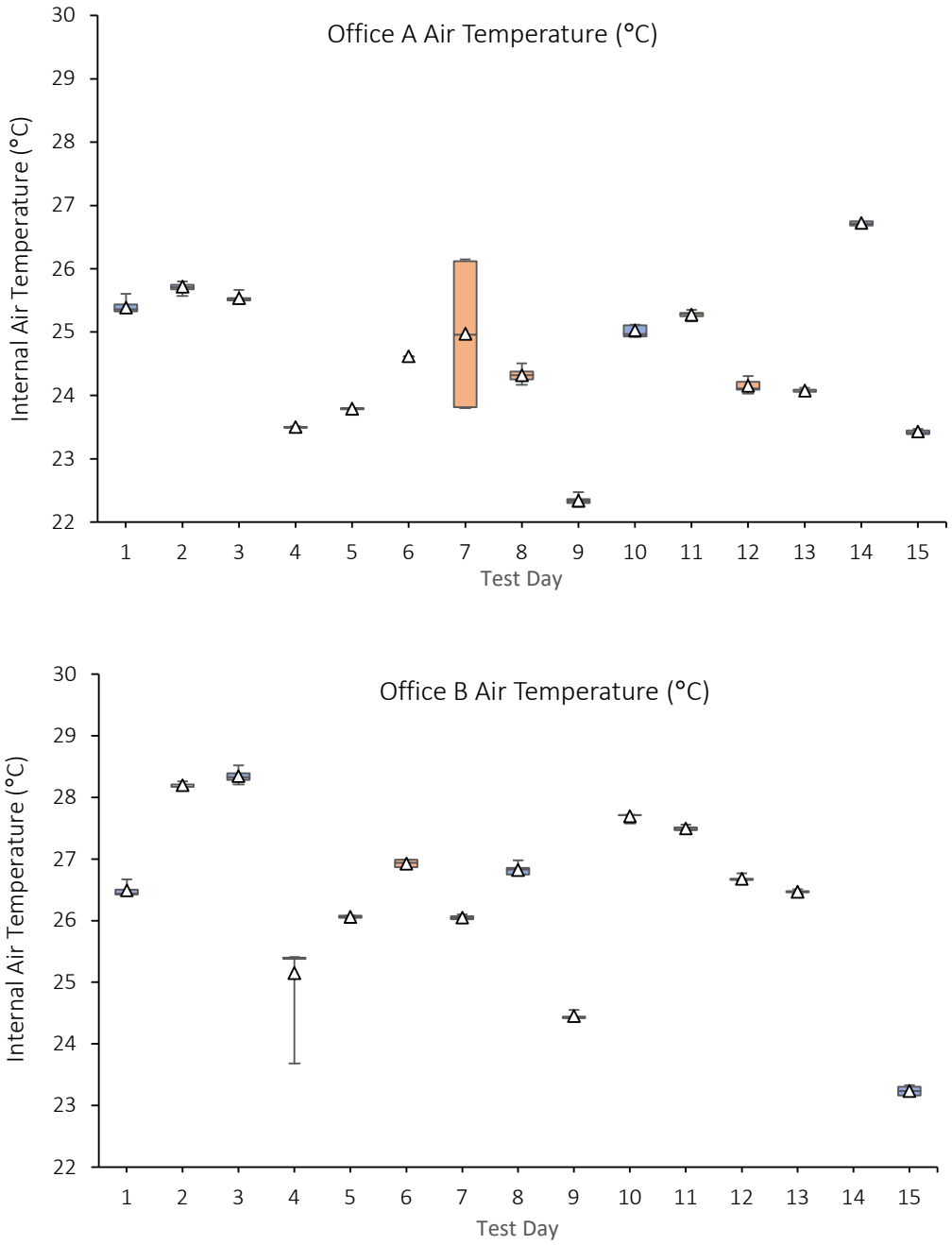


Figure 122. Office A and Office B Average Air Temperatures across test days in Open (Orange) and Closed (Blue) Blind Conditions (Δ = Mean).

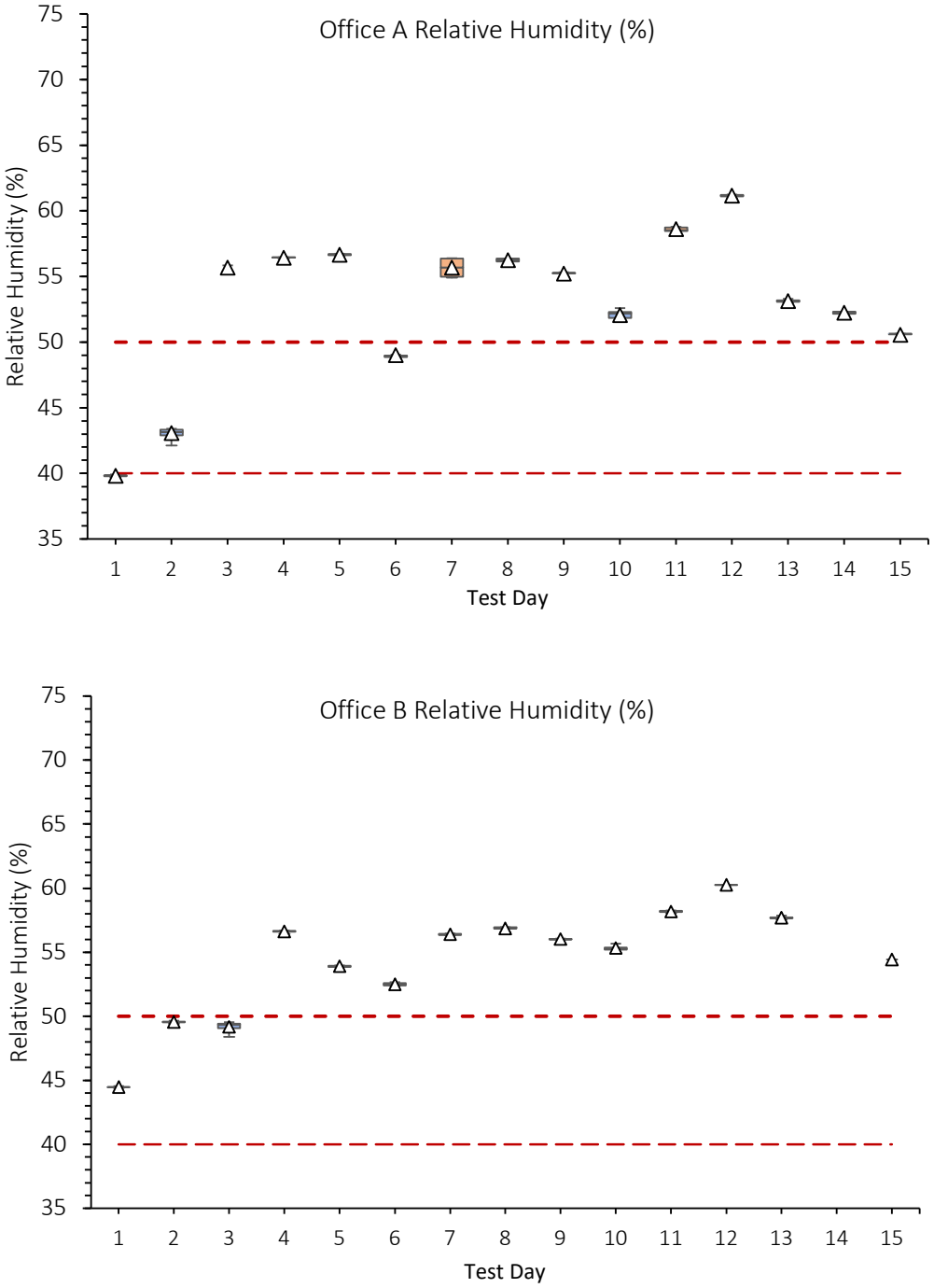


Figure 123. Office A and Office B Average Relative Humidity across test days in Open (Orange) and Closed (Blue) Blind Conditions (40-50% = dashed line, Δ = Mean).

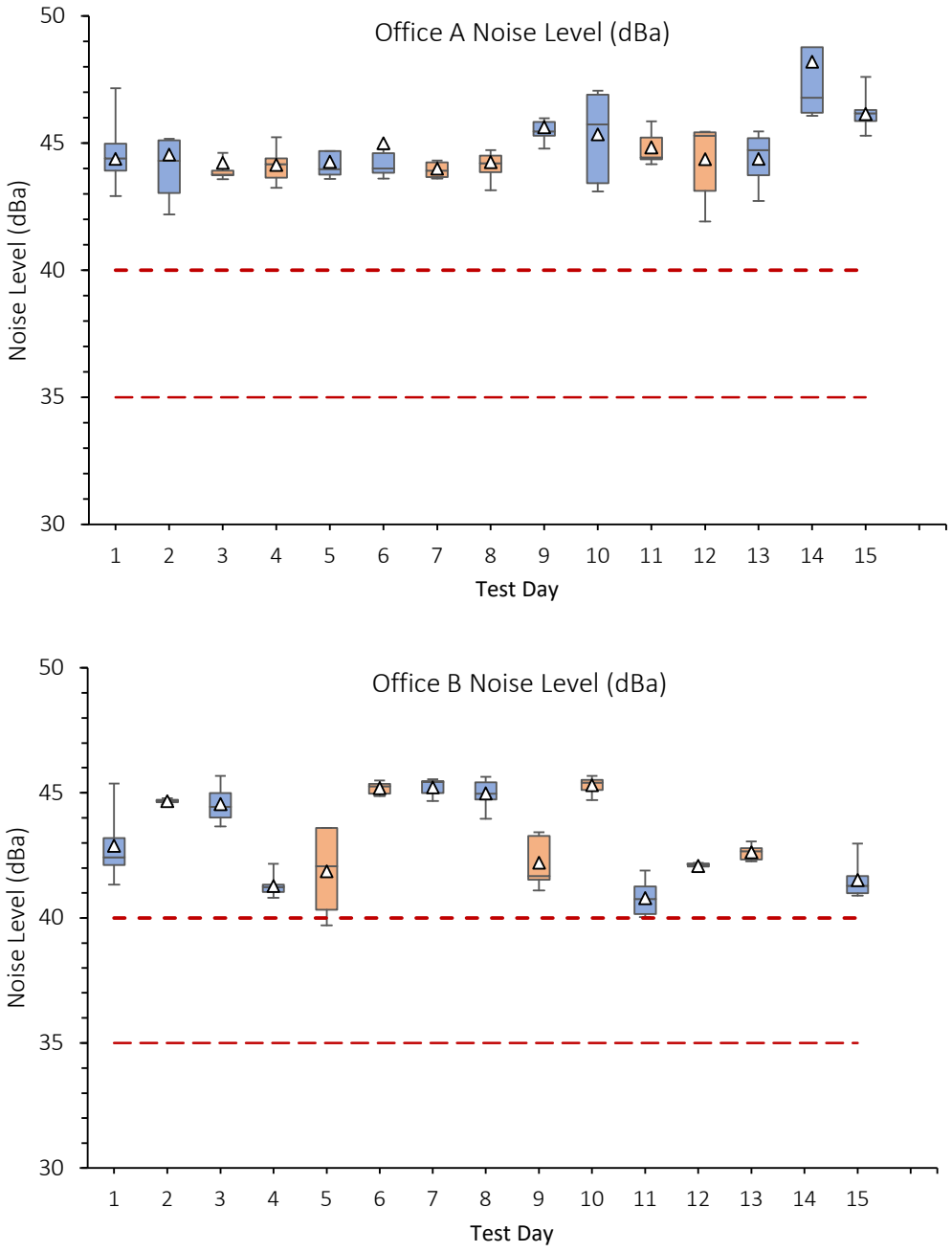


Figure 124. Office A and Office B Average Noise Level (dBA) across test days in Open (Orange) and Closed (Blue) Blind Conditions. (35 – 40 dBA = dashed line, Δ = Mean)

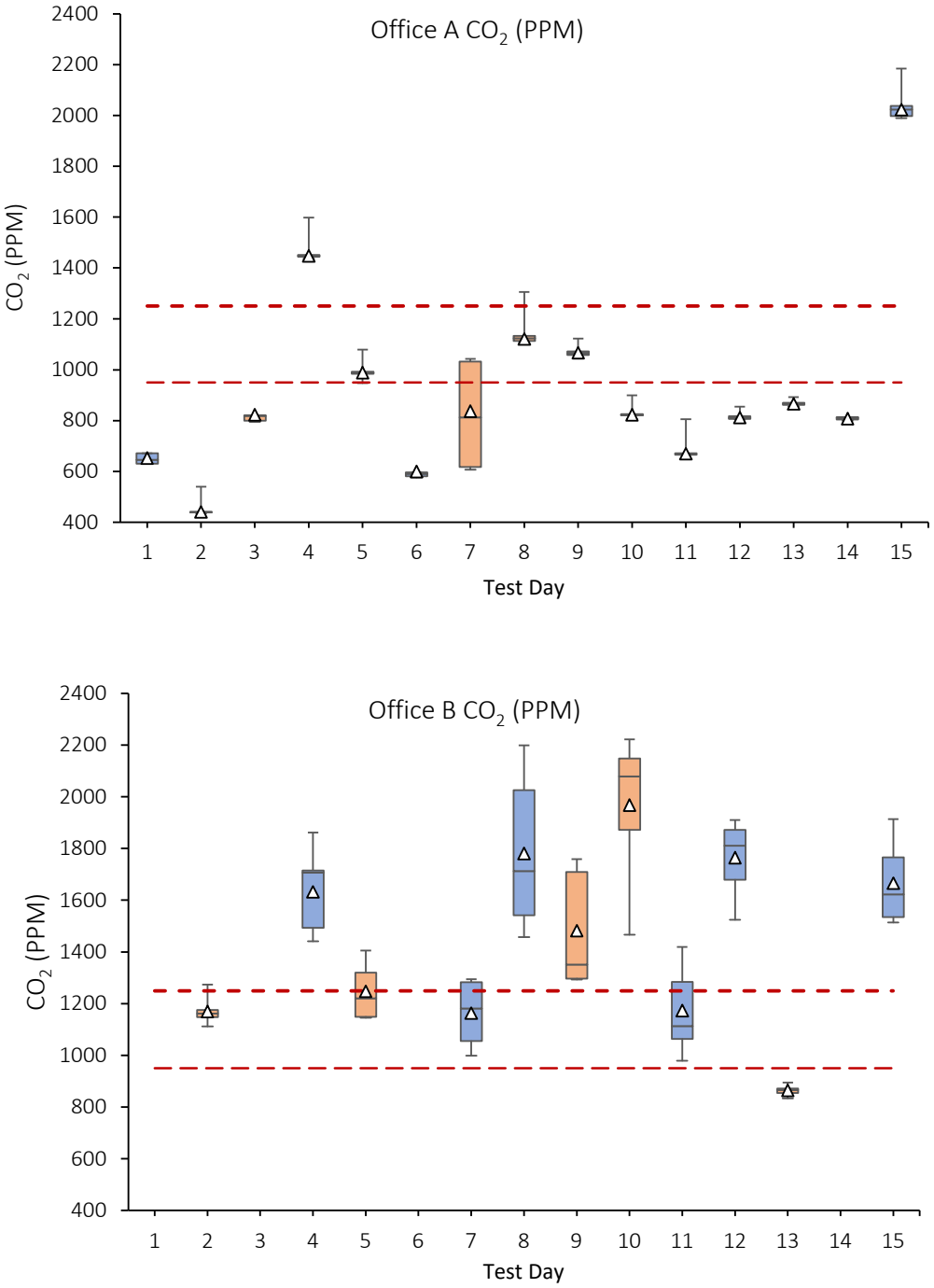


Figure 125. Office A and Office B Average CO_2 Level (PPM) across test days in Open (Orange) and Closed (Blue) Blind Conditions (500 – 1000 PPM = dashed line, Δ = Mean).

APPENDIX G. DETAILED ANALYSIS OF HIERARCHICAL REGRESSIONS

G1. Subjective Internal Environment

Thermal Comfort

Table G1 presents the results from the regressions relating to Thermal Comfort and this section contains a summary of those results:

Air Temperature Sensation:

This was found to be strongly significant, ($F (6, 135) = 6.79$, $p < .001$), with an R^2 0.23. Air temperature accounted for 17% of the variance in the sample with operative temperature contributed a further 1%, lux contributed 1% and the remaining IV's contributed 5%.

The standardised β coefficients identify that warmer thermal sensation was predicted by the increase in air temperature (Std.β = 0.40), relative humidity (Std.β = 0.19) and dBA (Std.β = 0.16).

Air Temperature Preference:

This was found to be significant, ($F (6, 135) = 2.23$, $p = 0.04$), with an R^2 0.09. Air Temperature accounted for 3% of the variance in the sample with operative temperature contributing a further 2% and the remaining IV's contributed 4%.

The standardised β coefficients identify that occupants preferring warmer thermal conditions was predicted by the decrease in air temperature (Std.β = -0.18) in the first model and the increase in CO_2 (Std.β = 0.23) when all variables were included in the fourth model.

Air Temperature Acceptability:

This was found to be strongly significant, ($F (6, 135) = 5.03$, $p < .001$), with an R^2 0.18. Air Temperature accounted for 16% of the variance and the remaining variables contributed 1%.

The standardised β coefficients identify that the air temperature was found to be more acceptable was predicted by the decrease in air temperature (Std.β = -0.43).

Table G1. Hierarchical Regressions of Thermal Comfort Measures

Model	Predictor	R^2	Change in R^2	F Change	Std.β
AIR TEMPERATURE SENSATION					
How do you feel the air temperature is at this time in the office?					
1		0.17***	0.17***	28.45***	
	Air Temperature				0.41***
2		0.18***	< 0.01	1.47	
	Air Temperature				0.28*
	Operative Temperature				0.16
3		0.18***	< 0.01	1.22	
	Air Temperature				0.28*
	Operative Temperature				0.14
	Lux				0.09
4		0.23***	0.05	2.75	
	Air Temperature				0.40*
	Operative Temperature				0.09
	Lux				0.04
	RH				0.19*
	CO_2				-0.08
	dBA				0.16*
Step 1: Air Temperature, Step 2: Operative Temperature, Step 3: Lux, Step 4: RH, CO_2, **dBA**					
AIR TEMPERATURE PREFERENCE					
How would you prefer to feel in your office?					
1		0.03*	0.03*	4.79*	
	Air Temperature				-0.18*
2		0.05*	0.01	1.85	
	Air Temperature				-0.02
	Operative Temperature				-0.19
3		0.09*	0.05	1.65	
	Air Temperature				-0.19
	Operative Temperature				-0.01
	Lux				-0.05
	RH				-0.10
	CO_2				0.23*
	dBA				0.06
Step 1: Air Temperature, Step 2: Operative Temperature, Step 3: Lux, RH, CO_2, **dBA**					
AIR TEMPERATURE ACCEPTABILITY					
How acceptable do you think the air temperature is at this moment?					
1		0.17***	0.16***	27.64***	
	Air Temperature				-0.41***
2		0.17***	0.01	0.01	
	Air Temperature				-0.40**
	Operative Temperature				0.01
3		0.18***	0.02	0.73	
	Air Temperature				-0.43**
	Operative Temperature				0.10
	Lux				0.06
	RH				-0.13
	CO_2				0.01
	dBA				-0.07
Step 1: Air Temperature, Step 2: Operative Temperature, Step 3: Lux, RH, CO_2, **dBA**					

Air Quality

Table G2 present the results from the regressions relating to air quality and this section contains a summary of those results:

Humidity Sensation:

This was found to be significant, ($F (6, 135) = 5.09$, $p < 0.001$), with an R^2 0.18. Air temperature accounted for 5% of the variance in the sample, relative humidity with contributed a further 5%, operative temperature contributed less than 1% and the remaining IV's contributed 8%.

The standardised β coefficients identify that the occupants felt the conditions were more humid was predicted by the increase in air temperature (Std.β = 0.36), relative humidity (Std.β = 0.35) and the decrease in CO_2 (Std.β = -0.25).

Air Freshness Sensation:

This was found to be strongly significant, ($F (6, 135) = 4.82$, $p < .001$), with an R^2 0.18. Air temperature accounted for 11%, operative temperature contributed 1% and the remaining IV's contributed 5%.

The standardised β coefficients identify that occupants perceiving fresher air was predicted by a decrease in air temperature (Std.β = -0.33) in the first model and by relative humidity (Std.β = -0.24) alone when all variables were included in the model.

Air Odour Preference:

This was found to be significant, ($F (6, 135) = 2.71$, $p = 0.016$), with an R^2 0.10. All IV's contributed to 10% of the variance.

The standardised β coefficients identify that the perception of odours and fragrances becoming more pleasant was predicted by an increase in air temperature (Std.β = 0.56) and relative humidity (Std.β = 0.20) and a decrease in CO_2 (Std.β = -0.19) and operative temperature (Std.β = -0.51).

Table G2. Hierarchical Regressions of Air Quality Measures (Part 1 of 2)

Model	Predictor	R^2	Change in R^2	F Change	Std.β
HUMIDITY SENSATION					
How would you describe the level of humidity at this time in the office?					
1		0.05**	0.05*	6.96*	
	Air Temperature				0.22**
2		0.10***	0.06**	8.57**	
	Air Temperature				0.23**
	Relative Humidity				0.24**
3		0.10**	0.01	0.14	
	Air Temperature				0.19
	Relative Humidity				0.24**
	Operative Temperature				0.05
4		0.18***	0.08**	4.46**	
	Air Temperature				0.36*
	Relative Humidity				0.35***
	Operative Temperature				-0.10
	Lux				-0.05
	CO_2				-0.25**
	dBA				0.16

Step 1: Air Temperature, Step 2: RH, Step 3: Operative Temperature, Step 4: Lux, CO_2, dBA

Model	Predictor	R^2	Change in R^2	F Change	Std.β
AIR FRESHNESS SENSATION					
How would you describe the freshness of the air at this time in the office?					
1		0.11***	0.11***	15.74***	
	Air Temperature				-0.33***
2		0.12***	0.02	2.30	
	Air Temperature				-0.15
	Operative Temperature				-0.21
4		0.18***	0.06	2.25	
	Air Temperature				-0.28
	Operative Temperature				-0.11
	Relative Humidity				-0.24**
	CO_2				0.12
	dBA				-0.10
	Lux				0.04

Step 1: Air Temperature, Step 2: Operative Temperature, Step 3: RH, Lux, CO_2, dBA

Table G3. Hierarchical Regressions of Air Quality Measures (Part 1 of 2)

Model	Predictor	R^2	Change in R^2	F Change	Std.β
AIR ODOUR/ FRAGRANCE PREFERENCE					
How would you prefer the level of odours/fragrances experienced to be in the room at this time?					
1		0.11*	0.11*	2.71*	
	Air Temperature				0.56***
	Lux				-0.11
	Operative Temperature				-0.51**
	Relative Humidity				0.20*
	CO_2				-0.19*
	dBA				0.04

Step 1: Air Temperature, Lux, Operative Temperature, RH, CO_2, dBA

Acoustic Comfort

Table G4 presents the results from the regression relating to acoustic comfort and this section contains a summary of those results:

Table G4. Hierarchical Regressions of Acoustic Comfort Measures

Model	Predictor	R^2	Change in R^2	F Change	Std.β
NOISE SENSATION					
How would you describe the level of noise within the room at present?					
1		0.03*	0.03*	4.61*	
	Air Temperature				-0.18*

Step 1: Air Temperature, Step 2: RH, Operative Temperature, Lux, CO_2, dBA

Acoustic Sensation:

This was found to be significant, ($F(1, 140) = 4.60$, $p = 0.03$), with an R^2 0.03. Air temperature accounted for 3% of the variance.

The standardised β coefficients identify that a quieter sensation was predicted by air temperatures decreasing (Std.β = -0.18).

Visual Comfort

Measures relating the Visual Glare Source, Visual Glare Magnitude, Visual Glare Feeling were not assessed using regressions as they did not meet the assumptions required. Table G5 to Table G7 present the results from the regression relating to the remaining Visual Comfort measures and this section contains a summary of those results.

Visual Sensation:

This was found to be strongly significant, ($F(6, 135) = 15.19$, $p < 0.001$), with an R^2 0.40. Lux accounted for 32% of the variance and the remaining IV's contributed to 8% of the variance.

The standardised β coefficient identify that occupants perceived brighter conditions was predicted by increased lux levels (Std.β = 0.62) and decreased operative temperature (Std.β = - 0.40) and CO_2 (Std.β = -0.25) measures.

Table G5. Hierarchical Regressions of Visual Comfort Measures (Part 1 of 3)

Model	Predictor	R^2	Change in R^2	F Change	β
LIGHTING SENSATION					
How do you find the level of brightness within the room at present?					
1		0.32***	0.32***	65.46***	
	Lux				0.57***
2		0.38**	0.08**	3.82**	
	Lux				0.62***
	Operative Temperature				-0.43**
	Relative Humidity				0.06
	CO_2				-0.25***
	dBA				-0.08
	Air Temperature				0.23
Step 1: Lux Step 2: Operative Temperature, RH, Air Temperature, CO2, dBA					
LIGHTING PREFERENCE					
How would you prefer the lighting to be within the room at present?					
1		0.17***	0.17**	27.57**	
	Air Temperature				0.40***
2		0.17***	0.01	1.45	
	Air Temperature				0.27*
	Operative Temperature				0.16
3		0.23***	0.05	2.38	
	Air Temperature				0.35*
	Operative Temperature				0.09
	Relative Humidity				0.19*
	Lux				0.04
	CO_2				-0.08
	dBA				0.16*
Step 1: Air Temperature, Step 2: Operative Temperature Step 3: Lux, CO_2, dBA					

LIGHTING ACCEPTABILITY					
How acceptable is the lighting within the room at present?					
1		0.10***	0.10***	15.96***	
	Lux				0.32***
2		0.18***	0.07*	2.40*	
	Lux				0.37***
	Operative Temperature				-0.05
	Air Temperature				-0.21
	RH				0.09
	CO_2				-0.01
	dBA				-0.09

Step 1: Air Temperature, Step2: Operative Temperature, Air Temperature, RH, CO_2, dBA

Visual Preference:

This was found to be strongly significant, (F (6, 135) = 6.63, p < 0.001), with an R^2 0.23. Air Temperature accounted for 17% of the variance, operative temperature contributes less than 1% and the remaining IV's contributed an additional 5%.

The standardised β coefficient identify that a preference for brighter conditions was predicted by an increase in air temperature (Std.β = 0.35), relative humidity (Std.β = 0.19) and dBA (Std.β = 0.16).

Visual Acceptability:

This was found to be strongly significant, (F (6, 133) = 4.79, p < .001), with an R^2 0.18. Lux accounted for 10% of the variance and the remaining IV's contributed 8%.

The standardised β coefficients identify that when occupants found the level of brightness more acceptable this was predicted by an increase in lux levels (Std.β = 0.37).

Visual Ease with Questionnaire:

This was found to be strongly significant, (F (6, 135) = 6.24, p < .001), with an R^2 0.22. Lux levels accounted for 18% of the variance in the sample and all other IV's contributed a further 4%.

The standardised β coefficients identify that when participants reported that reading the questionnaire was easier this was predicted by an increase in lux levels (Std.β = 0.46).

Visual Glare:

This was found to be significant, (F (6, 133) = 3.45, p = 0.003), with an R^2 0.14. Lux levels accounted for 4% of the variance in the sample, CO_2 accounted for 4%, operative

temperature and air temperature contributed 2% and the additional IVs contributed a further 2% of the variance.

The standardised β coefficients identify that more glare issues were predicted by a decrease in lux levels (Std.β = -0.18) in the first model and a decrease in CO_2 (Std.β = -0.30) and operative temperatures (Std.β = -0.40) when all environmental variables were included in the final model.

Table G6. Hierarchical Regressions of Visual Comfort Measures (Part 2 of 3)

Model	Predictor	R^2	Change in R^2	F Change	Std.β
VISUAL EASE					
Does the lighting at present make it easier or harder to read the questionnaire?					
1		0.18***	0.18**	31.49**	
	Lux				0.43***
2		0.22***	0.03	1.57	
	Lux				0.46***
	Air Temperature				- 0.11
	Operative Temperature				-0.05
	Relative Humidity				0.04
	CO_2				0.08
	dBA				0.41
Step 1: Lux Step 2: Operative Temperature, RH, Air Temperature, CO_2, dBA					
Model	**Predictor**	**R^2**	**Change in R^2**	**F Change**	**Std.β**
GLARE SENSATION					
Are you experiencing any issues with glare from the computer or on your person whilst sitting at your desk?					
1		0.04*	0.04*	5.01*	
	Lux				-0.19*
2		0.05**	0.02*	2.75*	
	Lux				-0.15
	Operative Temperature				-0.14
3		0.10**	0.05*	7.35*	
	Lux				-0.14
	Operative Temperature				-0.18*
	CO_2				-0.22**
4		0.12**	0.01	2.06	
	Lux				-0.14
	Operative Temperature				-0.37*
	CO_2				-0.27**
	Air Temperature				0.22
5		0.13**	0.01	0.72	
	Lux				-0.16
	Operative Temperature				-0.39*
	CO_2				-0.29**
	Air Temperature				0.26
	Relative Humidity				0.10
	dBA				0.05
Step 1: Lux Step 2: Operative Temperature Step 3: CO_2 Step 4: Air Temperature, Step 5: RH, dBA					

View Satisfaction:

This was found to be strongly significant, ($F (6, 135) = 6.76$, $p < .001$), with an R^2 0.23. Air temperature contributed 9% of the variance in the sample, operative temperature contributed 1%, CO_2 contributed 2%, lux contributed 11% and the remaining iv's contributed less than 1% of the variance in the sample.

The std. β identifies that more satisfactory views were reported by occupants was predicted by a decrease in operative temperature (Std.β = - 0.36) and an increase in lux levels (Std.β = 0.33) when all environmental variables were included in the final model. CO_2 (within the 3rd and 4th model) and air temperature in the 1st model was also found significant when fewer environmental variables were included in the model.

Table G7. Hierarchical Regressions of Visual Comfort Measures (Part 3 of 3)

Model	Predictor	R^2	Change in R^2	F Change	Std.β
VIEW SENSATION					
How satisfied are you with the quality of your view at your current desk location?					
1		0.09***	0.08***	13.39***	
	Air Temperature				-0.28**
2		0.10**	0.01	2.17	
	Air Temperature				-0.12
	Operative Temperature				-0.19
3		0.12***	0.02	3.23	
	Air Temperature				-.010
	Operative Temperature				-0.31*
	CO_2				-0.17*
4		0.23***	0.11***	18.94***	
	Air Temperature				-0.01
	Operative Temperature				-0.40*
	CO_2				-0.18*
	Lux				0.34*
5		0.23***	0.01	0.22	
	Air Temperature				-0.03
	Operative Temperature				-0.36*
	CO_2				-0.15
	Lux				0.33***
	Relative Humidity				-0.02
	dBA				0.11

Step 1: Air Temperature, Step 2: Operative Temperature, Step 3: CO_2, Step 4: Lux, Step 5: RH, dBA

G2. Subjective Comfort and Productivity

Subjective Comfort

Table G8 presents the results from the regressions relating to comfort. This was found to be significant, (F (6, 137) = 2.18, p =.049), with an R^2 0.09. Air temperature accounted for 6% of the variance in the sample, operative temperature contributed less than 1% and the remaining IV's contributed 2%.

The standardised β coefficients identifies the perception of more comfortable conditions was predicted by a decrease in air temperature (Std.β = - 0.28).

Table G8. Hierarchical Regressions of Comfort Measures

Model	Predictor	R^2	Change in R^2	F Change	Std.β
OVERALL COMFORT SENSATION					
At this time, how would you rate your overall comfort at your desk location?					
1		0.06**	0.06**	8.82**	
	Air Temperature				-0.24**
2		0.06*	< 0.01	0.01	
	Air Temperature				-0.25
	Operative Temperature				0.01
3		0.09*	0.03	1.07	
	Air Temperature				- 0.28*
	Operative Temperature				< 0.01
	Lux				0.12
	Relative Humidity				- 0.16
	CO_2				- 0.01
	dBA				- 0.07

Step 1: Air Temperature Step 2: Operative Temperature Step 3: Lux, RH, CO_2, dBA RH, dBA

Subjective Productivity

Table G9 presents the results from the regressions relating to subjective productivity. However, the PROD_EXT question which related to external issues potentially affecting occupants was not assessed. This was given a tick box question with three choices 'Yes', 'No' and 'Maybe' and did not meet the regression assumptions. This section contains a summary of those results:

Belief in Productivity being affected:

This was found to be strongly significant, F (6, 137) = 6.61, p <.001), with an R^2 0.23. Air temperature accounted for 15% of the variance in the sample, operative temperature and lux contributed less than 1% and the remaining IV's contributed 7%.

The standardised β coefficients identifies a more positive belief that their productivity is being affected by the surrounding environment was predicted by an increase in air temperature (Std.β = 0.62) and relative humidity (Std.β = .28).

Willingness to exert effort:

This was found to be strongly significant, (F (6, 136) = 2.64, p =.019), with an R^2 0.10. operative temperature accounted for 6% of the variance in the sample and the remaining IV's contributed 4%.

The standardised β coefficients identifies a higher motivation to complete the tacks set was predicted by a decrease in operative temperature (Std.β = - 0.44).

Table G9. Hierarchical Regressions of Subjective Productivity Measures

Model	Predictor	R2	Change in R2	F Change	Std.β
BELIEF OF THE ENVIRONMENT AFFECTING THEIR WORK PRODUCTIVITY					
To what extent do you believe the environment is impacting your work productivity at this moment?					
1		0.15***	0.15**	25.53**	
	Air Temperature				0.39***
2		0.16***	< 0.01	0.49	
	Air Temperature				0.47***
	Operative Temperature				-0.10
3		0.16***	0.01	1.15	
	Air Temperature				0.47***
	Operative Temperature				-0.12
	Lux				0.09
4		0.23***	0.06*	3.68*	
	Air Temperature				0.62***
	Operative Temperature				-0.25
	Lux				0.04
	RH				0.28***
	CO_2				-0.13
	dBA				0.03
Step 1: Air Temperature, Step 2: Operative Temperature, Step 3: Lux, Step 4: RH, CO_2, dBA					
WILLINGNESS TO EXERT EFFORT ON THE TASKS SET					
How willing they were to exert effort on the tasks set at this moment?					
1		0.06**	0.06**	8.77**	
	Operative Temperature				-0.24**
2		0.10*	0.05	1.40	
	Operative Temperature				-0.44**
	Air Temperature				0.18
	Lux				0.15
	Relative Humidity				-0.05
	CO_2				-0.12
	dBA				0.04
Step 1: Operative Temperature Step 2: Air Temperature, Lux, RH, CO_2, dBA , RH, dBA					

G3. Health and Well-being

This section presents the results of the regressions relating to health and well-being pre-test and post-test.

Pre-Test

Table G10 to Table G11 present the results from the regression and this section contains a summary of those results:

Tenseness:

This was found to be significant, (F (6, 137) = 3.65, p =.002), with an R^2 0.14. Operative Temperature accounted for 4% of the variance in the sample, air temperature contributed 1% and the remaining IVs contributed 9%.

The std. β coefficients identify that occupants' feeling tenser was predicted by an increase in operative temperature (Std.β = 0.48) and a decrease in lux levels (Std.β = - 0.22).

Table G10. Hierarchical Regressions of Health and Well-being Pre-Test (Part 1 of 2)

Model	Predictor	R^2	Change in R^2	F Change	Std.β
MOOD: FEELING TENSE					
How would you describe your mood at present? Tense?					
1		0.04**	0.04**	6.58**	
	Operative Temperature				0.21**
2		0.05*	0.01	1.24	
	Operative Temperature				0.34*
	Air Temperature				-0.16
3		0.14**	0.09*	3.38*	
	Operative Temperature				0.48**
	Air Temperature				-0.25
	Lux				-0.22**
	dBA				-0.10
	CO_2				0.17
	Relative Humidity				-0.01
Step 1: Operative Temperature, Step 2: Air Temperature, Step 3: Lux, dBA, CO_2, Relative Humidity					
MOOD: FEELING SAD					
How would you describe your mood at present? Sad?					
1		0.03*	0.03*	4.60*	
	Operative Temperature				0.18*
2		0.07**	0.04*	5.70*	
	Operative Temperature				0.21**
	CO_2				0.20*
3		0.07*	< 0.01	0.02	
	Operative Temperature				0.22
	CO_2				0.20*
	Air Temperature				-0.02
Step 1: Operative Temperature, Step 2: CO_2, Step 3: Air Temperature, Step 4: Lux, Relative Humidity, dBA					

MOOD: FEELING ANXIOUS *How would you describe your mood at present? Anxieties?*					
1		0.03*	0.03*	4.00*	
	Operative Temperature				0.17*
2		0.10*	0.07	2.08	
	Operative Temperature				0.29
	Lux				-0.15
	Air Temperature				-0.08
	Relative Humidity				-0.06
	CO_2				0.18
	dBA				-0.11
Step 1: Operative Temperature, Step 2: Lux, Air Temperature, Relative Humidity, CO_2, dBA					

Feeling Sad:

This was found to be significant, (F (3, 140) = 3.47, p =.18), with an R^2 0.07. Operative temperature accounted for 3% of the variance in the sample CO_2 contributed 4%, air temperature contributed < 1%.

The standardised β coefficients identify that occupants feeling sadder is predicted by an increase in operative temperature (Std.β = 0.21) and CO_2 (Std.β = 0.20) in the 2nd model. However, when air temperature was introduced CO_2 alone was found to predict the response.

Feeling Anxious:

This was found to be significant, (F (6, 137) = 2.42, p =.029), with an R^2 0.10. Operative temperature accounted for 3% of the variance in the sample and the remaining IV's contributed 7%.

The standardised β coefficients identify that occupants feeling more anxious was predicted by an increase in operative temperature (Std.β = 0.17).

Feeeling Confused:

This was found to be significant, (F (6, 137) =3.07, p =.007), with an R^2 0.12. Operative temperature accounted for 6% of the variance in the sample, air temperature contributed less than 1%, CO_2 contributed 3% and the remaining IV's contributed an additional 2%.

The standardised β coefficients identify that occupants felt more confused was predicted by increased operative temperature (Std.β = 0.25) in the 1st model and by CO_2 (Std.β = 0.18) alone in the 3rd model.

Level of Fatigue:

This was found to be significant, (F (6, 136) = 2.87, p =.012), with an R^2 0.12. Operative Temperature accounted for 5% of the variance in the sample and the remaining IV's contributed 6%.

The standardised β coefficients identify that occupants feeling more alert was predicted by decreased operative temperature (Std.β = -0.37) and increased lux levels (Std.β = 0.21).

Table G11. Hierarchical Regressions of Health & Well-being Pre-Test (Part 2 of 2)

Model	Predictor	R^2	Change in R^2	F Change	Std.β
MOOD: FEELING CONFUSED					
How would you describe your mood at present? Confused?					
1		0.06**	0.06**	9.42**	
	Operative Temperature				0.25**
2		0.07**	0.01	0.57	
	Operative Temperature				0.16
	Air Temperature				0.11
3		0.09**	0.03*	4.54*	
	Operative Temperature				0.28
	Air Temperature				-0.03
	CO_2				0.18*
3		0.12**	0.02	1.21	
	Operative Temperature				0.28
	Air Temperature				0.03
	CO_2				0.16
	Lux				-0.14
	Relative Humidity				0.04
	dBA				-0.07
Step 1: Operative Temperature, Step 2: Air Temperature, Step 3: CO_2, Step 4: Lux, Relative Humidity, dBA					
DESCRIPTION OF FATIGUE					
How would you describe your state of fatigue at this moment?					
1		0.05**	0.05**	7.77**	
	Operative Temperature				-0.23**
2		0.11**	0.06	1.84	
	Operative Temperature				-0.37**
	Air Temperature				0.11
	CO_2				-0.05
	Lux				0.21*
	Relative Humidity				-0.05
	dBA				0.08
Step 1: Operative Temperature, Step 2: Air Temperature, Step 3: CO_2, Lux, Relative Humidity, dBA					

Post-Test

Table G12 - Table G17 present the results from the regression relating to the post-test health and well-being survey and this section contains a summary of those results:

Lip Dryness:

This was found to be significant, ($F (1, 140) = 6.20$, $p = .014$), with an R^2 0.04. Air Temperature accounted for 4% of the variance in the sample and the remaining IV's were not found to significantly contribute to the model.

The standardised β coefficients identify that occupants perceived that their lips felt less dry was predicted by the decrease in air temperature (Std.β = -0.21).

Skin Dryness:

This was found to be significant, ($F (6, 135) = 2.74$, $p = .015$), with an R^2 0.11. Air temperature accounted for 3% of the variance in the sample, operative temperature accounted for an additional 3%, dBA accounted for 2% and the remaining IV's contributed the remaining 2% of the variance.

The standardised β coefficients identify that occupants perceived that their skin felt less dry was predicted by the increase in air temperature (Std.β = 0.16) in the first model and operative temperature (Std.β = 0.45) when all environment measures were included.

Eyes Smarting/Hurting:

This was found to be significant, ($F (6, 135) = 2.36$, $p = .034$), with an R^2 0.10. Operative Temperature accounted for 3% of the variance in the sample and the remaining IV's contributed 6% of the variance.

The standardised β coefficients identify that occupants perceived that their eyes were hurting/smarting less was predicted by the decrease in operative temperature (Std.β = -0.50) and an increase in air temperature (Std.β = 0.32).

Table G12. Hierarchical Regressions of Health & Well-being Post-Test (Part 1 of 6)

Model	Predictor	R^2	Change in R^2	F Change	Std.β
LIPS: DRY OR NOT DRY?					
On a scale from 0 to 100, how do you feel at the present time? Lip dry or not dry?					
1		0.04*	0.04*	6.20*	
	Air Temperature				-0.21*
Step 1: Operative Temperature, Step 2: Lux, Air Temperature, RH, CO2, dBA					
SKIN: DRY OR MOIST?					
On a scale from 0 to 100, how do you feel at the present time? *Skin dry or moist?*					
1		0.03*	0.03*	4.09*	
	Air Temperature				0.17*
2		0.06**	0.04*	5.26*	
	Air Temperature				-0.10
	Operative Temperature				0.33*
3		0.08**	0.02	3.06	
	Air Temperature				-0.10
	Operative Temperature				0.31**
	dBA				-0.14
4		0.02*	0.02	1.22	
	Air Temperature				-0.21
	Operative Temperature				0.45**
	dBA				-0.12
	RH				-0.06
	Lux				-0.08
	CO_2				-0.15
Step 1: Air Temperature, Step 2: Operative Temperature, Step 3: dBA Step 4: Lux, Relative Humidity, CO_2, dBA					
EYES: SMARTING/HURTING OR NOT SMARTING/HURTING?					
On a scale from 0 to 100, how do you feel at the present time? Eyes Smarting / Hurting to Eyes Not Smarting/Hurting?					
1		0.03*	0.03*	4.67*	
	Operative Temperature				-0.18*
2		0.10*	0.06	1.85	
	Operative Temperature				-0.50**
	Lux				0.14
	Air Temperature				0.32*
	Relative Humidity				0.09
	CO_2				-0.15
	dBA				0.07
Step 1: Operative Temperature, Step 2: Lux, Air Temperature, Relative Humidity, CO_2, dBA					

Experienceing a headache:

This was found to be significant, (F (6, 135) = 2.72, p =.016), with an R^2 0.11. Air Temperature accounted for 7% of the variance in the sample, Operative Temperature contributed <1% and the remaining IV's contributed 3% of the variance.

The standardised β coefficients identify that occupants experiencing fewer headache symptoms was predicted by the decrease in operative temperature (Std.β = -0.27).

Clarity of Thinking:

This was found to be significant, (F (6, 135) = 2.96, p =.010), with an R^2 0.12. Operative temperature accounted for 8% of the variance in the sample, air temperature contributed for an additional 1% and the remaining IV's contributed 3% of the variance.

The standardised β coefficients identify that occupants finding it harder to think was predicted by the increase in operative temperature (Std.β = 0.54).

Table G13. Hierarchical Regressions of Health & Well-being Pre-Test (Part 2 of 6)

Model	Predictor	R^2	Change in R^2	F Change	Std.β
HEADACHE SYMPTOMS					
On a scale from 0 to 100, how do you feel at the present time? Severe *Headache or No Headache?*					
1		0.07***	0.07***	10.79***	
	Operative Temperature				-0.24***
2		0.07**	< 0.01	0.01	
	Operative Temperature				-0.02
	Air Temperature				-0.26
3		0.11*	0.04	1.37	
	Operative Temperature				-0.16
	Air Temperature				-0.15
	Lux				0.13
	Relative Humidity				0.05
	CO_2				-0.14
	dBA				0.04
Step 1: Operative Temperature, Step 2: Air Temperature, Step 3: Lux, Relative Humidity, CO_2, **dBA**					
CLARITY OF THINKING					
On a scale from 0 to 100, how do you feel at the present time? Head Clear to Difficult to think?					
1		0.08***	0.08***	11.48***	
	Operative Temperature				0.28***
2		0.09***	0.02	2.25	
	Operative Temperature				0.45**
	Air Temperature				-0.22
3		0.12**	0.03	0.98	
	Operative Temperature				0.54**
	Air Temperature				-0.25
	Lux				-0.13
	Relative Humidity				-0.09
	CO_2				0.03
	dBA				-0.03
Step 1: Operative Temperature, Step 2: Air Temperature, Step 3: Lux, Relative Humidity, CO_2, **dBA**					

Feeling Dizzy:

This was found to be significant, (F (6, 135) = 2.62, p =.019), with an R^2 0.10. Operative temperature accounted for 5%, air temperature accounted for < 1% and the remaining IV's contributed 4% to the model.

The standardised β coefficients identify that occupants perceived that occupants feeling dizzy was predicted by the increase in operative temperature (Std.β = 0.23).

Feeling Bad or Good:

This was found to be significant, (F (1, 140) = 7.94, p =.006), with an R^2 0.05. Operative temperature accounted for 5% of the variance in the sample and none of the remaining IV's contributed to the variance in the model.

The standardised β coefficients identify that occupants feeling good was predicted by the decrease in operative temperature (Std.β = -0.23).

Concentration Level:

This was found to be significant, (F (1, 140) = 6.28, p =.013), with an R^2 0.04. Operative Temperature accounted for 4% of the variance in the sample and the remaining IV's did not significantly contribute to the variance.

The standardised β coefficients identify that concentration was perceived to be easier was predicted by the decrease in operative temperature (Std.β = -0.21).

Happiness / Positivity:

This was found to be significant, (F (1, 140) = 4.63, p =.033), with an R^2 0.03. Operative Temperature accounted for 3% of the variance in the sample and the remaining IV's did not significantly contribute to the variance.

The standardised β coefficients identify that a feeling of positivity was predicted by a decrease in operative temperature (Std.β = -0.18).

Table G14. Hierarchical Regressions of Health & Well-being Post-Test (Part 3 of 6)

Model	Predictor	R^2	Change in R^2	F Change	Std.β
Dizziness Sensation					
On a scale from 0 to 100, how do you feel at the present time? Not Dizzy to Dizzy?					
1		0.05**	0.05**	6.74**	
	Operative Temperature				0.22**
2		0.05*	0.01	0.65	
	Operative Temperature				0.12
	Air Temperature				0.12
3		0.10*	0.05	2.04	
	Operative Temperature				0.23
	Air Temperature				0.02
	Lux				-0.11
	Relative Humidity				-0.09
	CO_2				0.14
	dBA				-0.14
Step 1: Operative Temperature, Step 2: Air Temperature, Step 3: Lux, Relative Humidity, CO_2, dBA					
General Feeling					
On a scale from 0 to 100, how do you feel at the present time? Feeling Bad to Feeling Good?					
1		0.05**	0.05**	7.93**	
	Operative Temperature				-0.23**
Step 1: Operative Temperature, Step 2: Air Temperature, Lux, Relative Humidity, CO_2, dBA					
Ability to Concentrate.					
On a scale from 0 to 100, how do you feel at the present time? Difficult to concentrate - Easy to concentrate?					
1		0.04*	0.04*	6.28*	
	Operative Temperature				-0.21*
Step 1: Operative Temperature, Step 2: Air Temperature, Lux, Relative Humidity, CO_2, dBA					
General Attitude					
On a scale from 0 to 100, how do you feel at the present time? Depressed to Positive?					
1		0.03*	0.03*	4.63*	
	Operative Temperature				-0.18*
Step 1: Operative Temperature, Step 2: Air Temperature, Step 3: Lux, Relative Humidity, CO_2, dBA					

Alert or Sleepy:

This was found to be significant, (F (6, 135) = 2.60, p =.021), with an R^2 0.10. Operative Temperature accounted for 7% of the variance in the sample, air temperature contributed less than 1% and the remaining IV's contributed to 3% the variance.

The standardised β coefficients identify that occupants feeling sleepy was predicted by an increase in operative temperature (Std.β = 0.26) in the 1st model and a decrease in a lux levels (Std.β = -0.18) when all environmental measures were included.

Mental Demand:

This was found to be significant, ($F (6, 135) = 2.49$, $p = .026$), with an R^2 0.10. Air temperature accounted for 6% of the variance in the sample, operative temperature contributed less than 1% and the remaining variables contributed 3%.

The standardised β coefficients identify that a high mental demand was required for the tests was predicted by the increase in air temperature (Std.β = 0.24).

Physical Demand:

This was found to be significant, ($F (6, 135) = 2.82$, $p = .013$), with an R^2 0.11. CO_2 accounted for 5% of the variance in the sample, air and operative temperature both contributed < 1% of the variance and the remaining IV's contributed 5% to the variance.

The standardised β coefficients identify that a high physical demand was required for the tests was predicted by the increase in CO_2 (Std.β = 0.20) and air temperature (Std.β = 0.18) in the 2nd model. However, when operative temperature was included in the model an increase CO_2 alone (Std.β = 0.20) was found to predict a higher physical demand.

Table G15. Hierarchical Regressions of Health & Well-being Post-Test (Part 4 of 6)

Model	Predictor	R^2	Change in R^2	F Change	Std.β
Alertness					
On a scale from 0 to 100, how do you feel at the present time? Alert or Sleepy?					
1		0.07**	0.07**	9.98**	
	Operative Temperature				0.25**
2		0.07**	0.01	0.36	
	Operative Temperature				0.19
	Air Temperature				0.09
3		0.10*	0.04	1.30	
	Operative Temperature				0.25
	Air Temperature				0.06
	Lux				-0.18*
	Relative Humidity				-0.05
	CO_2				0.02
	dBA				0.01
Step 1: Operative Temperature, Step 2: Air Temperature, Step 3: Lux, Relative Humidity, CO_2, dBA					
Mental Demand Required					
On a scale from 0 to 100, how mentally demanding were the tasks set? Very Low to Very High?					
1		0.06**	0.06**	8.60**	
	Air Temperature				0.25**
2		0.06**	0.01	0.28	
	Air Temperature				0.19
	Operative Temperature				0.08
3		0.10*	0.04	1.49	
	Air Temperature				0.15
	Operative Temperature				0.11
	Lux				-0.07
	Relative Humidity				-0.11
	CO_2				0.03
	dBA				-0.13
Step 1: Air Temperature, Step 2: Operative Temperature, Step 3: Lux, Relative Humidity, CO_2, dBA					
Physical Demand Required					
On a scale of 1 to 100, how physically demanding were the tasks set? Very Low to Very High?					
1		0.05*	0.05*	6.54*	
	CO_2				0.21*
2		0.08**	0.03	4.76	
	CO_2				0.20*
	Air Temperature				0.18*
2		0.08*	< 0.01	0.01	
	CO_2				0.20*
	Air Temperature				0.18
	Operative Temperature				-0.01
3		0.11*	0.04	1.78	
	CO_2				0.17
	Air Temperature				0.21
	Operative Temperature				-0.02
	Lux				-0.12
	Relative Humidity				-0.01
	dBA				-0.14
Step 1: Air Temperature, Step 2: Operative Temperature, Step 3: Lux, Relative Humidity, CO_2, dBA					

Effort of Tasks:

This was found to be significant, (F (6, 135) =2.42, p =.03), with an R^2 0.10. Air temperature accounted for 5% of the variance in the sample and the remaining IV's contributed to 5% the variance.

The standardised β coefficients identify that occupants felt they worked harder on the tasks was predicted by an increase in air temperature (Std.β = 0.23).

Insecure:

This was found to be strongly significant, (F (6, 135) = 5.52, p < .001), with an R^2 0.20. Operative temperature accounted for 8% of the variance in the sample, air temperature contributed 2%, dBA contributed 4% and the remaining variables contributed 6%.

The standardised β coefficients identify that occupants felt more insecure when conducting the tasks which was predicted by an increase in operative temperature (Std.β = 0.57) and a decrease in air temperature (Std.β = -0.32), dBA (Std.β = -0.22) and relative humidity (Std.β = -0.25).

Discouraged:

This was found to be significant, (F (6, 135) = 3.28, p =.005), with an R^2 0.13. Operative Temperature accounted for 5% of the variance in the sample, air temperature contributed less than 1%, CO_2 contributed 4% and the remaining IV's contributed 4% to the variance.

The standardised β coefficients identify that the occupants feeling discouraged was predicted by the increase in operative temperature (Std.β = 0.39) and CO_2 (Std.β = 0.22).

Table G16. Hierarchical Regressions of Health & Well-being Post-Test (Part 5 of 6)

Model	Predictor	R^2	Change in R^2	F Change	β
Amount of effort required to achieve level of performance on the Tasks Set					
On a scale of 1 to 100, how hard did you have to work to achieve your level of performance on the tasks set overall? Not at all hard to Very hard?					
1		0.05**	0.05**	7.71**	
	Air Temperature				0.23**
2		0.09*	0.05	1.34	
	Air Temperature				0.37*
	Lux				0.01
	Operative Temperature				-0.21
	Relative Humidity				-0.10
	CO_2				0.03
	dBA				-0.17
Step 1: Operative Temperature, Step 2: Air Temperature, Lux, Relative Humidity, CO_2, **dBA**					
Feeling Insecure when completing the Tasks Set					
On a scale of 1 to 100, how insecure did you feel whilst completing the tasks set? Not at all insecure to Very Insecure?					
1		0.08***	0.08***	12.79***	
	Operative Temperature				0.29***
2		0.10***	0.01	1.71	
	Operative Temperature				0.44**
	Air Temperature				-0.19
3		0.14***	0.04*	6.35*	
	Operative Temperature				0.41**
	Air Temperature				-0.17
	dBA				-0.20*
4		0.20***	0.06*	3.49*	
	Operative Temperature				0.57***
	Air Temperature				-0.32*
	dBA				-0.22**
	Lux				-0.06
	Relative Humidity				-0.25**
	CO_2				0.16
Step 1: Operative Temperature, Step 2: Air Temperature, Step 3: **dBA**, Step 4: Lux, Relative Humidity, CO_2.					
Feeling Discouraged when completing the Tasks Set					
On a scale of 1 to 100, how discouraged were you whilst completing the tasks set? Not at all discouraged to Very discouraged?					
1		0.05*	0.05*	6.55*	
	Operative Temperature				0.21*
2		0.05*	0.01	0.01	
	Operative Temperature				0.20
	Air Temperature				0.01
3		0.09**	0.04*	6.09*	
	Operative Temperature				0.35*
	Air Temperature				-0.13
	CO_2				0.22*
4		0.13**	0.04	2.18	
	Operative Temperature				0.39*
	Air Temperature				-0.14
	CO_2				0.22*
	Lux				-0.15
	Relative Humidity				-0.07
	dBA				-0.09
Step 1: Operative Temperature, Step 2: Air Temperature, Step 3: CO_2, Step 4: Lux, Relative Humidity, **dBA.**					

Irritated:

This was found to be significant, ($F(6, 135) = 5.96$, $p < .001$), with an R^2 0.21. Operative temperature accounted for 12% of the variance in the sample and the remaining IV's contributed to 9% the variance.

The standardised β coefficients identify that occupants feeling more irritated by the tasks was predicted by an increase in operative temperature (Std.β = 0.59) and CO_2 (Std.β = 0.21) and a decrease in lux levels (Std.β = -0.23).

Stressed:

This was found to be strongly significant, ($F(6, 133) = 6.63$, $p < .001$), with an R^2 0.23. Operative Temperature accounted for 11% of the variance in the sample, Air Temperature contributed less than 1%, and the remaining variables contributed 11%.

The standardised β coefficients identify that occupants feeling stressed was predicted by the increase in operative temperature (Std.β = 0.58) and CO_2 (Std.β = 0.27) and the decrease in relative humidity (Std.β = -0.21).

Annoyed:

This was found to be strongly significant, ($F(6, 135) = 5.65$, $p < .001$), with an R^2 0.20. Operative temperature accounted for 11% of the variance in the sample, air temperature contributed less than 1% and the remaining IV's contributed 9% to the variance.

The standardised β coefficients identify that occupants feeling annoyed was predicted by the increase in operative temperature (Std.β = 0.64) and the decrease in lux levels (Std.β = -0.25).

Table G17. Hierarchical Regressions of Health & Well-being Post-Test (Part 6 of 6)

Model	Predictor	R^2	Change in R^2	F Change	Std.β
Feeling Irritated when completing the Tasks Set					
On a scale of 1 to 100, how irritated were you whilst completing the tasks set? Not Irritated to Very Irritated?					
1		0.12***	0.12***	18.20***	
	Operative Temperature				0.33***
2		0.12***	< 0.01	0.04	
	Operative Temperature				0.36*
	Air Temperature				-0.03
3		0.21***	0.09**	4.02**	
	Operative Temperature				0.59***
	Air Temperature				-0.20
	Lux				-0.23**
	Relative Humidity				-0.14
	CO_2				0.21*
	dBA				-0.02
Step 1: Operative Temperature, Step 2: Air Temperature, Step 3: Lux, Relative Humidity, CO_2, dBA.					
Feeling Stressed when completing the Tasks Set					
On a scale of 1 to 100, how stressed were you whilst completing the tasks set? Not Stressed to Very Stressed?					
1		0.11***	0.11***	16.45***	
	Operative Temperature				0.33***
2		0.11***	< 0.01	0.01	
	Operative Temperature				0.35*
	Air Temperature				-0.03
3		0.22***	0.11***	4.84***	
	Operative Temperature				0.58***
	Air Temperature				-0.24
	Lux				-0.13
	Relative Humidity				-0.21*
	CO_2				0.27**
	dBA				-0.15
Step 1: Operative Temperature, Step 2: Air Temperature, Step 3: Lux, Relative Humidity, CO_2, dBA					
Feeling Annoyed when completing the Tasks Set					
On a scale of 1 to 100, how annoyed were you whilst completing the tasks set? Not Annoyed to Very Annoyed?					
1		0.11***	0.11***	16.46***	
	Operative Temperature				0.32***
2		0.11***	0.01	1.01	
	Operative Temperature				0.44***
	Air Temperature				-0.14
3		0.20***	0.09**	3.72**	
	Operative Temperature				0.64***
	Air Temperature				-0.27
	Lux				-0.25**
	Relative Humidity				-0.11
	CO_2				0.17
	dBA				-0.01
Step 1: Operative Temperature, Step 2: Air Temperature, Step 3: Lux, Relative Humidity, CO_2, dBA					

G4. Objective Productivity

Work Type Tests

From the Work Type tests only one of the three tests analysed found significance. The Data Checking and the Grammar test produced no significant regressions. Only those tests with significant regressions produced have been presented below.

Text Typing:

Table G18 presents the significant results from the text typing test.

Number of words typed per minute:

Text typing speed was found to be strongly significant, ($F(6, 144) = 3.60$, $p = .002$), with an R^2 0.13. Operative temperature accounted for 7% of the variance in the sample, Air temperature and CO_2 accounted for less than 1% and the remaining environmental variables contributed an additional 4%.

The standardised β coefficients identifies a higher text typing speed was predicted by the decrease in Operative Temperature (Std.β = -0.27). However, text typing error and text typing accuracy were not found significant.

Table G18. Hierarchical Regressions of Work Type Test – Text Typing

Model	Predictor	R^2	Change in R^2	F Change	Std.β
Number of words typed per minute (WPM)					
1		0.07***	0.07***	11.47***	
	Operative Temperature				-0.27***
2		0.08**	0.01	0.88	
	Operative Temperature				-0.16
	Air Temperature				-0.13
3		0.10**	0.02	3.22	
	Operative Temperature				-0.25**
	Air Temperature				0.05
	CO_2				0.15
4		0.13**	0.03	1.87	
	Operative Temperature				-0.28
	Air Temperature				-0.05
	CO_2				-0.15
	Lux				0.15
	Relative Humidity				0.02
	dBA				0.09

Step 1: Operative Temperature, Step 2: Air Temperature, Step 3: CO_2 Step 4: RH, dBA, Lux.

G5. Cognitive Function Tests

From the cognitive function tests that were analysed four of the six tests produced a significant regression. Choice Reaction and the Short-Term Memory test produced no significant regressions. Only those tests with significant regressions produced have been presented below.

Number Search:

Table G19 presents the significant results from the number search test.

Table G19. Hierarchical Regressions of the Cognitive Function Test – Number Search

Model	Predictor	R^2	Change in R^2	F Change	Std.β
Time taken to respond (s)					
1		0.07**	0.06**	10.36**	
	Air Temperature				0.26**
2		0.07**	< 0.01	0.03	
	Air Temperature				0.24
	Operative Temperature				0.03
Step 1: Air Temperature, Step 2: Operative Temperature, Step 3: Lux, RH, CO_2, dBA					
Accuracy of responses (%)					
1		0.04**	0.04**	5.71**	
	CO_2				0.20*
Step 1: CO_2, Step 2: Lux, Operative Temperature, Air Temperature, RH, CO_2, dBA					

Time taken to respond:

Number Search Speed was found to be strongly significant, (F (2, 139) = 5.16, p = .002), with an R^2 0.07. Air Temperature accounted for 7% of the variance in the sample, Operative Temperature contributed less than 1% and the remaining environmental variables contributed did not significantly contribute to the model.

The standardised β coefficients identifies a longer time was taken to complete the number search was predicted by the increase in air temperature (Std.β = 0.26).

Accuracy of responses:

Number Search Accuracy was found to be strongly significant, (F (1, 140) = 5.71, p = .018), with an R^2 0.04. CO_2 accounted for 4% of the variance in the sample and the remaining environmental variables did not significantly contribute to the variance.

The standardised β coefficients identifies improved accuracy on the number search test was predicted by the increase in CO_2 (Std.β = 0.20).

Processing Speed & Accuracy:

Table G20 and Table G21 present the significant results from the Processing Speed and Accuracy task.

Table G20. Hierarchical Regressions of the Cognitive Function Test – Processing Speed (Part 1 of 2)

Model	Predictor	R^2	Change in R^2	F Change	Std.β
Mean time to respond to control stimuli (s)					
1		0.07**	0.07**	10.05**	
	CO_2				-0.26**
2		0.14***	0.07**	10.04**	
	CO_2				-0.20*
	Relative Humidity				-0.26**
3		0.18***	0.05	2.21	
	Relative Humidity				-0.31***
	CO_2				-0.18
	Lux				0.21*
	Operative Temperature				0.06
	Air Temperature				< 0.01
	dBA				-0.07
Step 1: CO_2, Step 2: Relative Humidity, Step 3: Lux, Operative Temperature, Air Temperature, dBA					
Mean time to respond to incongruent stimuli (s)					
1		0.07***	0.07***	11.11***	
	Relative Humidity				-0.27***
2		0.09**	0.02	2.20	
	Relative Humidity				-0.24**
	CO_2				-0.12
3		0.13**	0.05	1.74	
	Relative Humidity				-0.28**
	CO_2				-0.15
	Lux				0.22**
	Operative Temperature				-0.12
	Air Temperature				0.05
	dBA				-0.06
Step 1: RH, Step 2: CO_2, Step 3: Lux, Operative Temperature, Air Temperature, dBA					
Mean time to respond to congruent stimuli (s)					
1		0.12***	0.12***	18.24***	
	Relative Humidity				-0.34***
2		0.19***	0.08*	2.50*	
	Relative Humidity				-0.36***
	CO_2				-0.15
	Lux				0.21*
	Operative Temperature				0.01
	Air Temperature				-0.02
	dBA				-0.13
Step 1: RH, Step 2: CO_2, Step 3: Lux, Operative Temperature, Air Temperature, dBA					

Mean time (s) taken to react to control stimuli:

Processing speed to the control stimuli was found to be strongly significant, ($F (6, 135) = 5.05$, $p < .000$), with an R^2 0.18. CO_2 accounted for 7% of the variance in the sample, Relative Humidity contributed 6% and the remaining environmental variables contributed 5%.

The standardised β coefficients identifies a longer response time to the control stimuli was predicted by the decrease in CO_2 (Std.β = -0.20) in the 1st and 2nd model. However, when all environmental variables were included a decrease in relative humidity (Std.β = -0.31) and an increase in lux (Std.β = 0.21) predicted a poorer performance.

Mean time (s) taken to react to incongruent stimuli:

Processing speed to the incongruent stimuli was found to be significant, ($F (6, 135) = 3.44$, $p = .003$), with an R^2 0.13. Relative Humidity accounted for 7% of the variance in the sample, CO_2 contributed 2% and the remaining environmental variables contributed 4%.

The standardised β coefficients identifies a longer response time to the incongruent stimuli was predicted by the decrease in relative humidity (Std.β = - 0.28) and the increase in lux (Std.β = 0.22).

Mean time (s) taken to react to congruent stimuli:

Processing speed to the congruent stimuli was found to be strongly significant, ($F (6, 135) = 5.28$, $p < .001$), with an R^2 0.19. Relative Humidity accounted for 12% of the variance in the sample and the remaining environmental variables contributed 3%.

The standardised β coefficients identifies a longer response time to the congruent stimuli was predicted by the decrease in relative humidity (Std.β = - 0.36) and an increase in lux (Std.β = 0.21).

Percentage of control stimuli responded to correctly:

This was found to be strongly significant, ($F (6, 135) = 5.20$, $p < .001$), with an R^2 0.19. CO_2 accounted for 7% of the variance in the sample, Relative Humidity contributed 6% and the remaining environmental variables contributed 6%.

The standardised β coefficients identifies that an improved accuracy of control stimuli was predicted by a decrease in CO_2 (Std.β = - 0.18) and relative humidity (Std.β = - 0.32) and an increase in lux levels (Std.β = 0.21).

Table G21. Hierarchical Regressions of the Cognitive Function Test – Processing Accuracy (Part 1 of 2)

Model	Predictor	R^2	Change in R^2	F Change	Std.β
Accuracy of responses to control stimuli (%)					
1		0.07**	0.07**	10.13**	
	CO_2				-0.26**
2		0.13***	0.07**	10.43**	
	CO_2				-0.19*
	Relative Humidity				-0.26**
3		0.19***	0.06	2.29	
	CO_2				-0.18*
	Relative Humidity				-0.32***
	Lux				0.21*
	Operative Temperature				0.05
	Air Temperature				0.01
	dBA				-0.08
Step 1: CO_2, Lux, Operative Temperature, Air Temperature, RH, **dBA**					
Accuracy of responses to incongruent stimuli (%)					
1		0.05**	0.05	7.65	
	Relative Humidity				-0.23**
2		0.07**	0.04*	5.82*	
	Relative Humidity				-0.20*
	CO_2				-0.11
3		0.11**	0.04	1.65	
	Relative Humidity				-0.24**
	CO_2				-0.11
	Lux				0.21*
	Operative Temperature				- 0.02
	Air Temperature				0.03
	dBA				-0.05
Step 1: CO_2, Step 2: RH, Step 3: Lux, Operative Temperature, Air Temperature, **dBA**					
Accuracy of responses to congruent stimuli (%)					
1		0.12***	0.12***	18.39***	
	Relative Humidity				-0.34***
2		0.19***	0.08*	2.56*	
	Relative Humidity				-0.36***
	CO_2				-0.16
	Lux				0.21*
	Operative Temperature				0.01
	Air Temperature				0.01
	dBA				-0.13
Step 1: RH, Step 2: CO_2, Step 3: Lux, Operative Temperature, Air Temperature, **dBA**					

Percentage of incongruent stimuli responded to correctly:

This was found to be significant, ($F (6, 135) = 2.59$, $p = .021$), with an R^2 0.10. Relative Humidity accounted for 5% of the variance in the sample, CO_2 contributed 1% and the remaining environmental variables contributed 4%.

The standardised β coefficients identifies that an improved accuracy of incongruent stimuli responses was predicted by a decrease in relative humidity (Std.β = - 0.24) and an increase in lux levels (Std.β = 0.21).

Percentage of congruent stimuli responded to correctly:

This was found to be strongly significant, ($F (6, 135) = 5.37$, $p < .001$), with an R^2 0.19. Relative Humidity accounted for 12% of the variance in the sample and the remaining environmental variables contributed 3%.

The standardised β coefficients identifies that an improved accuracy of congruent stimuli responses was predicted by a decrease in relative humidity (Std.β = - 0.36) and an increase in lux (Std.β = 0.21).

Working Memory:

Table G22 present the significant results from the Stroop test.

Total number of digits recalled correctly:

Working Memory was found to be significant, ($F (6, 135) = 3.24$, $p = .005$), with an R^2 0.13. Operative temperature accounted for 7% of the variance in the sample, air temperature contributed less than 1%, CO_2 contributed 5% and the remaining environmental variables contributed 1%.

The standardised β coefficients identifies that an improved backward digit score was predicted by the increase in operative temperature alone in the 1st model (Std.β = 0.27) and by CO_2 alone when all environmental variables were included (Std.β = 0.23).

Table G22. Hierarchical Regressions of the Cognitive Function Test – Working Memory

Model	Predictor	R^2	Change in R^2	F Change	Std.β
Working Memory					
1		0.07**	0.06***	10.72***	
	Operative Temperature				0.27**
2		0.07**	< 0.01	0.47	
	Operative Temperature				0.19
	Air Temperature				0.10
3		0.12**	0.05**	7.25**	
	Operative Temperature				0.35*
	Air Temperature				-0.05
	CO_2				0.24**
4		0.13**	< 0.01	0.28	
	Operative Temperature				0.33
	Air Temperature				-0.05
	CO_2				0.23**
	Lux				-0.01
	Relative Humidity				-0.03
	dBA				-0.08

Step 1: Operative Temperature, Step 2: Air Temperature, Step 3: CO_2, Step 4: Lux, RH, dBA

Long-term Memory:

Table G23 presents the significant results from the Long-Term Memory Test.

Total number of correct answers:

Long Term Memory was found to be strongly significant, (F (6, 135) = 2.62, p = .019), with an R^2 0.10. CO_2 accounted for 4% of the variance in the sample, relative humidity contributed 5 % and the remaining environmental variables contributed 1%.

The standardised β coefficients identifies an improved long term memory score was predicted by the decrease in CO_2 (Std.β = -0.19) in the 1st model. However, when all environmental variables were included a decrease in relative humidity (Std.β = -0.24) alone predicted an improved long-term memory score.

Table G23. Hierarchical Regressions of the Cognitive Function Test – Long-term Memory

Model	Predictor	R^2	Change in R^2	F Change	Std.β
Long- Term Memory					
1		0.04**	0.04*	5.48*	
	CO_2				-0.19*
2		0.09***	0.05**	8.25**	
	CO_2				-0.14
	Relative Humidity				-0.24**
3		0.10**	0.01	0.48	
	CO_2				-0.15
	Relative Humidity				-0.24**
	Lux				0.10
	Operative Temperature				-0.09
	Air Temperature				0.06
	dBA				0.05

Step 1: CO_2, Step 2: Relative Humidity, Step 3: Lux, Operative Temperature, Air Temperature, dBA

APPENDIX H. ENVIRONMENT SENSATION MEASURES AND HEALTH AND WELL-BEING MEASURES

Table H1 – J7 presents all significant relationships found ($p < 0.05$) between the environment sensation measures and pre and post-test health and well-being measures described and discussed in Section 4.5.5.2.5.

Air Temperature Sensation

Table H1. Relationships between Air Temperature Sensation and the Health and Well-being Measures

	Air Temperature Sensation			
	Open Blinds (N = 80)		Closed Blinds (N = 97)	
Health and Well-being Measure	R_2	*p*	R_2	*p*
Pre-Test				
Description of Fatigue	-0.31**	0.01	-0.15	0.14
Post-Test				
Mouth: Dry or Running?	-0.19	0.10	-0.24*	0.02
Lips: Dry or Not Dry?	-0.23*	0.04	-0.17	0.09
Skin: Dry or Moist?	0.30**	0.01	0.19	0.06
Eyes: Dry or Not Dry?	-0.11	0.31	-0.26**	0.01
Eyes: Smarting/Hurting or Not Smarting/ Hurting?	-0.10	0.38	-0.25*	0.01
Eyes: Aching or Not Aching?	-0.31**	< 0.01	-0.37**	< 0.01
Headache Symptoms	-0.27*	0.02	-0.22*	0.03
Clarity of Thinking	0.47**	< 0.01	0.35**	< 0.01
Dizziness Sensation	0.42**	< 0.01	0.18	0.07
General Feeling	-0.32**	< 0.01	-0.26*	0.01
Tiredness	-0.32**	< 0.01	-0.25*	0.01
Ability to Concentrate	-0.43**	< 0.01	-0.35**	< 0.01
General Attitude	-0.32**	< 0.01	-0.20	0.05
Alertness	0.41**	< 0.01	0.25*	0.01
Office Cleanliness	0.03	0.79	-0.34**	< 0.01
Amount of effort required to achieve level of performance on the Tasks Set	0.29**	0.01	0.17	0.09
Feeling Discouraged when completing the Tasks Set	0.24*	0.03	0.18	0.08
Feeling Irritated when completing the Tasks Set	0.35**	< 0.01	0.36**	< 0.01
Feeling Stressed when completing the Tasks Set	0.34**	< 0.01	0.25*	0.01
Feeling Annoyed when completing the Tasks Set	0.33**	< 0.01	0.28**	0.01

Air Quality Sensation Measures

Table H2. Relationships between Humidity Sensation and the Health and Well-being Measures

	Humidity Sensation			
	Open Blinds (N = 80)		Closed Blinds (N = 97)	
Health and Well-being Measure	R_2	*p*	R_2	*p*
Post-Test				
Mouth: Dry or Running?	-0.21	0.06	-0.30**	< 0.01
Skin: Dry or Moist?	0.35**	< 0.01	0.20	0.05
Nails: Brittle or Supple?	0.28*	0.01	-0.05	0.64
Eyes: Dry or Not Dry?	-0.03	0.76	-0.33**	< 0.01
Eyes: Smarting/Hurting or Not Smarting/ Hurting?	0.08	0.50	-0.30**	< 0.01
Eyes: Aching or Not Aching?	-0.27*	0.02	-0.38**	< 0.01
Eyes: Feel Gritty or Not Gritty?	-0.07	0.52	-0.24*	0.02
Headache Symptoms	-0.09	0.45	-0.24*	0.02
Clarity of Thinking	0.24*	0.04	0.31**	< 0.01
Dizziness Sensation	0.21	0.07	0.20*	0.05
General Feeling	-0.07	0.55	-0.31**	< 0.01
Ability to Concentrate	-0.28*	0.01	-0.30**	< 0.01
Office Cleanliness	-0.09	0.44	-0.38**	< 0.01
Amount of effort required to complete the Tasks Set	0.07	0.56	0.21*	0.04
Feeling Irritated when completing the Tasks Set	0.10	0.39	0.28**	< 0.01
Feeling Annoyed when completing the Tasks Set	0.11	0.34	0.23*	0.02
Feeling Discouraged when completing the Tasks Set	-0.29**	0.01	-0.25*	0.01
Feeling Irritated when completing the Tasks Set	-0.31**	< 0.01	-0.32**	< 0.01
Feeling Stressed when completing the Tasks Set	-0.33**	< 0.01	-0.23*	0.02
Feeling Annoyed when completing the Tasks Set	-0.36**	< 0.01	-0.29**	< 0.01

Table H3. Relationships between Air Freshness Sensation and the Health and Well-being Measures

	Air Freshness Sensation			
	Open Blinds (N = 80)		Closed Blinds (N = 97)	
Health and Well-being Measure	R_2	*p*	R_2	*p*
Pre-Test				
Fatigue before Tasks	0.27*	0.02	0.18	0.09
Post-Test				
Mouth: Dry or Running?	0.31**	< 0.01	0.32**	< 0.01
Lips: Dry or Not Dry?	0.25*	0.02	0.24*	0.02
Skin: Dry or Moist?	-0.23*	0.04	-0.20*	0.05
Eyes: Smarting/Hurting or Not Smarting/ Hurting?	0.07	0.54	0.23*	0.03
Eyes: Aching or Not Aching?	0.31**	< 0.01	0.34**	< 0.01
Headache Symptoms	0.22*	0.05	0.31**	< 0.01
Clarity of Thinking	-0.41**	< 0.01	-0.35**	< 0.01
Dizziness Sensation	-0.47**	< 0.01	-0.31**	< 0.01
General Feeling	0.30**	0.01	0.35**	< 0.01
Tiredness	0.23*	0.04	0.18	0.08
Ability to Concentrate	0.50**	< 0.01	0.37**	< 0.01
General Attitude	0.34**	< 0.01	0.25*	0.02
Alertness	-0.32**	< 0.01	-0.21*	0.03
Office Cleanliness	0.18	0.12	0.39**	< 0.01
Feeling Discouraged when completing the Tasks Set	-0.30**	0.01	-0.25*	0.01
Feeling Irritated when completing the Tasks Set	-0.31**	< 0.01	-0.32**	< 0.01
Feeling Stressed when completing the Tasks Set	-0.33**	< 0.01	-0.23*	0.02
Feeling Annoyed when completing the Tasks Set	-0.36**	< 0.01	-0.29**	< 0.01

Table H4. Relationships between Air Odour/ Fragrance Sensation and the Health and Well-being Measures

	Air Odours and Fragrance Sensation			
	Open Blinds (N = 80)		Closed Blinds (N = 97)	
Health and Well-being Measure	R_2	*p*	R_2	*p*
Post-Test				
Mouth: Dry or Running?	-0.21	0.06	-0.30**	< 0.01
Skin: Dry or Moist?	0.35**	< 0.01	0.20	0.05
Nails: Brittle or Supple?	0.28*	0.01	-0.05	0.64
Eyes: Dry or Not Dry?	-0.03	0.76	-0.33**	< 0.01
Eyes: Smarting/Hurting or Not Smarting/ Hurting?	0.08	0.50	-0.30**	< 0.01
Eyes: Aching or Not Aching?	-0.27*	0.02	-0.38**	< 0.01
Eyes: Feel Gritty or Not Gritty?	-0.07	0.52	-0.24*	0.02
Headache Symptoms	-0.09	0.45	-0.24*	0.02
Clarity of Thinking	0.24*	0.04	0.31**	< 0.01
Dizziness Sensation	0.21	0.07	0.20*	0.05
General Feeling	-0.07	0.55	-0.31**	< 0.01
Ability to Concentrate	-0.28*	0.01	-0.30**	< 0.01
Office Cleanliness	-0.09	0.44	-0.38**	< 0.01
Amount of effort required to complete the Tasks Set	0.07	0.56	0.21*	0.04
Feeling Irritated when completing the Tasks Set	0.10	0.39	0.28**	< 0.01
Feeling Annoyed when completing the Tasks Set	0.11	0.34	0.23*	0.02
Feeling Discouraged when completing the Tasks Set	-0.29**	0.01	-0.25*	0.01
Feeling Irritated when completing the Tasks Set	-0.31**	< 0.01	-0.32**	< 0.01
Feeling Stressed when completing the Tasks Set	-0.33**	< 0.01	-0.23*	0.02
Feeling Annoyed when completing the Tasks Set	-0.36**	< 0.01	-0.29**	< 0.01

Noise Sensation

Table H5. Relationships between Noise Sensation and the Health and Well-being Measures

	Noise Sensation			
	Open Blinds (N = 80)		Closed Blinds (N = 97)	
Health and Well-being Measure	R_2	*p*	R_2	*p*
Post-Test				
Nose: Clear or Blocked?	-0.09	0.45	-0.22*	0.03
Lips: Dry or Not Dry?	0.25*	0.02	0.20*	0.05
Skin: Dry or Moist?	-0.02	0.83	0.20*	0.05
Eyes: Aching or Not Aching?	0.27*	0.01	0.16	0.11
Headache Symptoms	0.27*	0.01	0.14	0.16
Tiredness (Post-Test)	0.18	0.12	0.25*	0.01
Mental Demand Required	-0.23*	0.04	0.15	0.15

Lighting and View Sensation

Table H6. Relationships between Lighting Sensation and the Health and Well-being Measures

	Lighting Sensation			
	Open Blinds (N = 80)		Closed Blinds (N = 97)	
Health and Well-being Measure	R_2	*p*	R_2	*p*
Pre-Test				
Mood: Feeling Tense	-0.06	0.61	-0.24*	0.02
Mood: Feeling Sad	-0.13	0.24	-0.21*	0.04
Mood: Feeling Anxious	-0.07	0.54	-0.28**	0.01
Mood: Feeling Enthusiastic	0.08	0.47	0.25*	0.01
Mood: Feeling Confused	-0.76	0.50	-0.37**	< 0.01
Post-Test				
Nose: Dry or Running?	0.14	0.22	0.20*	0.05
Eyes: Smarting/Hurting or Not Smarting/ Hurting?	-0.18	0.11	0.22*	0.03
Eyes: Aching or Not Aching?	-0.29*	0.01	0.09	0.36
Eyes: Feel Gritty or Not Gritty?	-0.03	0.79	0.22*	0.03
Headache Symptoms	-0.24*	0.03	0.12	0.23
Office Cleanliness	-0.16	0.17	0.21*	0.04
Physical Demand Required	0.04	0.71	-0.22*	0.03
Feeling Discouraged when completing the Tasks Set	0.02	0.88	-0.27**	0.01
Feeling Irritated when completing the Tasks Set	-0.02	0.87	-0.21*	0.04

Table H7. Relationships between View Sensation and the Health and Well-being Measures

	View Sensation			
	Open Blinds (N = 80)		Closed Blinds (N = 97)	
Health and Well-being Measure	R_2	*p*	R_2	*p*
Pre-Test				
Mood: Feeling Enthusiastic	-0.14	0.21	-0.29**	< 0.01
Post-Test				
Mouth: Dry or Running?	0.02	0.88	0.29**	< 0.01
Skin: Dry or Moist?	-0.04	0.72	-0.29**	< 0.01
Clarity of Thinking	-0.06	0.62	-0.35**	< 0.01
Ability to Concentrate	-0.03	0.77	0.27**	0.01
Alertness	-0.16	0.16	-0.30**	< 0.01
Feeling Irritated when completing the Tasks Set	0.14	0.21	-0.28**	0.01

APPENDIX I. FOCUS GROUP

Focus Group Location:	**London South Bank University, Doctoral Academy**
Date: 05/09/2017	
Number of Attendees:	11
Name of Transcriber:	Zoe De Grussa
Number of Tapes:	Two recorded simultaneously, one at the rear of the room and one at the front.

Schedule of Questions:

1. Did the equipment installed impact you in anyway during your day to day?
2. What do you think about the new blinds installed?
3. Did you find any of the interventions placed on the rooms challenging?
4. Were there any issues when completing the tests?
5. How relevant do you think the tests were to your day to day work activities?
6. Do you feel your performance on the tests differed between different test sessions?
7. How do you feel about the frequency and length of the tests?

M: So, did the equipment installed impact you in anyway during your day to day?

MP: No

P8: mmm…. only the trunking on the floor

M: The trunking on the floor?

P8: Yea…

M: …so to do with the cabling

P8: (every now and again yes)

M: Any other comments? Abou- [/About/] so, we had cameras in there, we had various sensors, we had…some of the offices had the partitions put in

P2: Partitions were a bit long...

M: [cuts in] Yep

P2: all in all…But I do know…We had this conversation today because Elsa's study, the MAGIC Project. She's requested that we keep the partitions up.

M: Yea

P2: … and I asked her to ask =John Doe= whether that was ok, and actually =John Doe='s a big fan of them were going to keep them up going forward… (at least in our space… I don't know about the others)... so erm

P5: Yeah, I think the notice boards… because they were for longer desks were a problem because a few people did accidentally fall into them? [short laugh] and erm ….including myself at one point because your spatial awareness says it's not supposed to be there because the end of the desk is there, so it kind of you either just stop before you hit the thing or you've actually hit the thing…oh my God…have I broken it.

M: Ok, great. Anyone else want to add anything?

P4: I didn't like them…the partitions, so... the partitions did make me feel a little bit like you were er… partitioned…(laugh). For me it was better to have it open, that made me feel as a part of the team. So that bit did impact me in a (negative way).

M: Ok, moving on

M: So what do you think about the new blinds installed?

P5: I liked them.

PM: Yeah.

P4: Thought they were good.

P3: Very nice.

M: So why did we like them?

P5: I liked the fact that… when they were down, I could still see out. If, like, Even I, Coz (/because/) when I think or I try to settle information in my brain, I like to look out of the (short laugh) window at the tree or something just so that my brain start to filter things out. So, I actually like the fact I can still see outside.

P4: Yea it's a little bit depressing having blinds down, so I think the new blinds gave that sense you can were connected to the outside world.

P9: I thought they were depressing, because they were… I thought I would only have them down, if I needed them down, because I thought they like… they altered the light anyway. I thought they were of value when it was like really like really sunny (and) you have no other option (but to have the blind down.) But if they were just down anyway I thought it was rather depressing, it was like being in a sad National Trust places where the fabrics fade… and the lights were a lot stronger and I don't like the artificial light so.

P10: I agree, I think they are better for the purpose, of like, it's too sunny, I need to pull the blind down. But in the example, of having the conditions when they were all down, I found that like quite, sort of like, ugh. It's really dark, it's really dingy…

P8: [cut in] The offices (are) warmer.

P10: Do you think?

P8: When they were down, it felt like it was encro- [unfinished word, encroached], not claustrophobic but it felt enclosed. So, the inside it felt a lot warmer. It was warm outside, it was warmer inside.

P1: Yeah, it affected the atmosphere as well. (Certainly, within our space…) It felt very quiet. And a bit… I don't know (feel a bit)…

M: When they were down?

P1: Yeah.

M: So more in comparison to the old set?

P4: I think they were better than-, I think they were better than the old set. But I think the… it's better to have the windows, blinds up but if you had to have the blinds down, I would say…

P3: [cut in] The new ones are better.

P4: …the new ones are better. Yea

P9: I think there's an association between us being more focussed and quieter with the blinds being down.

P5: (so that…) it was more that it was a test situation because they were down all morning. Not just for the hour that we were doing the test… So, when you came in, your first reaction was oh were in a test environment, so you might not have said things that you would have done as openly as you perhaps did in the afternoon.

P7: It looked more …It made the office look more clinical I think, kind of…so I think [inaudible] (because it looked completely different to before.) [inaudible]

M: mmm…Ok, that's great. Moving onto the next question…

M: Did you find any of the interventions placed on the rooms challenging?

PM: mmm

P5: Yeah [giggle]

P7: Second to last one. [Cough] That day was really hot but for me that was the only day that was difficult…but the other days were kind of warm…, but it wasn't too unbearable.

M: So, errr what intervention would it be that you found challenging?

P7: Not being able to open the window or turn on the fan.

P4: And the light

P3: It was pretty grim, you know we had a pretty good summer, with some pretty high temperatures……. even now I've got the window open, I'm sitting at =John Doe='s desk and I've got the window open… erm it's not particularly warm out there or cold but I mean we had some pretty high temperatures outside during the test period, and yes, it was a bit frustrating… You couldn't open the blind (or) open the window or turn the fan on, … but anyway there we are…[Cough]

P9: The window, it was not just about that temperature I think, …not having any air in, made it it [stutter] like…

P3: Yea

P9: …slight smell, and you come in and it's like you'd notice, immediately… it was not exactly (stopping you)…

P8: [cut in] Smelt of building

P9: ...not that I am saying anything about my colleagues [laughter] but…

PM: [laughter]

P4: Yea….It (did seem) very bright as well…without the blinds down… presumably because you get daylight coming at you, so it seemed harsh.

PM: mmmm

P9: [Inaudible Speech]

P4: [Inaudible Speech]

P5: If supposedly I was in a normal environment I would be opening and shutting the windows, I tend not to use the fans as much unless I absolutely have to umm because I actually don't like the feeling of the fan on me, but umm I found that quite difficult because normally my blinds would be particularly in the summer months my blinds maybe would be half way down just so that it stopped people getting sunlight in their eyes rather than anything else which was better where these were either fully up or fully down.

M: Ok, has everyone had their say? We'll move onto the next question.

M: Were there any issues when completing the tests?

PM: [Laughter]

P3: Well I didn't do very well still…

PM: [Laughter]

P4: Yea me too…they made me feel thick [laugh]

PM: [Laughter]

P3: I mean particularly the question on, thh [stutter] …the you know there was the correct grammar kind of one…fill all the words in….

P11: Yea

P3: He said blank... well that was kind of ok but what was all that negative adverbs

P11: Subjective

P3: Subject thing…

PM: [Laughter]

P3: I didn't have a clue….I didn't have a clue what that was about but...err but I mean I enjoyed doing it. You know.

P11: It did get easier. I found it…

P4: Did it?

P10: I found it did get easier.

M: Why do you think it get easier?

P10: Just because you kind of knew what to expect, you knew what was coming, kind of thing the order of stuff erm…yea… I definitely towards the end felt a bit more like… ok…(short laugh) got into the routine of it I suppose a little bit…yeah the fact that you were doing it maybe twice a week, or, unless you were off or whatever…it kind of kept the momentum going a bit…

P9: (I didn't know much) about the specific reasons for the tests and I think that on the data entry one….I was trying to do it on speed, I was hitting the box, there were times I was hitting the box 3 times and like, hitting madly and it didn't seem to take it… and I thought it was a bit glitchy or I was not quiet precise enough so there was that one, and there definitely one that said hit enter but you didn't hit enter on it, that was just slightly irritating but it was more the data entry that would hinder your performance as it wouldn't change pages for me either so that was naughty…

P10: [cuts in] And I made the same mistake twice, nearly three times…[short laugh] on the booklet exercise [short laugh] when you had to do plus three and minus three and then they alternate…

M: Yep

P10: and you had to click on the screen…

P?: oh yea

P?: yea

P10: and I clicked forward too much, do you know what I mean…

P3: Yea I did that one

P10 Yea yea…I dunno [/don't know/], that was like, Aaargh, I've done it again!

PM: [Laughter]

P10: Damn! Yeah, but yea… then it meant you had missed out on the whole section because you'd moved forward too much.

M: Yep.

P?: Remembering the numbers...I tried like three or four strategies to remember the numbers.

P10: Was that the last task?

PM: Yeah.

P10: I found a strategy in the end that worked, I experimented like different times then I found one that worked…but I know what you mean…it was like took me a while to go… how am I gonna [/going to/] like…it was alright when it was like three or four…

P?: [cuts in] three or four.

P10: …but when it got beyond four I was like how… I need a strategy to help me remember this better.

P6: Mine worked…

P4: What was it?

P6: I wrote it down

PM: Gasps [Jokingly]

P4: Naughty [Jokingly]

PM: oooo [Laughter]

M: It's alright were in safe space

PM: [Laughter]

P6: It didn't say that that you can't write it down, did it?

PM: [Short Laugh]

P4: Remembering the pictures…the long-term thing

PM: that was good / Oh yea/ mmmm / yea

P7: If I had known that I wasn't gonna [/going to/] see it again… I probably would have tried…I tried very hard anyway but I would have…

M: Do you think you would have approached it in a different way?

P7: Yea… I thought we'd see it again [Short Laugh]

P9: I understand, where that's like, or I assume that's like part of the tests, different ways that memory cognition work, so you will work differently if your given a task I think, to if you… like randomly remember things the difference between a genius (or whatever)…

P8: // I assumed it was the same thing…

P9: …if I'm told the task I'll remember where, if I'm not told a task I won't.

P4: Just make sure this doesn't get to my boss, ok.

PM: [Laughter]

M: No, all the results are strictly private and confidential.

PM: [Laughter]

P4: [Inaudible Speech]

P2: The test became quite routine afterwards it was too easy to keep on doing…I don't know whether (it could be on performance) or because of the blind or because of that you were used to that routine of work so...

M: yea

P2: … (that could be) one factor you can look into because otherwise it was quite easy. I remember on the very first day remembering all the pictures and then it becomes so boring for 2 minutes, waiting (because I knew what it would be)

P10: [cut in] oh yeah, that's a good point, it was too long…I'd type it up and then I'd go and do something.

PM: [Laughter]

P10: (Inaudible)

P2: It doesn't matter if it was just four objects…

M: // Yea… Yea … Yea

M: Yeah, Ok…

P5: (It was) similar things that erm… where I had this strategy to remember everything because it said… if you get something wrong so I stopped trying so I only did the four that I was really confident with and the last sort of four sessions I went 'oh sod it' I'm just going to go for it [Short Laugh] and I just added the whole load of others that I thought may or may not 'ave [/have/] been on there from, you know, from trying to remember…

P4: [Cuts in] (Good luck with that one.)

PM: [Laughter]

P5: …So we'll see how that goes… and I didn't like the grammar one because that one I am not good at anyway, so I just looked at that and I was guessing… so in the end I tried to get the same one each time so that there was some kind of, way of, recording it. [Short Laugh]

P10: [Cuts in] There were those three questions at the end of that section that appeared, and I was like well… how…err I was kind of a little bit erm confused I suppose…about how the test conditions would affect that information… because that's the kind of information you either know or you don't know, you've either have been taught it or you've learn it so I was kind of always thinking in my head well like how… like how does the test situation and circumstances going to affect this… You either know it or you don't…do you know what I mean?

P4: Maybe it was there to fluster you

P10: Yes, well yea, that did cross my mind…

P2: [cuts in] and also the short-term memory test after the grammar test because it would ask you what fruit was mentioned or what name and I remember now after 2, 3 tests it was always the same one because one of them was (grapes and then) (inaudible) or something I don't remember now, so I could remember that immediately so…

P10: Yea, I found that quite hard, yea it was like what kind of animal…what name or what (Inaudible)…

P2: ...but it was repeating afterwards after a few times, (I remember) I didn't have a problem.

PM: [Various conversations start]

P9: [cuts in] (inaudible) you knew you had to fill out the task in the grammar (inaudible) …it was the grammar and you were not using the part of your memory that some people remember those anyway but a lot of us wouldn't but if you were told, you were going to have to pick up some parts from the sentences then you focus on it so it was the test that changed things…

M: [cuts in] Yea

P9: …but I thought that test was like erm because you didn't understand the marking scheme…so you didn't know… if it was a good thing to write something if you were not 100% sure or not, because you didn't understand the marking scheme and that was, so your (focus) doesn't change but your decision of how your approaching the test has changed and I wondered if that was (something considered in the test.)

M: Yes

P2: (The) questionnaire at the end suddenly you were asking about your nose, your hair is dry … I will always say 50%...

P?: [Short Laugh]

P2: …if it's not making too much difference on my body, my nose is dry or not, I will always say yes, it is dry…

P?: Yea

P2: …(but) I would just slightly move the cursor, so it was just 50% so I had 50/50 for each of the questions.

P10: Hair brittle…

M: Yea

P10: … yea that section I was just a bit like...

P9: [cuts in] that was sad for me…

PM: [Laughter]

P4: At least you've got hair…

PM: Laughter

P9: It was shocking… my nails are terrible… (Inaudible)

P5: So you know that should have been a question…have you got any nail splitting going on, rather than brittleness.

P9: I think it's to do with the DIY I'm doing… not the tests I'm sure.

M: Ok good, So you've have been through quite a few of the tests. Are there anyone's that people haven't picked up on or…?

P10: I'm trying to think

P4: [Cuts In] I quite liked the coloured box thing.

P10: Yea I like the coloured box

P3: Yeah

P10: If I had to pick a favourite that would have been my favourite

M: …so that was the squares? the reaction one?

P4: Yea that's the one

P10: Yea

PM: (Inaudible – Multiple Conversations)

P5: I think the typing test I found most difficult because erm… I was trained as a touch typist so what I found that I just kept typing even though the minute probably finished a minute ago and then realise most annoyingly that that's what I've done. And that took me two or three times to actually make myself look at the screen periodically but then that took me away from… and was really frustrating. [Short Laugh]

P4: Yeah, the typing wasn't the best…

PM: [Short Laugh]

P?: [Inaudible Comment]

289 PM: [Laughter]

290 P9: I'm sitting there doing that [Typing Action Slow] and then I hear P7's little fingers
291 going… [Typing action rapid]

292 P8: Note to self (Inaudible) typing.

293 P4: My performance was… poor.

294 M: Ok, were going to move onto the next question then if everyone thinks they've
295 mentioned all the tests that…yep, ok.

296 M: So,…

297 P?: [Cuts In, sneeze]

M: How relevant do you think the tests were to your day to day work activities?

P5: Well I think the figure tests probably…um relates to a lot of what I do…so that was erm quite relevant.

M: Was that the…backward digit or the plus and minus?

P5: Uhm no not the backward digit [Short Laugh], the Plus, minus and alternating…umm

P?: (inaudible)

M: …so the data entry, yea.

P8: grammar…

M: Yea

P8: for emails

PM: [Laughter]

P4: I think (it had) a bit of everything to be honest.

P5: I thought also the, believe it or not, the coloured ones because that's all about your reactions.

PM: Yea

P5: And a lot of what most of us are having to do is, <u>is</u> to react to things umm either positively or negatively [Short Laugh] depending on what it is… but for (everybody) things coming through via email… making business decisions, those sort of things, so I thought there was some relevance there.

M: Yeah…

P10: Yea, (I think the) decision making throughout… so a lot of it did require you to make kind of like choices and decisions and that's, we are doing that all of the time.

P1: Maybe grammar test as well, because it made you think about the construction of your sentences and even when your writing emails, making sure what your saying is very clear so there's no kind of… so you're not misunderstood.

P4: Helps you not commit apostrophe crime?

PM: [Laughter]

P4: And getting the right person's name?

PM: [Laughter]

M: Ok, some Yes, are there any <u>No's</u>?

P3: Yes I suppose I would go more no than yes, please.

PM: mmm

P3: You can treat it as an exercise for your PhD… and its first time I've thought sitting here thinking about it particularly, err yea you can argue…that reading text, typing tests because we all type it's the main way we all communicate really… urmm… err but I…I always just think, how those tests… other than that really, really helped to be honest …my day to day job.

M: So other than the text typing?

P3: Yeah… erm I mean it was good fun I particularly did like the colour ones…when you had to type the colour of whatever it was, whether it was a square…the word green…but it was actually blue…so you had to click the blue button stuff like that…. I mean I enjoyed that.

PM: [Laughter]

P3: … but uhhh yea, no I enjoyed doing it, you know…I wish I could have opened the window a bit more often at times.

PM: [Laughter]

P3: …But no, I don't see it … that it particularly helped my day to day job really.

P5: I think it covered different components.

P3: Yes… yea

P4: It covers a range of different skills and attributes that we possibly might be using on a particular day, particularly the data entry and the accuracy of data entry…erm you know… so it did test quite a lot.

P8: But we know were doing this subconsciously anyway in a day,… in our daily activities and we don't realise were doing it.

P4: I think that's quite right.

P9: But these answers reflect the type of jobs we do, which are primarily are more managerial jobs. So therefore, it's harder for us to understand the relationship between the performance of the tests [Emergency Siren in Background] and our actual roles (not because there) isn't one, it's just not directly related unlike others in different roles. (Like someone with more of an admin job.)

M: Ok… good. Does anyone else want to add anything else? [Pause] No? Ok we'll move on to the next question. I think there are only two more left.

M: Do you feel your performance on the tests differed between different test sessions?

P4: Yeah.

P10: Yea

M: So what test sessions? Not specifics, but are we talking start to the end of test or are we talking between different interventions or…?

P10: Yea I think I was finding that if it was particularly hot day…and the windows were down and you couldn't put any fans on or anything…and I think if you had been sat at your desk since 9 o'clock and you took the test at 12 or something… that situation definitely impacted on me… whereas if I was only sat there for half an hour before I took the test, I know it asked that… then I'd be a bit more kind of...erm… relaxed about it, yeah…whereas if I'd been sat there longer on a hot day I'll be a bit like… argh… here we go …

PM: [Laughter]

P8: [Cuts in] …wilting

P10: Yea, yea for me… some days I thought that was alright and other days it was like that was terrible.

P4: It was interesting for me for a couple of them… I hadn't had much sleep the night before for a variety of reasons.

PM: // [Laughter]

PM: // ooo

PM: // Scandal

P4: So…it was really interesting in doing that…because bearing the horrendous heat and the lack of sleep…and the oh my god what am I doing, so I think it did have… did have an impact and it shows that if you are less than optimum…it really did, I felt degrade your ability.

P3: … that's what I thought, it picked up quite well what you felt about the environment and everything but if you were feeling like really crappy in the morning and you were affected by different factors… there wasn't that, I feel really bad today. I have a lot going on in my life…and it's like there's was one little question saying yes, no, maybe factors and I thought that was one of the things that sort of worried me… because there was quite a subtlety about the environmental variables but whereas (Inaudible) you weren't quite picking that up, quite as well, so I was worried there's a whole big thing apart from P4's sleepless nights…

PM: [Laughter]

PM: [Inaudible]

P5: I had a couple of occasions where I had a lot going on in the office and was also really hot and sticky and really headachy… and I found by the time I got to the test I

was actually really, really angry… and I never get really, really angry ever…unless somebody has really pushed me to a limit…

P4: [Inaudible]

PM: [Laughter]

P5: …and that was quite… I didn't like that…that made me feel out of balance all day really even when the, the condition then changed to normal I found by the time I left I was still annoyed and I would never feel like that…so those was were quite a surprise to me I suppose.

P2: ….sometimes when it was like hot and sometimes the temperature was not that…effecting your performance [Inaudible] performance and sometimes I was in a hurry because I wanted to go somewhere just after the test [Inaudible] I was quick… and otherwise as we moved with the time because [inaudible] I didn't notice much difference [Inaudible].

P6: It was good because I feel cold all the time, as you all know so.

PM: [Laughter]

M: Yea

P6: So maybe for me if it was a different subject… or maybe if I was blind folded or windows open would affect me more but the things which really affected me was my own personal health issues… so for the first few days I wasn't feeling well, I don't think, so I don't think I did so well on the tests…

M: Yea

P6: Inaudible

M: Ok, So, going back to the performance in the test between different test sessions, so we spoke about each one, but what about the start one to the end. I know we captured that a little bit earlier so are there differences from when you first did the test to when you did the test at the end?

P10: I think ……I don't know… I'm just thinking like, this has happened but it hasn't but it felt like I was doing it quicker so it felt less onerous like it feel like oh this is an hour, you know duh duh, you knew you'd get it done in like whatever kind of I didn't even look at the time but it felt quicker, over the period of time, the number of weeks so… yea that kind of felt easier so yeah, that kind of felt easier…

P8: From the memory the images we would have spent more time looking at them and remembering them if you knew each week you knew you had to do it, that's what I felt because I could only remember 5 out of however many there were on the page…

P4: In the end I couldn't remember them…I would just guess…

PM: Laughter

P?: Cat

PM: Laughter

P8: …ladder …fork …circle…

P4: Wow, I didn't get any those.

P5: No…I didn't get those either.

P8: Can we have a refresher?

PM: Laughter

P4: You were more… you didn't feel….because the first time you went into it you were not scared but a bit nervous because you probably wanted to make sure it was good enough for your research…well by the end of it…I thought well at least I know what's coming so...

PM: [Short Laugh]

P8: Did you know that though, though? From doing the test at the beginning, were we expecting the same test to be repeated every week? …I wasn't.

P?: No, I wasn't.

P10: Oh, see I… I sort of made the assumption I've done it like maybe for two weeks, so four times… and I was like oh ok this is the… this is the order of things now so then…yea I guess if you had just thrown and changed it all…then yea, i would have become like gone back to the beginning again… but I didn't expect it to change, I was like oh ok, this is it now.

P8: With data entry I was getting a lot quicker, with other things I wasn't expecting… like at week three, was I expected to remember that? I wasn't concentrating on, but when it came to the grammar and then remembering what was in the text, [Inaudible] because I was concentrating more on what I was reading so I could remember that that's what's gonna [/going to/] be asked.

P3: That's a key point, yeah

P10: Where I kind of kept forgetting about that question…

PM: [Laughter]

P3: I was the same really… I was the same

P10: So I was kind of ploughing through all the grammar stuff and then the question will come out in the end and I was like oh for God's s-- [Laughter]

P3: Yea

P10: I wasn't really reading the sentences… like I was skim reading the sentences

P3: …to answer that particular question… what you were (looking for) was the question at the end, well what was the persons's name… or

P10: Or what was the animal or what was the…?

P3: …[Cuts in] I got the animal one maybe… but I mean maybe maybe, I was just beginning to start to think, hold on a minute its gunna ask me a question.. so I'd kind of learnt that by then but that was obviously towards the end but…but there was one question and I thought oooo what was the name?

P8: You started becoming complacent.

PM: [Laughter]

M: But the frequency of your testing was quite different to what the others were.

P3: Yes, I only did 50% of them.

M: Yeah, because your only in on Tuesdays.

PM: [Laughter]

PM: // Oooo's

P8: So, yours would have been harder.

P10: Yea that's interesting though.

P4: Same here.

P3: Yea…That's true, P4's only did Tuesdays as well.

P10: …so you weren't exposed to it as much, so it might have felt like you weren't kind of getting in the momentum.

P?: …or the repetition

PM: Yeah

P3: And I got slightly better at the number recollection one…doing things backwards but not to a great degree of efficiency.

P4: I reached the heights of (inaudible).

P3: I got to 5 once (boastful)

P?: Alright

PM: [Laughter]

P3: but only once, only once

P10: I thought what was quite interesting erm that particular test, that it feedback to you at the end… that you knew how many you got right..

P7: I think it lied…

PM: Laughter

P10: Yeah

PM: Laughter

P10: Because the first time I did it, I wasn't like very good at it because I kind of and it said I dunno you had something at the end I only got two right and I was like…I got more than two right... two digits… you know…

P4: Computer said no [Short Laugh]…

M: Ok yea

P10: Yea so… in the head it was like, to begin with I thought that piece of information was quite demoralising because I thought… I got more than two right like I got four two-digit ones… all those right… so how can I … so that frustrated feeling…so then I just ignored it… like what it said at the end.

P4: (Inaudible)… delusional.

P7: I knew I remembered it and then it said the same number as the time before and I was like that's not right…

M: Ok

P10: Yeah

P7: I think I got higher anyway so!

P4: That's why we have counselling sessions

PM: [Laughter]

M: That's quite interesting as it was the only test you were actually given feedback on.

P4: That's right

PM: Yea/Yes's

P10: Yes, it was…and then I decided to ignore it about half way through.

PM: [Laughter]

P5: See I think…that result was confusing because when I first looked at it and it said four right and I'm thinking I know I got more than four right because I did about ten two digits ones and then it took me to about the fifth test to work out what it was telling me is that I'd managed to do up to four digits correctly.

P?: //Aaaaaah

P5: …and not just four right.

M: Ok…Yea, So the feedback on that was how many digits you got correctly in reverse order.

P3: …yeah, maximum number……

M: Yea

P?: I got that

P3: Did you only have to get one right? If you got… How many did you have to get right out of each batch?

P10: //Ohh

M: I think it was either three or four… I think it was three… so you had to get three right…consec- not consecutively but out of a group of six or something.

P4: Oh I see… So you could have got more?

P10: //Ohh

P3: So you could have got six twos, six threes, six fours…

M: But you had to get three correct… And then it will say: well done! You've passed level 2 or you got 2 right…maybe it was the wording in the feedback that was confusing.

MP: //Oh I see / Ohhh

P4: // (Maybe, I misinterpreted the feedback then.)

M: OK

P5: Which is what I did up to week 5… because I'm thinking to myself ok I know I might not have got five, four was a bit dodgy…but I definitely knew I did two or three…

P10: but that's interesting because you obviously spotted that and then tried to unpick it, where as I though ahhh… (inaudible)

PM: [Laughter]

P5: It's only because it annoyed me…

P10: Yea it annoyed me too so (I thought) I'm just gunna forget about it

P10: Yea but maybe I can't remember but maybe it was the interpretation of the wording…or something…

M: Yea

P6: [Inaudible] I was thinking like Oh My God!

PM: [Laughter]

M: If it makes any of you feel better the average score is four of five so it's between those.

P10: OK

M: If you get higher than that…genius…[Short Laugh] I got four so…

P7: (Better get) some Redbull.

P8: You need to send the Redbull.

P4: Maybe we should all get (some).

P8: No, thank you.

P5: I think, I agree with P4 in the erm… certainly in the first few sessions you were kind of, I was kind of excited about it because even though I didn't like the grammar

ones at all, but then I knew that was something I didn't really understand or what it wanted from me, (is it a) verb….noun…whatever

P10: …or adjective [Short Laugh]

P5: yea…so those ones I thought well whatever, but I was quite enthusiastic and excited to do it because you know it was for your research, it will be interesting to see what the data is and the benefit to us, you know, eventually, it will be really useful to know erm… and then those two sessions that I definitely wasn't [Short Laugh] having a very good day, made me think why did I say I was gonna [/going to/] do this [Short Laugh], because I wasn't doing very well… and then I found that… as it went on, you know, it felt that some of things felt a bit easier… erm I think it is just at the very beginning because you wanted to do so well. Then I didn't understand the long-term memory thing, I mean, I read that and then I studied it as if it was gonna [/going to/] be long term memory… but when it said long-term memory test next, I thought what do you mean?

PM: [Laughter]

P5: Long-term memory test, I didn't see a long-term memory test?

PM: [Laughter]

P5: …And that's because you were focussed on the now really, so I found myself then going, What's this question mean? So, you know, you did try...try and do your best on it each time, but I know those two days where I wasn't having a good time (with) it. I really struggled with it, to the point that the computer was very close to going out of the window.

PM: [Laughter]

P4: Blinds and all

P5: Blind and all, yea [Laugh]

P?: (Blinds Up or Down)

PM: [Laughter]

M: So, our last question, we have kind of touched on this already but….

M: How do you feel about the frequency and length of the tests?

PM: hmmm

P10: I suppose I've got nothing to compare it to…but it felt like... it felt ok…

PM: Yeah

P10: It felt like… it felt ok, it wasn't too… if you were getting to three times a week or something it would feel a be a bit like, huh [Anguished Sigh], But two seems like manageable…

P3: I felt like there was enough…there was enough erm number of tests…if you add them all up you know over the duration of the, with all the different colours and things like that… I felt…that we knew what this was for, your PhD, at the end of the day that's why we were doing it and I felt that there was enough variety errrr and I appreciate I only did 50% of the test but I felt there was enough quantity and variety where clearly you were getting something useful from it. You know those tests had clearly been designed to do our number skills, typing skills…and you would compare that to, …you know, I was very tired, I think the last one particularly I was hot and sweaty, and I was quite tired. It'd be interesting to see how I did, bit worse on that one, than my average over the others perhaps but I felt, you know, from that perspective it was about right.

M: Cool

P5: Well I found, from the work perspective, erm I found the two days were a bit much… I'm not complaining about it…

M: No, this is your time to complain. [Short Laugh]

P5: Well, mainly because… =John Doe= can't take that heat at all… so that for two days of the week erm he would have to go out for up to half a day but when we were first when we were first signing up. I think, it was misunderstood, and we thought it would only be for an hour.

M: Yea

P5: …like with the blinds up or down kind of thing but when we discovered then that it was all morning and then the test… that's half a day where you've gotta find somewhere else for someone to work.

P3: Yea, that's a good point, that's a good point.

P5: err… and at this time frame we didn't really, we had this space, but it hasn't got a telephone of computer or… that sort of thing… so that I found quite complicated.

M: Yeah

P5: And also, from my own perspective was I am worried that during those times when we were affected by those conditions is. Did I do my normal job as well as I would expect to do it in a normal condition, has that affected what I have been doing? Time will only tell when I get the complaints from all the students through [Short Laugh]. All those things, I felt, from my side it was, was too much.

M: Yea

P5: …and certainly once a week would have been easier I think in that respect so.

P10: I think that's a good point P5, because what I've just said twice a week felt ok, but August and July are our quietest period. If you were doing this now, in September and October I probably would have be more reluctant to do it because were just flat out and I would have found it, I think, a bit too stressful [Short Laugh].

PM: [Laughter]

P10: …all the time I would have been thinking like uhh I've gotta [/got to/] do this, I've gotta [/got to/] do that, where is because it was over that period for me personally, I was like, this is a quiet period it's much more manageable but if you're in a busy period, yea, I would be like.

P5: Which I suppose for us, it was.

P8: [Laughter] …were always in a busy period.

PM: [Laughter]

P10: Yea well that's it, were all ...yea different so it might have been more…

P8: Well I literally tried to slot it in… is it Two? Two times I started it …and then third I got midway through and I had to stop.

M: Yea

P8: …yea, so it did impact on me slightly, but not as much as I thought it would because basically I just slotted it in.

M: hmm you did it that way.

P4: I felt bad that I wasn't able to do more of it for you because obviously research is important, so…

P8: We can always do with more data.

P4: Yea and given the sense of the time.

P3: I thought it was reasonable…I mean, I think… sorry… I think the point of that job was…it was very warm in there, it was very nice to get the blinds up and so, done!

PM: [Laughter]

P8: Why was each cubicle different temperatures? Is it because some of us have more stuff in than the others?

P4: Some were hotter than others?

P8: Yeah, because even when the blinds were down, it was cooler in with you than it was with us for some unknown reason and when it was cooler with us, it was perishingly hot with you lot.

P5: Also the other thing is our side…we've got erm…

P8: more sun?

P5: we've got the wall…errr in P1's office…so that's, whereas you've got…

P8: …the gangway.

P5: the gangway and going around.

M: Yeah, I will definitely address that question, I just can't address it all right now…

P8: //Oh go on

M: So we are getting a lot deeper, so I was still taking additional measurements at the end to work out the different ways of working out…offsetting and things like that.

P10: One thing… that it did but this isn't entirely related to this question. But one thing that it did highlight to me.

M: I'm just gunna [/going to/] move onto the next slide…

P10: Oh, sorry…

M: No, it's ok, its open. You can just speak about what you want… [Slide Displayed Any Other Questions]

P10: …the one thing it highlighted to me, which I didn't quite appreciate beforehand, is how much noise affects my work and concentration.

M: Yea

P10: So even though [Short Laugh] there were real kind of pluses and minuses, so having the windows down was far too hot on some sessions, you know, you couldn't work like that all the day… but the quietness in our space, was just like a relief, you know, it was like oh wow. I can actually hear =Jane Doe= who sits by the window with the window open, I can actually hear her talk to me, normally I have to get up and go to her desk because it's so loud you know because of all the traffic. So, it did highlight that for me so, I was like, noise really impacts on me, more than I kind of thought.

P: Yeah

P1: I think the other issue was that some people started the tests later than others. So, I know you said between 12 and 1, but I know there were instances with people coming back and starting at twenty past 12.

M: Yea

P1: …and others who'd finished but come back (be like) oh and they'd start talking and eating

PM: // mmm

PM: // yea

P1: Because it was over for them, it was, but it wasn't over for others. And I remember once I tried to remember the number backwards, but people were talking just at that point…

PM: [Laughter]

PM: //yea

P1: …then you screw that number up, and you'd be like augh

P10: We all tried to start in our little pod… rough [/roughly/]… you know, within 15 minutes of 12 otherwise we'd … yea.

M: But does that not then… relate to real-world conditions where you can't… especially in open plan offices like, there's people come in talking to you when you're trying to write up an email, potentially?

P5: I think it's people forgot actually, I did on two occasions…I thought everyone have finished but …erm because everyone had been quiet all day until at least about 3-ish when people actually remembered we were all around again…erm I said something to somebody not realising somebody was still doing the test…and then you go 'awww God, I didn't mean to do that'…and then of course you go sorry which doesn't help either.

PM: [Laughter]

P5: …So then you go I'm going out to lunch… So that was sort of, you know , kind of when you thought things were finished but then realised they weren't finished and then you'd feel guilty because there trying really hard to this test really well…

P6: P3 just reminded me of something erm because I was changing desks every time I found it was unsettling…

M: [Cuts in] Uh huh

P6 …sat at somebody else's desk… yea… that was something…

P3: That's interesting… because I hot desk, I quite like slightly different, you know I mean recently yesterday I was at =Jane Doe's= desk, today I was at =John Doe='s desk and tomorrow I'll be at P4's desk but erm……There was one particular test I was doing I think you might have asked, about, maybe I'm thinking about the noise… so I'm in the middle block, right, and where P6 normally sits that group of eight people or sort of seven because P6 did the test by moving desks erm ….and it was, it was =John Doe= who's got quite an infectious laugh and talks fairly loudly I had to tell him to just shut up a minute.

PM: [Laughter]

P3: But of course normally, it wouldn't bother me… but because I was actually trying to concentrate… like as you say if at that time I was trying to write one of those emails that you actually had to think about rather than just say, you know, see you down the pub at 5 o'clock or whatever… if it was an email that you actually put some effort in and you wanted to concentrate, and you'd been or anyone else was making noise, maybe I would find that a distraction, but it was interesting…I think P10's raised a good point that it's made me more aware of noise and the traffic going past…bloody sirens, we get one every 20 minutes in our office …driving past here and they are loud

754 P10: mmm... It's so loud

755 P3: Yea…It has made me more aware of noise in the office.

756 M: And is it just noise?

757 P5: No, it's a mixture of stuff…

758 P?: A mixture

759 P5: I mean… my team our work is very much we need to talk to one another about
760 things, so we are probably the worst people to have as err open plan office people

761 P?: [Short laugh]

762 P5: … but also the other thing is the traffic outside is very noisy.

763 P?: It's the traffic, it's the traffic

764 P5: I sit by the window and I spend my entire time as soon as the phone goes…I can't
765 take a note because I have to close the window, because I can't hear them and
766 then of course I am too hot and then your opening the window and down again
767 and of course now they are doing the building work, so you used to be able to have
768 just have that window open…

769 PM: Yea

770 P5: …with the fans…that would work…but because now they are doing that now all the
771 dust is coming in so now you're getting dust, noise…

772 P3: and a lot of noise…

773 P5: drilling things…the building shaking

774 PM: Yea

775 P5: Yea the shaking is really quite unnerving

776 PM: (Inaudible Segment – Multiple conversations)

777 P10: But I think, ki-, just saying about the noise thing there's different types of noise, so
778 you're talking about, so say if you were talking about conversations with
779 colleagues, were a bit the same in our bit, were probably quite loud as a group
780 because we talk quite a lot but… that's kind of different I think, somehow to like
781 the length of traffic going by…

782 P5: Yes and no… probably is fine for us in our work but these guys behind us are
783 probably more like I wish that lot'd [/lot would/] shut up (Short laugh) particularly
784 because they are dealing with a different sorts of work, you know, very detailed
785 contracts and stuff erm and I do find myself thinking…'Oh God, it's really loud!' To
786 turn it down a bit…that lasted about five minutes

787 M: I think that's why they split you guys up

788 PM: [Laughter]

789 M: …one at each end of the block

M: Ok has anyone else got any other questions? I'm basically leaving this open to you guys if you have any questions whatsoever? Or any comments?

P5: (Inaudible Comment)

M: Yes of course

P5: So just out of curiosity, how did you decide on the tests you were going to use?

M: Erm through a literature review of different tests that had been used before, so some of them are mimicking previous studies, for me to either prove that they are maybe not so good, prove that they are better alternatives, prove that potentially that we should look into other aspects in a bit more detail and that there are lot more confounding issues than what there was made out. So yea…It was to do with a large literature review erm and then it was picking out those that are, where it has been found that there were significance in differences in performance, for the actual test, depending on heat and light. So concentrating on those two aspects for this test battery. Where if I was looking into maybe noise I might have used different types of tests…

P10: Yea I know you were measuring that

M: …which is why some of the variables we looked at trying to control so like the air quality trying to keep it the same throughout which meant no fans, no fans , windows closed so you were all in the same atmosphere… erm but they were only a couple, so the noise was reduced so we ruled that out as a variable, the noise levels were fairly similar within those rooms … so it makes it easier to try to understand the differences between heat and light. Does that makes sense? Yea

P10: Yea thankyou

P1: Did Elsa's project have any effect on yours?

M: I…it's very hard to say whether it did or didn't…erm

P1: …with the MAGIC project, you know Elsa (because they put in sensors).

M: I think erm… we worked with what data we collected.

PM: [Laughter]

M: Erm yea…I mean the first session was quite an important session, but we managed to work our way around it so I think I got other people to do that first session again, at a different time and then we'll try and work out how to work that out with the data…so it makes it a little bit more complicated but we'll get around it…but I mean errrr, we are trying to work with MAGIC as well so there's a big asset there because another thing we can look at is air quality and productivity…to see if there were differences within those test days and I obviously got all your responses in those offices that were having the monitoring done in those offices with CO2 levels with MAGIC. So, we are looking to see if we can combine your subjective responses with what they were measuring…so there are aspects there that were looking at, we are collaborating…but it was just… a bit of a rocky start.

P10: Just out of interest I know there are kind of some rules around erm minimum temperatures in an office space…

M: Yes

P10: …is there weirdly not a maximum? Or?

M: No

P10: It just seems maddening to me but erm…

M: But there is in residential

P10: Yea yea… But is there something similar like you mentioned CO2 and pollution?

M: Yea

P10: Are there… like…erm sort of maximum

M: Ahhh there are…

P10: … readings that would say actually this building is, you know, way over what we would recommend for people to work in…

M: Erm…With I think workplaces are very different, there isn't a lot of, it should be this, but there are recommendations.

P10: there are recommendations

M: …because it's all about the owners of the building…it's them, that make people want to have their buildings, so they see that as a return effect. Where I think there is an increasing trend now of …we all apps to be more healthy, we are all becoming more aware of our fitness and productivity…and how much we sleep at night and things like that …so its getting more and more questioned.

P10: I am just thinking… like I mean were not the only ones, that building if had slight windows open, all that pollution from the London road coming in, coming up and in from the building work… were by no means, kind of, there will be loads of buildings like that London…is that what MAGIC is measuring?

M: Yes, so they are monitoring erm, particles in the air, VOC's, CO2, loads of different bits…they are doing it within the offices here but then also within three or five miles radius around and seeing how ventilation flows and all that kind of stuff… so we'll see how that pans out in the end. Yea so that should be interesting. Any other questions?

P3: So, how did you feel about it all? So, are you happy it's gone well?

M: Yes. I'm glad its done. [Laugh]

PM: [Laughter]

P24: I mean there is a lot of data to be analysed, I mean in terms of… methodology and the content. Are you, with what you have seen so far, happy that you have chosen the right tests? Are you happy that you chose the right frequency?…

M: Yes, I think… with research there is obviously, the reason for putting such a large test battery or why I was always trying to reduce it but not too much so that I don't shoot myself in the foot but I had to make it so large because I didn't really know 100% which ones were going to come off. I know it's all based on other researchers going 'Yes there should be some differences when you do this' but those tests the majority of those have only been done in the lab conditions where bringing those tests into the real world and all the other factors that actually affect people in different environments, all come into play, so- yes, I am happy with how the test battery went…there is still a lots of work to be done it terms of improvement, that's why your feedback into it erm is really important so how we can make it better, instructions things like that and your understanding of the tests…so that's really important to make it simpler erm so it's a starting step into looking at productivity as not just a what you think you do but making it an objective measure. Does that answer your question?

P3: Yea

M: …I think it's gone well, there is a lot of data…it's been a lot of hard work and now I deserve a holiday.

PM: [Laughter]

M: …but it's been really interesting I have learnt a lot erm about loads of different aspects from…coding of the tests, creating test, to monitoring the environment, trying to work out some of the odd things that get thrown up, like I did not expect one of the rooms to always seem hotter…. And whether that's to do with the logging and then unpicking that is the next challenge.

P3: Have you seen any… even though its early days… you may not want to comment on this until you've scrubbed the data but have you seen any correlation with performance, temperature, humidity….etc.? Obviously, it's gotta vary depending on the external…whether it is a hot day or a cloudy day whatever…have you seen any correlations between with the blinds up/ blinds down because obviously at the end of the day your work is sponsored by the BBSA and I expect that what they would love to see…There you go, Window with blinds, 5 % saving on the energy, cuts down the glare, you feel better, look we've got the scientific evidence that has all been done independently…but at the end of the day…they are gonna [/going to/] get what they are gonna [/going to/] get…they are gonna [/going to/] get what you find…so I just wondered whether you could see anything…

M: Whether it is a pro or negative [blind research] .

P3: Yes, exactly.

M: At the moment I have been treating the data sets as separate entities. I've seen some little patterns but it's been very from afar at the moment…the amount of data that we've had downloading and collected…it's been more about maintenance of that data, making sure that I'm keeping it, logging it, and then trying to organise it so that I can make some, some like erm some some evaluations as I am going through encase I need to make tweaks so like in the last week we ran another base test so I don't know whether you noticed but the last week you both

had the blinds down again…because I noticed some anomalies which I wasn't quite happy with so I wanted to re-check some measurements and then so those are the things that were important running through. And obviously making sure that your productivity stuff was all being logged, and it makes sense and that the participants participating in it was all uploading correctly and verifying. So, I am treating as separate for the moment and the next stage I will bring it all together…so we will first be looking at erm what you think about your productivity, so there was a question in there saying do you think or something along the lines of do you think you are going to be productive in this test etc or what do you think of your productivity level. ermm So that is one of the key methodologies of how productivity is actually assessed, they just ask the occupants. Do you think your productivity is impacted? And we are gonna [/going to/] examine that with the object- objective measures and see if there is a pattern… and then we are gonna [/going to/] bring in the environmental constraints as well... but we'll see.

M: Thank you very much again and thank you for coming.

End of Interview

APPENDIX J. FOCUS GROUP THEMATIC MAP

Thematic Map of Focus Group Data Assessing the Study Design

Perceptions of Tests & Questionnaires

Understanding of Tests & Questionnaires

Negative

- I didn't have a clue....I didn't have a clue what that was about... (refering to Grammar Test) [119]
- I didn't know much about the specific reasons for the tests...and I think that on the data entry one....I was trying to do it on speed[130-131]
- If I had known that I wasn't gonna see it again... I probably would have tried... (referring to Long-Term Memory Test)[172]
- Maybe it was there to fluster you...[217] (referring to Grammar Test)
- ...you didn't understand the marking scheme...so you didn't know... if it was a good thing to write something if you were not 100% sure or not...(referring to Short-Term Memory Test)[232 - 234]
- I always just think, how those tests... other than that (the text typing test) really, really helped to be honest...[319-321]
- ...it's harder for us to understand the relationship between the performance of the tests and our actual roles not because there isn't one, it's just not directly related unlike others in different roles. Like someone with more of an admin job. [340-343]
- From the memory the images we would have spent more time looking at them and remembering them if you knew each week you knew you had to do it... (referring to Long-Term Memory Test)[409-410]
- I think it lied...[476] (Referring to feedback on Working MemoryTest)
- ...that result was confusing...[503-505] (Referring to feedback on Working MemoryTest)
- I didn't like the grammar ones at all, but then I knew that was something I didn't really understand or what it wanted from me...[545-547]
- Then I didn't understand the long-term memory thing, I mean, I read that and then I studied it as if it was gonna be long term memory... but when it said long-term memory test next, I thought what do you mean? [556-558]

Positive

- I assume that's like part of the tests, different ways that memory cognition work...[176-177]

Neutral

- ...if I'm told the task I'll remember where, if I'm not told a task I won't. (referring to Short Term Memory Test) [180]

Operation of Tests & Questionnaires

Negative

- ...it was a bit glitchy or I was not quiet precise enough... [132 -133] (referring to the Data Entry Test) ...that would hinder your performance as it wouldn't change pages for me either so that was naughty...[135 -136]
- ..said hit enter but you didn't hit enter on it, that was just slightly irritating... (referring to instruction page)[134]
- I made the same mistake twice, nearly three times...on the booklet exercise when you had to do plus three and minus three and then they alternate... that was like, Aaargh, I've done it again! [137- 139,146]
- I wrote it down[162]...It didn't say that that you can't write it down, did it?[168] (referring to the Backward Digit Task)
- ...it was too long...I'd type it up and then I'd go and do something. [194]
- ... I was trained as a touch typist so what I found that I just kept typing even though the minute probably finished a minute ago ... And that took me two or three times to actually make myself look at the screen periodically...[268-271]
- ...if I was only sat there for half an hour before I took the test... then I'd be a bit more ... relaxed about it, ...whereas if I'd been sat there longer on a hot day I'll be a bit like... argh...[354-356]
  - ...some people started the tests later than others. [670]...and others who'd finished but come back... and they'd start talking and eating...[674] ...Because it was over for them... but it wasn't over for others. And I remember once I tried to remember the number backwards, but people were talking just at that point...[677-678] ...then you screw that number up, and you'd be like argh[681]
  - We all tried to start in our little pod... roughly... within 15 minutes of 12 otherwise we'd ... yea.[682-683]
  - I was changing desks every time I found it was unsettling...[696-697]

Approach to Tests & Questionnaires

Positive

- ...I tried like three or four strategies to remember the numbers (referring to Working Memory).[151]
- I found a strategy in the end that worked...(referring to Working Memory)[154]

Negative

- I wrote it down[162]...It didn't say that that you can't write it down, did it?[168] (referring to the Backward Digit Task)
- ...I stopped trying so I only did the four that I was really confident with and the last sort of four sessions I went 'oh sod it' I'm just going to go for it and I just added the whole load of others that I thought may or may not 'ave been on there...(referring to Long-Term Memory Test)[201-204]
- I was guessing...[208] (Referring to Grammar Test)
- (The) questionnaire at the end suddenly you were asking about your nose, your hair is dry... I will always say 50%. (referring to SBS Survey) [238-239]
- In the end I couldn't remember them...I would just guess... [412] (Referring to Long Term Memory Test)
- You did try...try and do your best on it each time...[563]

Believed Performance on the Tests & Questionnaires

Negative

- Well I didn't do very well still. [108]
- I was kind of a little bit erm confused I suppose...about how the test conditions would affect that information... because that's the kind of information you either know or you don't know... (referring to Grammar Test)[211 - 213]
- My performance was... poor. [280]
- I think the typing test I found most difficult...[268]
- the typing wasn't the best....
- ...for the first few days I wasn't feeling well, I don't think, so I don't think I did so well on the tests...[396-397]
- ... I wasn't doing very well... [552-554] ...erm I think it is just at the very beginning because you wanted to do so well. [555]
- Well I think the figure tests probably... relates to a lot of what I do.[286] (referring to Plus and Minus)

Positive

- It did get easier... Just because you kind of knew what to expect, you knew what was coming...[125 -126]
- ...it felt like I was doing it quicker, so it felt less onerous... [404 - 405]
- ...it felt quicker, over the period of time, the number of weeks... yea that kind of felt easier [406-407]
- With data entry I was getting a lot quicker...[432]
- ...as it went on, you know, it felt that some of things felt a bit easier... erm I think it is just at the very beginning because you wanted to do so well. [554-556]

Frequency of Tests & Questionnaires

Positive

- It did get easier... Just because you kind of knew what to expect, you knew what was coming...[125 -126]
- ...definitely towards the end felt a bit more like... ok...(short laugh) got into the routine of it I suppose a little bit...yeah the fact that you were doing it maybe twice a week...[126 -128]
- ...it felt like I was doing it quicker, so it felt less onerous... [404 - 405]
- ...it felt quicker, over the period of time, the number of weeks... yea that kind of felt easier [406-407]
- ...well by the end of it... I thought at least i know whats coming so...[424]
- With data entry I was getting a lot quicker...[432] but when it came to the grammar and then remembering what was in the text (Short Term Memory), ...because I was concentrating more on what I was reading so I could remember that that's what's gonna be asked [434-436]
- ...as it went on, you, know, it felt that some of things felt a bit easier... erm I think it is just at the very beginning because you wanted to do so well. [554-556]
- ....two (tests per week) seemed, like, manageable... [577]

Neutral

- I suppose I've got nothing to compare it to...but it felt like... it felt ok... [574]
- ... twice a week felt ok, but August and July are our quietest period. If you were doing this now, in September and October I probably would have been more reluctant to do it because were just flat out and I would have found it, I think, a bit too stressful. [611-614]
- I thought it was reasonable... [634]

Negative

- The test became quite routine afterwards it was too easy to keep on doing... [186-187]
- ...on the very first day remembering all the pictures and then it becomes so boring for 2 minutes, waiting... ... it was too long...[191-193] (referring to Long-Term Memory Test)
- You started becoming complacent. [452]
- ...after 2, 3 tests it was always the same one because one of them was grapes ... or something, I don't remember now, so I could remember that immediately so... [220-222] (referring to short term memory test)
- Yes, I only did 50% of them. [455] So, yours would have been harder. [459] ...so you weren't exposed to it as much, so it might have felt like you weren't kind of getting in the momentum. [463-464] Or the repititon. [465]
- I found the two days were a bit much... I'm not complaining about it... [589 -590]
- ...certainly once a week would have been easier I think in that respect so. [610]

Perceptions of Interventions on Participants

Control

Negative

- ...it felt enclosed. So the inside felt alot warmer...[52-53]
- It was pretty grim, you know we had a pretty good summer, with some pretty high temperatures... [80]
- ...if I'd been sat there longer on a hot day I'll be a bit like... argh... here we go... [355-356]
- ...so having the windows down was far too hot on some sessions... [663]
- ...if it was particularly hot day...and the windows were down and you couldn't put any fans on or anything...and I think if you had been sat at your desk since 9 o'clock and you took the test at 12 or something... that situation definitely impacted on me...[351-353]
- I hadn't had much sleep the night before for a variety of reasons... [359-360] because bearing the horrendous heat and the lack of sleep...did have an impact and it shows that if you are less than optimum...it really did, I felt degrade your ability.[367-368]
- I had a couple of occasions where I had a lot going on in the office and was also really hot and sticky and really headachy... [378-379]

Thermal Comfort

Negative

- Not being able to open the window or turn on the fan. [78] And the light. [79]
- ...it was a bit frustrating...You couldn't open the blind (or) open the window or turn the fan on. [83-84]
- If supposedly I was in a normal environment I would be opening and shutting the windows, I tend not to use the fans as much unless I absolutely have to umm because I actually don't like the feeling of the fan on me, but umm I found that quite difficult because normally my blinds would be particularly in the summer months my blinds maybe would be half way down just so that it stopped people getting sunlight in their eyes rather than anything else... [99-103]
- I wish I could have opened the window a bit more often at times.[327-328]
- ..it's better to have the windows, blinds up...[59]

Acoustic Comfort

Positive

- ..the quietness in our space, was just like a relief... [664]
- It's made me more aware of noise and the traffic going past...bloody sirens, we get one every 20 minutes in our office... driving past here and they are loud. [713-715]

Neutral

- ...more focussed and quieter... [63]
- Yeah, it affected the atmosphere as well... It felt very quiet.[54]
- It has made me more aware of noise in the office. [717]

Visual Comfort

Positive

- I liked the fact... when they were down i could still see out [34]
- ...when I think or I try to settle information in my brain, I like to look out of the (short laugh) window at the tree or something just so that my brain start to filter things out. So, I actually like the fact I can still see outside.[35-37]
- ...the new blinds gave that sense you were connected to the outside world. [38-39]
- ...they are (the new blinds) are better for the purpose of its too sunny i need to pull the blind down. [46-47]
- ...they were of value when it was really sunny (and) you have no other option but to have the blind down. [41-43]

Neutral

- ...they altered the light... [41]

Negative

- ...the lights were a lot stronger and I don't like the artificial light [45]
- It's really dark, it's really dingy. [48]
- It (did seem) very bright as well...without the blinds down... presumably because you get daylight coming at you, so it seemed harsh.[94-95]

Mood

Negative

- I didn't like them...the partitions, so... the partitions did make me feel a little bit like you were er... partitioned [laugh]. For me it was better to have it open, that made me feel as a part of the team. So that bit did impact me in a (negative way). [24-26]
- ...it's a little bit depressing having blinds down.[38]
- I thought they were depressing... I would only have them down, if I needed them down...[40]
- ...it was like being in a sad National Trust place where the fabrics fade [44]
- ...it made the office look more clinical...[69]
- ...it was a bit frustrating...You couldn't open the blind (or) open the window or turn the fan on. [83-84]
- ... I found by the time I got to the test I was actually really, really angry... and I never get really, really angry... [379 - 380]

Positive

- ...more focussed and quieter... [63]
- Yeah, it affected the atmosphere as well... It felt very quiet.[54]
- ...when you came in, your first reaction was oh were in a test environment, so you might not have said things that you would have done as openly as you perhaps did in the afternoon.[66-68]

Behaviour

Air Quality

Negative

- ...not having any air in, made it it [stutter] like...slight smell, and you come in and it's like you'd notice, immediately... [86-87,89]
- Smelt of building [91]

General Attitude Towards ...

Tests & Questionnaires

Positive

- ... I enjoyed doing it. [119-120]
- Remembering the pictures...the long-term thing[170] That was good / Oh yea/ mmmm / yea[171]
- [Cuts In] I quite liked the coloured box thing.[260] If I had to pick a favourite that would have been my favourite. [263]
- I think (it had) a bit of everything to be honest.[295]
- I thought also the, believe it or not, the coloured ones because that's all about your reactions. ((referring to the Stroop Test) [297-298]
- ...a lot of what most of us are having to do is, is to react to things umm either positively or negatively depending on what it is [300]...so I thought there was some relevance there.[303]
- Maybe grammar test as well, because it made you think about the construction of your sentences and even when your writing emails, making sure what your saying is very clear so there's no kind of... so you're not misunderstood.[307-309]
- ...so alot of it did require you to make kind of like choices and decisions and that's..., we are doing that all of the time.[305-306]
- erm I mean it was good fun I particularly did like the colour ones[323] (referring to Stroop Test)
- I think it covered different components. [331]
- You did try...try and do your best on it each time...[563]
- It covers a range of different skills and attributes that we possibly might be using on a particular day...[333-334]
- ...in the first few sessions you were kind of, I was kind of excited about it [544-545]
- ... I was quite enthusiastic and excited to do it because you know it was for your research...[549-550]
- ...those tests had clearly been designed to do our number skills, typing skills...I think the last one particularly I was hot and sweaty, and I was quite tired. It'd be interesting to see how I did, bit worse on that one, than my average over the others perhaps but I felt...from that perspective it was about right.[583-587]

Negative

- ...they made me feel thick. [110]
- Just make sure this doesn't get to my boss, ok.[181]
- I found that quite hard, yea it was like what kind of animal...what name or what... (Referring to Short Term Memory Test) [223-224]
- That was sad for me. (Referring to SBS Symptom Survey) [249] At least you have hair... [251]
- It was shocking... my nails are terrible... [253] I think it's to do with the DIY I'm doing... not the tests I'm sure. [256]
- ...the first time you went into it you were not scared but a bit nervous because you probably wanted to make sure it was good enough..[421-423]
- ...it annoyed me...(Referring to feedback on Working Memory Test)[530]
- ... to begin with I thought that piece of information was quite demoralising because I thought... I got more than two right like I got four two-digit ones... all those right...so that frustrated [me]...so then I just ignored it...[485-488]
- ...It picked up quite well what you felt about the environment and everything but if you were feeling like really crappy in the morning and you were affected by different factors... there wasn't that, I feel really bad today. I have a lot going on in my life...and it's like there's was one little question saying yes, no, maybe factors and I thought that was one of the things that sort of worried me...[369-370]
- But we know were doing this subconsciously anyway in a day,... in our daily activities and we don't realise were doing it. [336-337]

Interventions

Negative

- mmm.... only the trunking on the floor.[3] (In response to Question 3)
- I think the notice boards (partitions)... because they were for longer desks were a problem because a few people did accidentally fall into them.[18-19]
- ...those two days where I wasn't having a good time (with) it. I really struggled with it, to the point that the computer was very close to going out of the window. [564-565]
- I am worried that during those times when we were affected by those conditions is. Did I do my normal job as well as I would expect to do it in a normal condition, has that affected what I have been doing? Time will only tell when I get the complaints... [604-608]

Neutral

- ... some days I thought that was alright and other days it was like that was terrible. [359-360]
- ...windows open would affect me more...[394-395]

Positive

- = John Doe='s a big fan of them were going to keep them up (partitions) going forward.[15-17]
- I think they (the blinds) were better than the old set [59]
- ..if you had to have the blinds down[60]... the new ones are better. [62]

APPENDIX K. PUBLICATIONS AND POSTERS

Lead Author:

De Grussa, Z., Andrews, D., Lowry, G., Newton, E.J., Yiakoumetti, K., Chalk, A. and Bush, D. (2019). A London residential retrofit case study: Evaluating passive mitigation methods of reducing risk to overheating through the use of solar shading combined with night-time ventilation. *Building Services Engineering Research and Technology*, 40(4), pp.389-408. Available at: https://doi.org/10.1177/0143624419840768 [Accessed 3 Nov. 2019].

De Grussa, Z., Andrews, D., Lowry, G., Newton, E.J., Yiakoumetti, K., Bush, D. and Chalk, A. (2018). A Real-world Study of the Relationship between Subjective Assessment of Productivity, Subjective Perception of Environmental Conditions and Objective Productivity Measures. *In: Chartered Institution of Building Services Engineers Technical Symposium*, London South Bank University, London, UK. 12-13th April 2018. Available at: https://openresearch.lsbu.ac.uk/item/86v4q [Accessed 3 Nov. 2019].

De Grussa, Z., Andrews, D., Lowry, G., Newton, E.J., Yiakoumetti, K., Bush, D. and Chalk, A. (2017). A Case Study assessing the impact of Shading Systems combined with Night-Time Ventilation strategies on Overheating within a Residential Property. *In: 38th AIVC - 6th TightVent & 4th Venticool Conference, 2017 Ventilating healthy low-energy buildings*,13-14 September 2017, University of Nottingham, Nottingham, UK. Available at: https://openresearch.lsbu.ac.uk/item/86xv5 [Accessed 3 Nov. 2019].

De Grussa, Z., Andrews, D., Newton, E.J., Lowry, G., Chalk, A and Bush, D. (2016) A Literature Review Outlining the Importance of Blinds and Shutters as a Sustainable Asset that has the Potential to enhance the Productivity of Occupants in the UK. In: *Going North for Sustainability Doctoral Workshop ARCOM / CHOBE.* London South Bank University, London, UK. 30 June 2016. Available at: https://openresearch.lsbu.ac.uk/item/8736z [Accessed 3 Nov. 2019].

Co-author:

Andrews, D, De Grussa, Z, Chalk, A and Bush, D (2018). Design and the Circular Economy in the UK Blinds and Shutter Industry. In: Charter, M (ed.) Designing for the Circular Economy. Routledge (Taylor & Francis Group), Oxford. pp. 360-368

Venturi, L., Andrews, D., De Grussa, Z., Chaer I,. (2018). The Challenge of Modelling Solar Shading Products and Their Impact on the Built Environment *In: Chartered Institution of Building Services Engineers Technical Symposium*. London South Bank University, London, UK. 12 - 13th April 2018. Available at: https://openresearch.lsbu.ac.uk/item/86v54 [Accessed 3 Nov. 2019].

Andrews, D, De Grussa, Z, Chalk, A and Bush, D (2017). The use and impact of manual and motorised blinds as aids to thermal and visual comfort in domestic buildings in the UK. *Living and Sustainability: An Environmental Critique of Design and Building Practices, Locally and Globally.* London South Bank University, London. Available at: https://openresearch.lsbu.ac.uk/item/87076 [Accessed 3 Nov. 2019].

Andrews, D., De Grussa, Z., Bush, D. and Chalk, A. (2016) THE BARRIERS TO AND DRIVERS OF A CIRCULAR ECONOMY FOR THE BLINDS AND SHUTTERS INDUSTRY IN THE UK. *5th International conference on Life Cycle Assessment: Life Cycle Thinking for leading managers.* Lille, France 08 - 09 Nov 2016. Available at: https://openresearch.lsbu.ac.uk/item/87198 [Accessed 3 Nov. 2019].

Andrews, D, De Grussa, Z, Chalk, A and Bush, D (2016). The Challenges and Benefits of Developing a Sustainable and Circular Business Model for the Blinds and Shutter Industry in the UK. *Sustainable Innovation 2016, 21st International Conference - 'Circular Economy' Innovation & Design'.* University for the Creative Arts, Epsom, Surrey, UK 07 - 08 Nov 2016. Available at: https://openresearch.lsbu.ac.uk/item/871q1 [Accessed 3 Nov. 2019].

Andrews, D, De Grussa, Z and Chaer, I (2015). Using Life Cycle Assessment to Illustrate the Benefits of Blinds as Passive and Sustainable Energy Saving Products in the Domestic Environment in the UK. *Going North for Sustainability.* London South Bank University, London UK. 25 Nov 2015. Available at: https://openresearch.lsbu.ac.uk/item/87591 [Accessed 3 Nov. 2019].

Posters:

London South Bank University, Doctoral Summer School 2019.

Evaluating the Use of Solar Shading Combined with Night-time Ventilation and its impact on Mitigating Overheating in Real-world London Residential Case Study.

Zoe De Grussa[1], Dr Deborah Andrews[1], Dr Gordon Lowry[2], Dr Elizabeth J. Newton[3], Kika Yiakoumetti[3], Andrew Chalk[4] and David Bush[4]
[1]School of Engineering, [2]School of The Built Environment and Architecture, [3]School of Applied Sciences, [4]British Blind and Shutter Association

The continuing rise in global average temperatures, improved insulation standards (necessary to mitigate heat losses during the winter) and poorly planned ventilation strategies are all responsible for exacerbating indoor overheating during warmer weather conditions. With the rise in the number of buildings that overheat and also the rise in the number deaths associated with indoor overheating. It is now crucial that passive measures in particularly (which are environmentally friendly and cost effective) become widely utilised. For these to work efficiently it is essential to educate building occupants in how and when to correctly use them so occupants are able to safeguard their homes and selves from overheating. The research evaluated below is centred around a real-world monitoring case study and investigates how the proposed passive measures can mitigate overheating risk. In order to maximise the positive impact that different types of shading could provide, a controlled window opening strategy (night-time ventilation) was applied in rooms where differing shading strategies were implemented. The data collected were evaluated according to CIBSE TM52 Overheating Criteria to assess the frequency and severity of overheating. Futhermore, the mitigation methods were statistically compared to analyse the difference in internal operative temperature increase according to the type of passive mitigation scenario implemented.

AIMS

The aim of this study was to:

- *Investigate the impact that solar shading and night-time ventilation strategies can have on mitigating overheating.*
- *Demonstrate how the frequency, severity and the absolute maximum temperature can be identified using existing industry criteria.*
- *Use inferential statistics to compare the effectiveness of differing shading strategies.*

THE CASE STUDY BUILDING

Bedroom A: Control Room (Non-shaded) Bedroom B: 80mm Aluminium Venetian Blind

Figure 1. (Above) External SW Facade of Case Study Building, (Below) Internal Equipment Setup.

- *The Case Study building was located in North London and had been retrofitted into apartments from a commercial premises.*
- *The glazed facade was orientated South West (242°), was thermally lightweight in design and incorporated 'single aspect' natural ventilation.*
- *The glazing installed was double Low-E argon filled glazing (4-16-4) with a black/grey spacer which fitted into a steel mullion framework. The glazed areas in each of the rooms were of equal size (3.2m x 1.85m) with less than 13% of the area openable via two top hung windows (0.85m x 0.45m)[1].*

METHODOLOGY

The building was monitored over three months from August to October 2016, and internal operative temperatures (T_{op}) and external air temperatures were monitored every 10 minutes. During this time differing internal and external solar shading systems were tested that had differing material properties calculated to BS EN 14501:2006[2].

*The data collected was analysed as per **CIBSE TM52**[3], which is a 3 criteria system that aims to assess the **frequency, severity** and **set an absolute maximum temperature** for overheating.*

Two of the following three criteria must be satisfied to avoid overheating risk:

1. *The number of hours in the non-heating season that the operative temperature can exceed the adaptive comfort threshold (defined by BS EN 15251[4]) should not exceed 3%.*
2. *Reviews the severity of the overheating within any one day. This criterion assesses the weighted exceedance in relation to the adaptive comfort threshold and should be less than or equal to 6 degree-hours (K.hr) in any individual day.*
3. *Sets an absolute maximum daily temperature. Where the maximum acceptable operative temperature (Tmax) should not be exceeded by 4K and is termed Tupp.*

In addition the operative temperature increase (ΔT) within a test day (Tmax - Tmin = ΔT) were statistically analysed using a Paired t-Test to observe whether internal and external shading had a significant impact on the operative temperature increase in comparison to the control room.

RESULTS

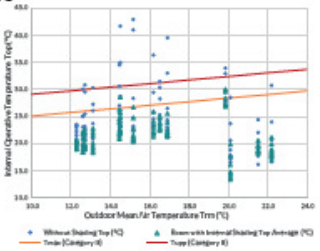


Figure 2. Scatter Plot of Hourly Averaged Indoor Top plotted against the exponentially weighted daily mean external air temperature (Trm) with plots relating to rooms with no shading (□) and rooms with internal shading (△). (112 monitored readings)

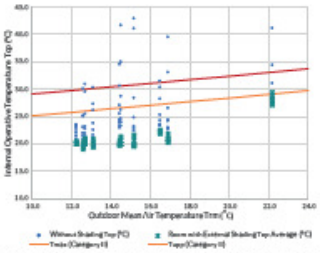


Figure 3. Scatter Plot of Hourly Averaged Indoor Top plotted against the Trm with plots relating to rooms with no shading (□) and rooms with external shading (◆). (80 monitored readings)

CIBSE Overheating Criteria: *Figure 2 and 3 present the T_{op} of the non-shaded, internally shaded and externally shaded rooms against the Trm. The scatter plots identify the following:*

*Criterion 1: was **failed** when rooms were **with no shading or internal shading** but was **passed when rooms had external shading.***
*Criterion 2: was **failed** when rooms were **without shading** but was **passed when rooms had either internal or external shading was used.***
*Criterion 3: was **failed** when rooms were **without shading**, but was **passed when rooms had either internal or external shading.***

Operative Temperature Increase: *The paired t-Test identified that in all cases there was a highly significant difference ($p < 0.005$) between the ΔT when both Internal ($N = 14$, $t = 10.68$) and external shading ($N = 11$, $t = 9.80$) were used and compared with the temperature increases monitored in the control room. Figure 4 graphically represents the 95% confidence interval in ΔT in relation to a non-shaded room. It is observed that internal shading achieves between 73-77% of the ΔT that external shading achieves.*

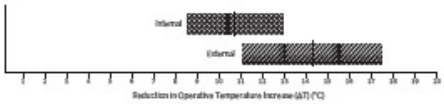


Figure 4. Graphical representation of the 95% Confidence Interval and mean values of Internal and externally shaded room operative temperature increase compared with an unshaded room.

CONCLUSION

- ***Solar shading combined with night-time ventilation** was found to **reduce the risk of overheating** by reducing the operative temperature increase throughout the day.*
- ***External shading is** observed to be **most efficient** when assessed against CIBSE TM52 Overheating Criteria.*
- *Rooms with **external shading** met all three of the criteria within **CIBSE TM52 Overheating Criteria** whereas rooms with **no shading failed to meet all 3-criteria.***
- ***Internal shading** is deemed less effective, as it only passed criteria 2 and 3, this study demonstrated that it **can achieve as much as 77% of the operative temperature.***

THE BARRIERS TO AND DRIVERS OF A CIRCULAR ECONOMY FOR THE BLINDS AND SHUTTER INDUSTRY IN THE UK

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London South Bank University[1], British Blind and Shutter Association (BBSA) UK[2]

Blinds and shutters create privacy in residential and commercial buildings; they can also be used to keep rooms cool when sunny and to minimise heat loss at night or in winter, which reduces use of air conditioning and heating, associated energy inputs, carbon and other outputs and costs. In addition to controlling temperature, they also reduce glare and control light levels, all of which contribute to general health and well-being. In many instances however these products are not used correctly and consequently their potential is not fully realised. Consequently a streamlined LCA was undertaken to measure overall environmental impact and to promote the value of blinds as passive and sustainable energy saving products in a typical house in the UK. The LCA also shows that recycling has a lower impact than other end-of-life scenarios although at present the majority of blinds and shutters are either landfilled, down-cycled with construction waste, or incinerated with energy recovery. The materials used in conjunction with component design, assembly, and disassembly processes indicate that it is technically feasible to develop a Circular Economy for this industrial sector to conserve resources and energy although there are a number of barriers to its development; therefore this paper concludes by discussing these barriers and drivers for change in order to help businesses to develop a Circular Economy and to bridge the gap between theory and practice.

AIMS

The aim of this paper is to:

- *illustrate and promote the **value of blinds as passive and sustainable energy saving products***
- *identify the drivers for a **Circular Economy** in this industrial sector*

METHODOLOGY

*A streamlined LCA using Ecoindicator 99 method and hierarchical weighting set in SimaPro was used to measure and compare the **combined embodied impacts and impacts energy use in a typical UK house with 7 double-glazed windows fitted with blinds. The impacts of 4 popular types of blind were averaged** (a polyester blackout roller blind, a linden wood venetian blind (50mm slats), an aluminium venetian blind (25mm slats) and a vertical blind (89mm polyester vanes) (see Figure 1, 2 & 3).*

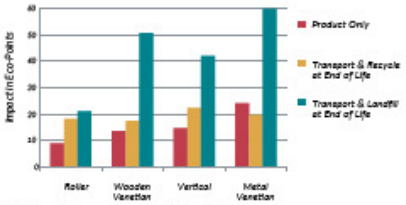


Figure 3. Eco-Point impact of four popular blinds with two end-of-life scenarios

*Average energy consumption for space heating in a UK house is 11,160 kWh / year. **Blinds can reduce energy consumption for heating up to 15%** and energy savings of 5%, 10% and 20% were calculated to account for variations in user behaviour, blind type, building orientation, type of glazing (single, double glazed, low-e glass) etc.*

***Average product life is 5 years** but this varies according to decorating preference, blind quality and consumer use so life spans of 3, 5, 10 , 15 and 20 years were included in the models. **Best case (100% recycling) and worst case (100% landfill) end-of-life scenarios** were also modelled (see Figure 4).*

RESULTS

The integrated energy and product LCAs show that in all scenarios but one, use of blinds during the heating season has a lower environmental impact than not using blinds.

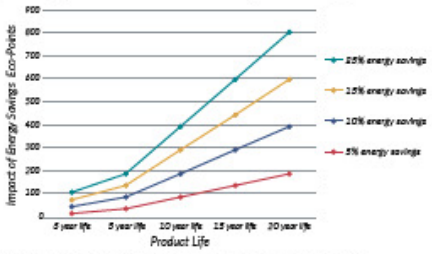


Figure 4. Benefit of Blind Use when Recycled at end-of-life and differing levels of energy saving

*The embodied impact of the blinds does not change but benefits of energy saving from blind use increase over time. If blinds are only used for **3 years with 5% energy saving** and sent to **landfill at end-of-life** the impact of using blinds is higher than not using blinds because the embodied impact is not counterbalanced by reductions in energy consumption.*

***In all cases recycling at end-of-life has a lower environmental impact** than sending blinds to landfill.*

Therefore a Circular Economy will be environmentally beneficial for this industrial sector.

LIFE CYCLE ASSESSMENT

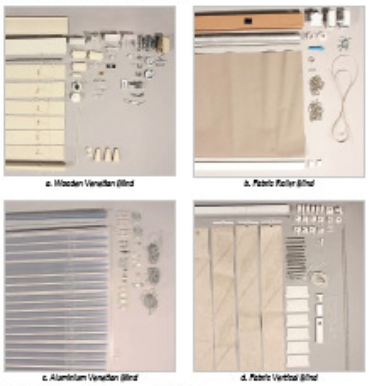


Figure 1. Product disassembly of four popular blinds

Blind Fabric/Slat Material	Blind Mechanism Material	Manufacturing Process
Linden wood (a) Polyester fabric (b) Aluminium (c) Polyester vanes (d)	Polystyrene Yarn, Nylon 6, Acetal, PVC, Polyester, Aluminium, Brass, Nickel Plated, Mild & Stainless steel	Moulding, Cutting, Forming & Machining, Braiding, Painting, Powder coating

Figure 2. Materials and Manufacturing Processes included

CIRCULAR ECONOMY FOR THE BLINDS INDUSTRY

At end-of-life blinds are not recycled: they are either sent to landfill, incinerated with energy recovery or crushed into hard core with other construction 'waste'

Barriers:

- *Blinds are regarded as 'decorative / fashionable, fixtures and fittings' that are replaced and discarded – this has a negative impact on their perceived value*
- *There are no guidelines or incentives to remanufacture or recycle blinds*

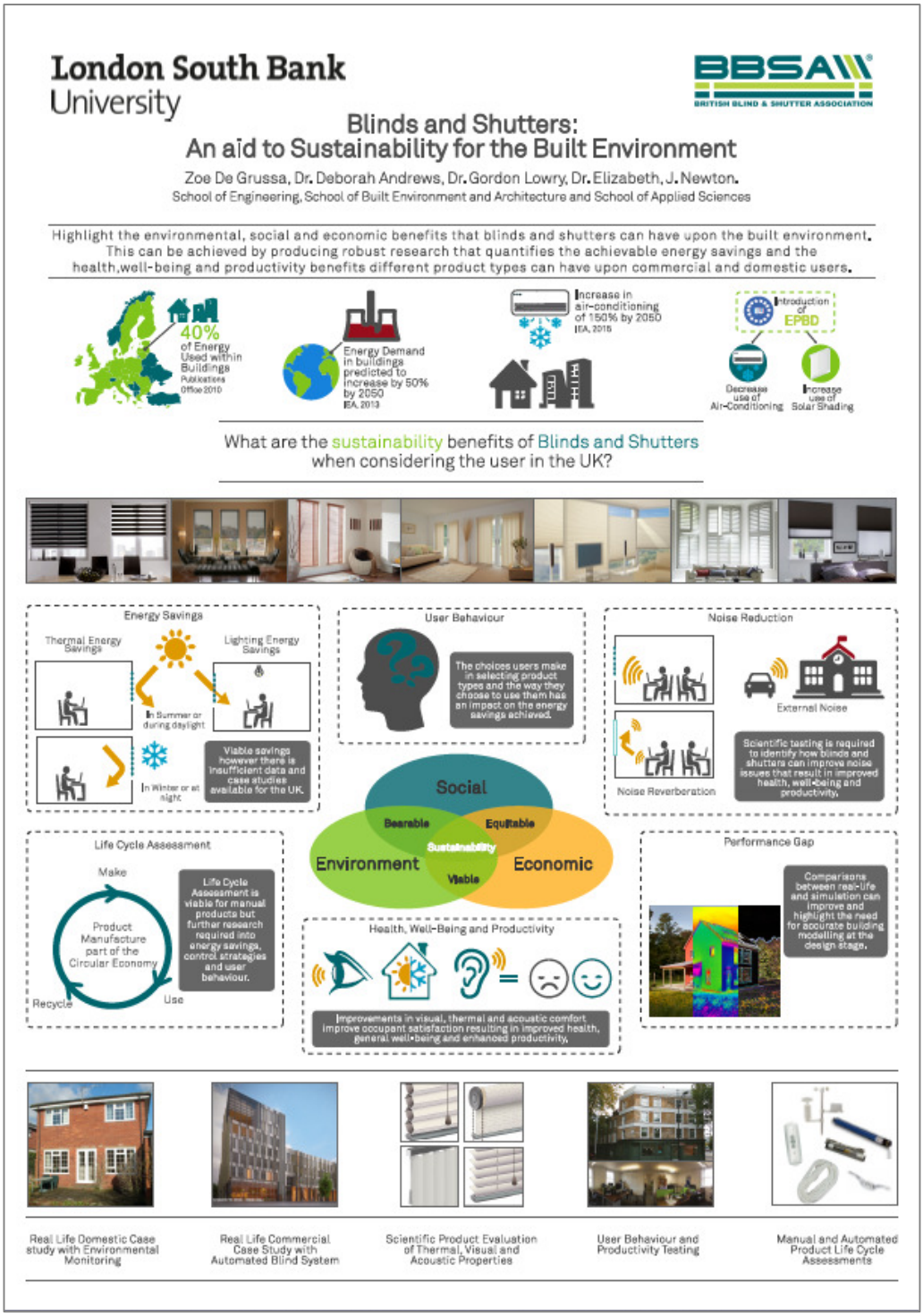
Drivers:

- *Blinds are usually assembled by hand - they are easy to disassemble*
- *Components can be easily changed to up-grade and reuse*
- *If blinds are motorised / automated the cost and perceived value will increase – product life will increase*

CONCLUSIONS

- ***Blind use in UK homes is environmentally beneficial** especially when recycled at end-of-life*
- *Blind materials and manufacturing processes lend themselves to **simple disassembly** and separation for **easy recycling***
- *Components can be reused and/or upgraded illustrate*
- ***A Circular Economy** in the sector **is achievable** if the above barriers can be overcome with **financial incentives, technical innovation and improving the perceived value of blinds***
- *However businesses need to develop alternative strategies and practice if blind sales decrease as a result of extended product life.*

Future work includes LCAs and economic studies of motorised and automated blinds to inform industry and encourage this transition from a linear economy to a Circular Economy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BRITISH BLIND & SHUTTER ASSOCIATION
Blinds and Shutters:
An aid to Sustainability for the Built Environment
Zoe De Grussa, Dr. Deborah Andrews, Dr. Gordon Lowry, Dr. Elizabeth, J. Newton.
School of Engineering, School of Built Environment and Architecture and School of Applied Sciences
Highlight the environmental, social and economic benefits that blinds and shutters can have upon the built environment. This can be achieved by producing robust research that quantifies the achievable energy savings and the health,well-being and productivity benefits different product types can have upon commercial and domestic users.
40% of Energy Used within Buildings
Publications Office 2010
Energy Demand in buildings predicted to increase by 50% by 2050
IEA, 2013
Increase in air-conditioning of 150% by 2050
IEA, 2018
Introduction of EPBD
Decrease use of Air-Conditioning
Increase use of Solar Shading
What are the sustainability benefits of Blinds and Shutters when considering the user in the UK?
Energy Savings
Thermal Energy Savings
Lighting Energy Savings
In Summer or during daylight
In Winter or at night
Viable savings however there is insufficient data and case studies available for the UK.
User Behaviour
The choices users make in selecting product types and the way they choose to use them has an impact on the energy savings achieved.
Noise Reduction
External Noise
Noise Reverberation
Scientific testing is required to identify how blinds and shutters can improve noise issues that result in improved health, well-being and productivity.
Social
Bearable
Equitable
Sustainability
Environment
Economic
Viable
Life Cycle Assessment
Make
Product Manufacture part of the Circular Economy
Recycle
Use
Life Cycle Assessment is viable for manual products but further research required into energy savings, control strategies and user behaviour.
Performance Gap
Comparisons between real-life and simulation can improve and highlight the need for accurate building modelling at the design stage.
Health, Well-Being and Productivity
Improvements in visual, thermal and acoustic comfort improve occupant satisfaction resulting in improved health, general well-being and enhanced productivity.
Real Life Domestic Case study with Environmental Monitoring
Real Life Commercial Case Study with Automated Blind System
Scientific Product Evaluation of Thermal, Visual and Acoustic Properties
User Behaviour and Productivity Testing
Manual and Automated Product Life Cycle Assessments