An investigation of the visual privacy obtained with two types of window treatment

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ABSTRACT

Cultural factors in Libya require female privacy to be maintained. Outside the home, female must wear clothing that reveals only their face and hands. When inside the home and located near windows, a similar degree of clothing cover or window treatment is required. This reduces exposure to natural daylight, with a resultant reduction in the health benefits of daylight. Females who wear hijab dresses when outside of the home expose only their hands and face, an exposed skin surface area of only 11.6% compared with 61% if wearing western-style summer clothing. Clothing restriction can be relaxed when in the home, but here the female privacy is maintained using window treatments and these also restrict access to daylight. Currently used window treatments in Libya (the roller blind and wooden shutter) make the interior space completely dark when closed, but when opened the interior space is exposed to the outside, which offers no privacy, and hence hijab style clothing must be worn when inside. This thesis explored the potential of window treatments to offer enough privacy so that females of some Muslim cultures might wear relaxed clothing when at home instead of needing to wear a high level of clothing.

The first stage in this study was a validation experiment where a novel pictorial clothing scale was created to allow females to state what level of clothing is needed to maintain privacy in different contexts. The result of the questionnaires inviting female participants from three nationalities (Saudi, Libyan and European) showed that variations in the cover and tightness of clothing affect the perceived level of privacy in different situations. For Libyan women, while a head scarf, and arms and legs fully covered by a jacket and trousers was the median expectation when inside the home but potentially visible to a stranger, this could be relaxed (to tighter-fitting clothing, greater degree of skin exposure) if visible only to members of the family.

The second stage was to explore the ability to provide sufficient visual privacy with two window treatments, horizontal blinds and frosted glass, varying the free area and degree of frosting respectively. The degree of privacy offered was operationalised by identification of the clothing level worn by a target behind the window treatment, the

aim being to reduce identification to a chance level. Two actors were used, to consider the effect of skin tone, and two durations, to consider the effect of gaze behaviour. For observations of 0.3 s duration, only the extreme level of each treatment (horizontal blinds set to 3% free area and distortion level 20 for the frosted glass) led to chance levels of clothing identification, for both actors.

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PAPERS RELATED TO THIS THESIS

Journal papers

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Conference proceedings papers

Husain, I., Fotios, S. (2021). Comparing the privacy vs daylight compromise for different window treatments. *In Proceeding of CIE2021 conference: Light for Life Living with Light, hosted by NC Malaysia online*, Sep27_29,2021, pp.787_792. DOI 10.25039/x48.2021.PO51

Poster presentation

ICEP 2019: International Conference on Environmental Psychology, Plymouth, United Kingdom (See Figure D.1 appendix D)

CIE 2021: International Conference **"**Light for Life - Living with Light**".** Kuala Lumpur Malaysia (See Figure D.2 appendix D)

Oral presentation

CIE 2021 conference **"**Light for Life - Living with Light**".** Malaysia (Online)

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CONTENT

ABSTRACT………………… ………………………………………………………………………………….i

ACKNOWLEDGEMENTS iii

PAPERS RELATED TO THIS THESIS iv

CONTENT………. v

LIST OF FIGURES...ix

LIST OF TABLES..xix

Chapter 1. The conflict between daylight and visual privacy................................. 1

1.1 Introduction 1

1.2 Problems associated with clothing and privacy screens.................................. 1

1.2.1. Influence of daylight reduction on health 2

1.2.2. The daylight screening of clothing... 2

1.3. Summary 5

1.4. Research aim 6

1.5. Thesis structure 7

Chapter 2. Literature Review 8

2.1. Introduction 8

2.2 Residential visual privacy 8

2.3. The need for visual privacy 12

2.3.1. Women's clothing (cultural aspects) 13

2.3.2. Measuring privacy by clothing... 15

2.3.3. Limitations of previous clothing scales 20

2.3.4. Muslim females' clothing and visual privacy inside the home 21

2.4. Window treatment 22

2.5. The effect of the degree of window treatment on daylight 23

2.6. External window treatment 24

2.6.1. Wood shutters, a previous adaptive window treatment in Libya 25

2.6.2. Roller shutter 26

2.7. Interior window treatment 27

2.8. Previous research on window treatment and visual privacy 31

2.9. Glass treatment 38

2.10. Summary 40

2.11. Research hypotheses 42

Chapter 3. Developing a scale to measure the privacy offered by clothing............43

3.1. Introduction 43

3.2. Investigating variations in female clothing in different contexts.....................43

3.2.1. Clothing scale 44

3.2.2. The questionnaire 46

3.2.3. Test sample 50

3.3. Results 51

3.3.1. Does clothing matter for visual privacy? 52

3.3.2 The desirable clothing for Libyan women in different contexts 54

3.4. Summary 55

Chapter 4. Method: Window visual privacy experiments 56

4.1. Introduction 56

4.2. Apparatus 56

4.3. Horizontal blinds experiment 60

4.3.1. Blind settings 60

4.3.2. Blinds gap and target size and resolution 63

4.3.3. Setting up the images 67

4.3.4. Procedure 69

4.4. Frosted glass experiment 71

4.4.1. Setting up the images 73

4.4.2. Test variables 77

4.4.3 Procedure 79

4.5. Summary 79

Chapter 5. Results: Window visual privacy experiments 81

5.1. Introduction 81

5.2. Horizontal Blinds 81

5.2.1. Effect of clothing level 85

5.2.2. Effect of observation duration 88

5.2.3. Effect of skin tone 89

5.3. Frosted Glass 91

5.3.1. Effect of clothing level 94

5.3.2. Effect of observation duration 97

5.3.3. Effect of skin tone 100

5.4. Experimental validation 101

5.5. Summary 103

Chapter 6. Discussion 104

6.1. Introduction 104

6.2. Privacy offered by clothing 104

6.3. Visual privacy offered by window treatments 107

6.3.1 Effect of clothing 111

6.3.2 Effect of skin tone 112

6.3.3 Effect of observation duration 113

6.4. Comparison with Previous Studies 116

6.5. Summary 119

Chapter 7. Conclusion 121

7.1. Conclusions 121

7.2. Limitations and Recommended Further Works 123

APPENDIX A: Experiment 1 (clothing scale) 127

APPENDIX B: Experiment 2 (Horizontal blinds) 135

APPENDIX C: Experiment 3 (Frosted glass) 159

APPENDIX:D Poster presentation 185

References 187

LIST OF FIGURES

Figure 1-1: Estimate of percentages of skin exposure for women wearing different types of clothing, based on (Table 1.1) 5

Figure 2-1: Examples of window locations, outdoors and indoors at ground level, with differences that provide satisfactory privacy. Details re-drawn after Basim (1986).... 10

Figure 2-2: Residential building in a high-density area in Libya: the height of the building is 1.75 times the width of the road. Three visual exposure scenarios from a short distance from the pedestrian eye to the house and from level to level. The height of the window on the ground floor is above the pedestrian's eyesight level, in this case, no visual exposure for the ground floor from the pedestrian... 11

Figure 2-3: Residential building in a low-density area in Libya: The setback for the front yard of a house (villa type) is 4m. Three visual exposure scenarios from a long distance from the pedestrian eye to the house and from level to level. The height of the fence is 1.85m, in this case no visual exposure from the pedestrian in the street. 12

Figure 2-4: Full body clothing worn by Muslim women; the left-hand image shows the hijab covering the body but leaving the hands and face exposed. The right-hand image shows a Niqab, a hijab covering the hands and face, as well as the body with only the eyes visible 14

Figure 2-5: Headscarf scale created by Moaddel (2013) showing the six levels of head covering used to investigate modesty preferences in public space.............................. 20

Figure 2-6: Three types of external window treatment; mashrabiyya reduces direct solar radiation, and improves the distribution of natural diffused light. The louver shutter reflects the light upwards if the slats are opened. The perforation in the roller diffuses the light, but when the shutter is opened, the light is transmitted directly inside. 25

Figure 2-7: Photograph of types of external wood shutter window treatment in Libya. Left: the fixed slats are opened downwards, which is optimal for direct sunlight and privacy. Middle: this provides a very dark interior. Right: for ventilation and daylight, the panels of the screen can be rotated 26

Figure 2-8: Diagram of the wooden shutter commonly used in Libya; the slats are angled at 30 to 60 degrees. Analysis by Gelil et al. (2015) shows that, in the diagram on the left, when the direction of the slats is optimal for ventilation, while in the diagram on the right, when the position is optimal for sunlight, it limits ventilation 26

Figure 2-9: The most common window treatment in Libya (roller shutter), the four roller shutter conditions show the effect of the perforations on the illuminance level inside the room: 1) the roller shutter is fully closed when the light is switched on; 2) the shutter is closed with open perforation; 3) the shutter is partly closed; 4) the shutter is fully opened. 27

Figure 2-10: Fabric curtains and fabric roller curtains are common types of interior window treatment in Libya. Sudare is a an interior roller used in Japan to control visual privacy and the outside view, and also for shading and ventilation. The horizontal blind is a commercial window treatment with slats that can be adjusted for daylight and visual privacy. 28

Figure 2-11: Horizontal blind: three opening conditions. In the left-hand image, the blind is raised completely to the top. In the middle image, the slats are in the horizontal position. The right-hand image shows the slats adjusted to the vertical position to completely block the view 29

Figure 2-12: The dimensions used for calculating the opening area: the height of the opening area (H), the apparent height of slat (A), the height of the slat (L) 30

Figure 2-13: The effect of the direction of the slats on solar radiation and the degree of opening area: left, upward-facing (direct solar) and right, downward facing (protects from direct solar); while downward-facing provides a uniform light, both directions give a similar degree of view, whether from outside or inside...30

Figure 2-14: Example of mashrabiyya screening in the old city of Jeddah, Saudi Arabia; photograph © Wajdi Atwah, used with permission 31

Figure 2-15: The mashrabiyya model designed and investigated by Kotbi (2019) 32

Figure 2-16: Scale figures used by Kotbi (2019) to investigate visual privacy and daylight using mashrabiyya 33

Figure 2-17: Sudare: window treatment used in Japan and Indonesia, inside (left) or outside (right) the building (image adapted from Hariyadi and Fukuda (2017a) 34

Figure 2-18: Physical laboratory experiment by Hariyadi et al. (2017); two rooms were divided by a sudare screen. The left-hand image shows the object room which contained the person who was being observed; the right-hand image depicts the room containing the test participants who were required to look into the other room. 35

Figure 2-19: Visual privacy experiment by Hariyadi and Fukuda (2017 b). Images were taken from the physical experiment, and the same experiment was repeated using images. On the left side, a figure guideline was placed beside each image to provide the participant with the same sensation of comparison. 35

Figure 2-20: Correlation coefficients computed by researcher to assess the relationship between Hariyadi and Fuchida's real and digital images experiments 36

Figure 2-21: Six examples of screen treatment and positions used to investigate the view to the outside and visual privacy by Oe et al. (2021) (dark screen and translucent screen randomised with zero screen coverage) 36

Figure 2-22: Living room model used by Oe et al. (2021) to evaluate the ability to see a doll outside the window; the left-hand image is the ground floor plan, and the right-hand image is a photo of the experiment taken through the peephole used by participants to evaluate the view of the doll 37

Figure 2-23: Characteristics of the random texture frosted glass (middle) orientated toward the light compared with the flat glass (left) and the organised frosted glass (right), as developed by Chen et al. (2016). The reflectance of the regular texture glass is considerably reduced due to repeated reflectance of the light.................................39

Figure 2-24: The 'haze' characteristics of organised and random frosted glass textures (Chen et al., 2016); the random texture achieves greater haze (85%), which is sufficient for visual privacy, compared with the texture of the organised frosted glass (73% haze). 40

Figure 3-1: An example of the image used in the first experiment. Left: the original image, photographed in the studio. Right: the cropped image used in the clothing scale 45

Figure 3-2: Scale developed to investigate the impact of clothing level on perceived privacy; each step represents a gradual change in skin exposure and/or the tightness of clothing to create a step change in privacy. The order of these steps relates to what is acceptable and unacceptable in Muslim society. 46

Figure 3-3: Demographic questions used to investigate the degree of clothing coverage required to maintain privacy in different contexts...48

Figure 3-4: The clothing scale used to investigate the degree of clothing coverage required to maintain privacy in different contexts...49

Figure 3-5: The mean level of clothing coverage of women from three different origins in four contexts: A, B, C, D..51

Figure 4-1: A numerical classification scale for human skin colour by Fitzpatrick. The current work used two actors. The first actor's skin tone is fair, between (II) and (III). The second actor's skin tone is dark brown to black (V to VI)...57

Figure 4-2: The seven clothing levels used in the two experiments investigating window privacy. Top row – actor 1, bottom row – actor 2. The two actors are wearing the same level of clothing, from left (a high degree of skin exposure, tight fitting) to right (the whole body covered, loose fitting) 58

Figure 4-3: The living room scene used as a background...59

Figure 4-4: Example photographs of an experiment in progress. The participant sits facing the wall onto which the test images were projected. The image shows trial of the category rating procedure. 59

Figure 4-5: An example of a horizontal blind; two degrees of angles are illustrated: left - fully closed, or 90° (vertical slats), and right - completely opened, slats 0° (horizontal) 60

Figure 4-6: The dimensions used for calculation of the height of opening area, 30 mm (H), and 20mm the apparent height of the slats, an example showing the highest opening area to outside (60%), which is provided by α=23.6˚ (slat angle) 61

Figure 4-7: The relationship between the slat angle and opening area (free area) and closing ratio. The trend shows the blind angles from 70 to 100˚ with a blind opening of less than 10%. For opening levels of about 50% or more, it was very easy to identify the clothing level. This opening was 30-degrees˚... 62

Figure 4-8: Examples of free areas of the blinds tested by researcher to identify range of blind opening levels used in the main experiment. Two free areas, the left 80% and the right 5%, the actor skin tone (type II), clothing level 2... 62

Figure 4-9: the viewing angle of Landolt's (1899) letter stroke, Minimum Angle of Resolution. The human eye with normal visual acuity may identify a detail within a viewing of 1 minute of arc 64

Figure 4-10: The reduction in the sizes of the blind openings. Using the Log MAR 1.0 log unit acuity principle provides 24 sizes 65

Figure 4-11:The reduction in the sizes of the blind openings using 0.25 log unit provides 6 blind opening areas... 65

Figure 4-12: The visual size and the distance from the participant's chair to pedestrians and the absolute target size 66

Figure 4-13: The dimensions of the projected area on the wall (required target size (mm) and the distance from observer to wall) 67

Figure 4-14: Illustration of variations in position for the horizontal blinds experiment. The top row shows the three variations in horizontal location of the actor. The bottom row shows enlarged details of the face to show changes in vertical position of the blind. In these images the blind is set to a free area of 34 %, the actor has skin type is II and is wearing clothing level 2) 68

Figure 4-15: Examples test images for investigating visual privacy offered by horizontal blinds. The two rows show the two actors, and in each case, they are wearing clothing level 1. The six columns show different levels of free area, ranging from 3% to 60% with intervals of 0.25 log units. In these images the actors are placed at the middle horizontal position (X=0). The vertical position of the blinds are set to eyes visible (top row) and eyes hidden (bottom row)..69

Figure 4-16: The range of distortion levels in frosted glass filter in Photoshop softwere.presentations have been made to identify the distortion levels used in the frosted glass experiment.The two rowa show two actors skin tone(VI and II type) , they are wearing clothing level 1. 75

Figure 4-17: Frosted glass filters in Photoshop Software. Example for Distortion level (4), Scaling 100%, presenting a comparison between two different smoothness levels (2, 1). Clear deformation can be seen in the image on the left. 76

Figure 4-18: A comparison of real frosted glass, in the middle, and layered film samples of two different smoothness levels: left image (1) and right image (2). 76

Figure 4-19: The right-hand image has a 100% scaling filter and was selected for the test images in the experiment, since it provides the ideal or average frosting....................77

Figure 4-20: Examples of test images for investigating visual privacy offered by frosted glass. The two rows show the two actors, and in each case, they are wearing clothing level 1. The five columns show different levels of distortion level, ranging from (4 to 20) in steps of four distortion units. In all images, the actor is placed in the middle of the three horizontal locations. 78

Figure 5-1: Median clothing level response plotted against actual clothing level for the six levels of free area (% shown in each graph). These results are for the two actors: a white skin tone (type II) and a dark brown to dark skin tone (type VI) and the 0.3 s, 3.0 s observation durations. The dot-dash line indicates the ideal response for correct identification of clothing level 84

Figure 5-2: Median clothing level responses plotted against actual clothing levels for five distortion levels of frosted glass, ranging from (4 to 20) in steps of four distortion units (shown in each graph). These results are for the two actors: a white skin tone (type II) and a dark brown to black skin tone (type VI) and the 0.3 s, 3.0 s observation durations. The centre dashed line represents the ideal response for correct identification.......... 95

Figure 5-3: The effect of changing actor's location (left, middle and right) on rating identification of clothing level. Example of four levels of free area for the horizontal blind (3%,11%,19% and 60%) for a white skin tone (type II) actor, during 0.3 s observation duration 102

Figure 6-1: Examples of clothing representing differently levels of acceptable provacy for Libyan women. *Left*: clothing level 2, acceptable in the family home, not visible to strangers. *Right*: Clothing level 6, worn in the home when they are at risk of being viewed by non-family members. 106

Figure 6-2: The Comparison of the results of privacy offered by two window treatments. Free area of 3% (left) for the horizontal blind and distortion level D=20 (right) for frosted glass. Each graph shows the slope line of the median response for clothing levels plotted against the actual clothing level for each actor's skin tone II and VI at an observation duration of 0.3s... 110

Figure 6-3: The threshold of the significant effect of the actors' skin tone (II and VI) on visual identification of clothing levels for the levels of free areas of horizontal blinds and the distortion levels in frosted glass. 113

Figure 6-4: The differences between the effects of observation durations of 0.3s and 3.0s on visual identification of clothing level for the free areas of the horizontal blind and distortion levels in frosted glass. Left side graphs show the actor with skin tone type II, and right side graphs the actor with skin tone type VI. The straight lines represent a 0.3s observation duration, and the dotted lines represent a 3.0s observation duration. 115

Figure 6-5: Differences between using pictures and real actors to investigate visual privacy. The advertisement images for frosted glass used by a glass film company (https://www.pilkington.com/en-gb/uk/householders/decorative-glazing). A copy of the permission is attached in Appendix F. 117

Figure 7-1 The effect of the reflection on the glass and the difference in luminance between outside and inside the house on visual privacy. The left image: the window without window treatments.The right image: the window covered by a curtain..........125

Figure A-1: Example of consent form used to confirm that the two actors were happy for their photographs to be used in the current research and arising publications. ...129

Figure B-1: pre-tested images for different degrees of free areas of the horizontal blinds with grey background to identify the images used in the main experiment..........135

Figure B-2: pre-tested images for different degrees of free areas of the horizontal blinds with living room background, to identify the images used in the main experiment. Examples of the Free areas from 5% to 50%, for the actor's skin tone (type: VI and II), Clothing levels: 1,2,3,5,6,8 136

Figure B-3: The effect of the light condition in the laboratory (light off and on). Pilot study presentation on the left vs the main experiment on the right. 139

Figure B-4: Pilot study results. Median clothing level response plotted against actual clothing level for the five levels of open area (% shown in each graph). These results are for the dark skin tone (type II) and the 0.3 s observation duration..........140

Figure B-5: Pilot study results. Median clothing level response plotted against actual clothing level for the five levels of open area (% shown in each graph). These results are for the dark skin tone (type VI) and the 0.3 s observation duration. 141

Figure B-6: Pilot study results. Median clothing level response plotted against actual clothing level for the five levels of open area (% shown in each graph). These results are for the white skin tone (type II)) and the 1.0 s observation duration. 142

Figure B-7: Pilot study results. Median clothing level response plotted against actual clothing level for the five levels of open area (% shown in each graph). These results are for the white skin tone (type VI) and the 1.0 s observation duration 143

Figure B-8: The versions of clothing used in experiment (2). Change in clothing level 7: the colour of the outer garment on the left was changed (by Photoshop) 144

Figure C-1: Comparisons between the distortion levels of the frosted glass in Photoshop in the left and real sample of the frosted film obtained from the frosted glass factory on the right 159

Figure C-2: The effect of changing the smoothness levels: S=1 in the left and S=2 in the right which has been selected to simulate the real frosted glass. The rows show two examples of distortion levels, 4 and 8, used in the experiment. **Note: Distortion, Smoothness and Scaling are variables in frosted glass filter in Photoshop** 160

Figure C-3: The effect of changing the Scaling levels to 50,100 and 200. The Scaling levels in the images in the experiment were maintained at Sc =100; this is because there was no deformation affecting the images when testing the three scaling levels. The rows show two examples of distortion levels, 4 and 8, used in the experiment. 161

Figure C-4: Pilot study results. Median clothing level response plotted against actual clothing level for eight distortion levels of frosted glass, ranging from (2 to 16) in steps of two distortion units (shown in each graph). These results are for the white skin tone (type II) and the 0.3 observation duration. The orange line indicates the ideal response for correct identification of clothing level. 165

Figure C-5: Normality profile, examples of the Histogram and Q_Q Plot for clothing identification of seven clothing levels at distortion level D=4 for the Actor/ skin tone type II, Observation time: 0.3 sec 167

Figure C-6: Normality profile, examples of the Histogram and Q_Q Plot for clothing identification of seven clothing levels at distortion level D=20 for the Actor/ skin tone type II, Observation time: 0.3 sec 170

Figure C-7: Normality profile, examples of the Histogram and Q_Q Plot for clothing identification of seven clothing levels at distortion level D=16 for the Actor/ skin tone type VI, Observation time: 0.3 sec 173

Figure C-8 : Normality profile, examples of the Histogram and Q_Q Plot for clothing identification of seven clothing levels at distortion level D=20 for the Actor/ skin tone type VI, Observation duration 0.3s 175

Figure C-9: A copy of the permission to use the frosted glass images advertised by the company (https://www.pilkington.com/en-gb/uk/householders/decorative-glazing). 184

Figure D-1: Poster presented in ICEP 2019: International Conference on Environmental Psychology, Plymouth, United Kingdom 185

Figure D-2: Poster presented in CIE2021: International conference **"**light for life - living with light**".** Kuala Lumpur Malaysia 186

LIST OF TABLES

Table 1-1: The surface of body parts of female age 25 y. Body part areas m² presented by US-EPA (2011c) reported as percentages of the total surface by (J.D. te Biesebeek et al., 2014). 4

Table 2-1: Studies employing clothing scales to investigate personal and cultural aspects affecting modesty among female Muslims; four main categories have been used: skin ccoverage, looseness and tightness,top length, and headscarf worn. 17

Table 2-2: Clothing scale created by Albrecht et al. (2014) that divided clothing into three groups for comparison: traditional Muslim dress, Western dress, and a mixed group (headscarf with Western dress) named Integration 18

Table 2-3: Clothing scale created by Ericsson (2017); six categories of clothing were created for different parts of the body (head, top, and bottom). For modesty, the top was divided into three classifications: one representing skin coverage, and the others for length and looseness. There were two categories of bottom clothing: one representing the skin covering, and the other the degree of looseness. 19

Table 2-4: Shading coefficient for different types of window treatment (Lechner, 2014). 23

Table 3-1: Descriptive statistics for the clothing scale questions regarding the desirable clothing levels for females from three different origins (Libya, Saudi Arabia, and Europe) 52

Table 3-2: Significant differences between the three groups in relation to the four contexts.......... 53

Table 3-3 :Comparison of groups regarding levels of privacy in clothing in different conditions using the Mann-Whitney test 54

Table 4-1: The reduction in the sizes of the openings and the slats, from the largest opening of 60% to the smallest opening of 3%, in uniform steps, with a constant ratio of

0.25 log unit steps. The left column is the angle (α) corresponding to each degree of openness 65

Table 4-2: Examples of the horizontal blind experiment to assess the effects of different variables 70

Table 4-3: Horizontal blind experiment. Sample Group Demographics: Gender and Age 70

Table 4-4: All possible combination ratings of variables categories in trial for the frosted glass experiment. 78

Table 4-5: Frosted glass experiment. Sample Group Demographics: Gender and Age.79

Table 5-1: Median frequency of clothing level responses through different blind openings for actors' skin tone types II and VI at observation duration 0.3 sec. Note: for these data, chance frequency is 4 (the desired level of privacy). Shaded numbers mean incorrect identification of clothing levels by participants. 82

Table 5-2: Median frequency of clothing level responses through different blind openings for actors' skin tone types II and VI at observation duration 3.0 sec. Note: for these data, chance frequency is 4. Shaded numbers mean incorrect identification of clothing levels by participants......83

Table 5-3: Significance of differences between reported clothing levels as tested using the Friedman test for different percentages of free area of horizontal blinds, for the two actors and the two observation durations......85

Table 5-4: Significant differences of the slope of the regression line from zero for different percentages of free area of the horizontal blind, for the two actors and the two observation durations. 86

Table 5-5: Pairwise clothing level comparisons for each blind opening, actor skin tone (type II) and observation duration 0.3 sec using Wilcoxon- Asymp. Sig. (2-tailed) Significant at P< 0.05. 87

Table 5-6: Pairwise clothing level comparisons for each blind opening, actor skin tone type (VI) and observation duration 0.3 sec using Wilcoxon- Asymp. Sig. (2-tailed) Significant at P< 0.05. 88

Table 5-7: Significant differences in the effect of observation duration (0.3 sec and 3.0 sec) on visual discrimination between clothing levels through different horizontal blind free areas for actor skin tone types II and VI. Wilcoxon- Asymp. Sig. (2-tailed). 90

Table 5-8: Significant differences for the effect of actor's skin tone type (II and VI) on visual discrimination of clothing levels through different horizontal blind free areas at 0.3 sec and 3.0 sec observation duration using Wilcoxon- Asymp. Sig. (2-tailed). 91

Table 5-9: Median frequency of clothing level responses through different distortion levels for actors' skin tone types II and VI, observation duration 0.3 sec. Note: for these data, chance frequency is 4. Shaded numbers mean incorrect identification of clothing levels by participants. 93

Table 5-10: Median frequency of clothing level responses through different distortion levels for actors' skin types II and VI, observation duration 3.0 sec. Note: for these data, chance frequency is 4. Shaded numbers mean incorrect identification of clothing levels by participants. 94

Table 5-11: Significance of differences between reported clothing levels as tested using the Friedman test for different levels of distortion for the frosted glass, for the two actors and the two observation durations 96

Table 5-12: Significance of differences of the slope of the regression line from zero, for different levels of distortion for the frosted glass, for the two actors and the two observation durations.. 96

Table 5-13: Calculated p_ values from pairwise comparisons of responses on clothing level at each distortion degree , actor skin tone type (II) and observation duration 0.3 sec using Wilcoxon- Asymp. Sig. (2-tailed) Significant at P< 0.05. 98

Table 5-14: Pairwise clothing level comparisons for each distortion degree, actor skin tone type (VI) and observation duration 0.3 sec using Wilcoxon- Asymp. Sig. (2-tailed) Significant at P< 0.05. 99

Table 5-15: Significant differences in the effect of observation duration (0.3 sec and 3.0 sec) on visual discrimination between clothing levels through the frosted glass (distortion levels)for actor skin tone types II and Vl. Wilcoxon- Asymp. Sig. (2-tailed) 100

Table 5-16: Significant differences in the effect of actors' skin tone type (II and VI) on visual discrimination between clothing levels through different levels of frosted glass (distortion level) for 0.3 sec and 3.0 sec observation durations, Wilcoxon- Asymp. Sig. (2-tailed). 101

Table 6-1: Results of Wilcoxon signed-rank test used to compare visual privacy offered by the degree of free area (3%) of horizontal blind and the distortion level of frosted glass (D=20). 111

Table 6-2: Pairwise comparisons for the effect of actors' skin tone on visual identification of clothing level across the degrees of free areas of the horizontal blind and the distortion levels of frosted glass. 112

Table 6-3: Pairwise comparisons for the effect of observation duration on visual identification of clothing level, across the degrees of free areas of the horizontal blind and the distortion levels of frosted glass. 114

Table A-1: The changes steps in the clothing scale (the degree of skin exposure).......127

Table A-2: The changes steps in the clothing scale (the degree of arms coverage) 127

Table A-3: The changes steps in the clothing scale (the degree of legs coverage 128

Table A-4: The changes steps in the clothing scale (the length of the Top clothing)...128

Table A-5: Raw results of clothing levels responses by Libyan women in four contexts 130

Table A-6: Raw results of clothing levels responses by Saudi women in Four contexts 131

Table A-7: Raw results of clothing levels responses by European women in Four contexts 132

Table A-8: Normality test for Q1(clothing responses by Libyan, Saudi and European women outside the house) 133

Table A-9: Normality test for Q2(Inside their home, visible only to family members) 133

Table A-10: Normality test for Q3(Inside their home, but potentially visible 134

Table: A-11: Normality test for Q4(Inside their home, in this case the 134

Table B-1: The illuminance level of the test images in the laboratory for the actor with skin tone type II. Blind opening (3% and 6%) 137

Table B-2: The illuminance level of the test images in the laboratory for the actor with skin tone type II. Blind opening (11% and 19%) 137

Table B-3: The illuminance level of the test images in the laboratory for the actor with skin tone type II. Blind opening (34% and 60%) 137

Table B-4: The illuminance level of the test images in the laboratory for the actor with skin tone type VI. Blind opening (3% and 6%) 138

Table B-5: The illuminance level of the test images in the laboratory for the actor with skin tone type VI. Blind opening (11% and 19%) 138

Table B-6: The illuminance level of the test images in the laboratory for the actor with skin tone type VI. Blind opening (34% and 60%) 138

Table B-7: Responses of horizontal blinds experiment for each clothing level and blind opening (free area 3%,6% and 11%)/Actor skin actor tone (type II)/observation duration 0.3s 145

Table B-8: Responses of blind experiment for each clothing level and blind opening (free area 19%,34% and 60%)/Actor skin tone (type II)/observation duration 0.3s 146

Table B-9: Responses of blind experiment for each clothing level and blind opening (free area 3%,6% and 11%)/Actor skin tone (type VI)/observation duration 0.3s 147

Table B-10: Responses of blind experiment for each clothing level and blind opening (free area 19%,34% and 60%)/Actor skin tone (type VI)/observation duration 0.3s...148

Table B-11: Responses of blind experiment for each clothing level and blind opening (free area 3%,6% and 11%)/Actor skin actor tone (type II)/observation duration 3.0s 149

Table B-12: Responses of blind experiment for each clothing level and blind opening (free area 19%,34% and 60%)/Actor skin tone (type II)/observation duration 3.0s....150

Table B-13: Responses of blind experiment for each clothing level and blind opening (free area 3%,6% and 11%)/Actor skin tone(type VI)/observation duration 3.0s......151

Table B-14: Responses of blind experiment for each clothing level and blind opening (free area 19%,34% and 60%)/Actor skin tone (type VI)/observation duration 3.0s...152

Table B-15: Normality profile for: The effect of blind opening (free areas 3% and 6%) on visibility value. Actor skin tone type II Observation time; 0.3 sec 153

Table B-16: Normality profile for: The effect of blind opening (free areas 11% and 19%) on visibility value. Actor skin tone type II Observation time; 0.3 sec 154

Table B-17: Normality profile for: The effect of blind opening (free areas 34% and 60%) on visibility value. Actor skin tone type II Observation time; 0.3 sec 155

Table B-18: Normality profile for: The effect of blind opening (free areas 3% and 6%) on visibility value. Actor skin tone type VI Observation time. 156

Table B-19: Normality profile for: The effect of blind opening (free areas 11% and 19%) on visibility value. Actor skin tone type VI Observation time; 0.3 sec.........................157

Table B-20: Normality profile for: The effect of blind opening (free areas 34% and 60%) on visibility value. Actor skin tone type VI Observation time; 0.3 sec.........................158

Table C-1: The illuminance level of the test images in the laboratory for the actor with skin tone type II. Distortion level (D=4 and D=8) 162

Table C-2: The illuminance level of the test images in the laboratory for the actor with skin tone type II. Distortion level (D=12 and D=16) 162

Table C-3: The illuminance level of the test images in the laboratory for the actor with skin tone type II. Distortion level (D=20) 162

Table C-4: The illuminance level of the test images in the laboratory for the actor with skin tone type VI. Distortion level (D=4 and D=8) 163

Table C-5: The illuminance level of the test images in the laboratory for the actor with skin tone type VI. Distortion level (D=12 and D=16) 163

Table C-6: The illuminance level of the test images in the laboratory for the actor with skin tone type VI. Distortion level (D=20) 163

Table C-7: Normality profile for the effect of Frosted glass (distortion degree= 4 and D=8) on visual identification of clothing level. Actor/ skin tone type II, Observation time; 0.3 sec 166

Table C-8 : Normality profile for the effect of Frosted glass (distortion degrees: D=12 and D= 16) on visual identification of clothing level. Actor/ skin tone type II, Observation time; 0.3 sec 168

Table C-9: Normality profile for the effect of Frosted glass (distortion degrees: D=20) on visual identification of clothing level. Actor/ skin tone type VI, Observation time; 0.3 sec 169

Table C-10: Normality profile for: The effect of Frosted glass (distortion degree D= 4 and D=8) on visual identification of clothing level. Actor/ skin tone type VI, Observation time; 0.3 sec 171

Table C-11: Normality profile for: The effect of Frosted glass (distortion degree D=12 and D=16) on visual identification of clothing level . Actor/ skin tone type VI, Observation time; 0.3 sec 172

Table C-12: Normality profile for the effect of Frosted glass (distortion degree D=20) on visual identification of clothing level. Actor/ skin tone type VI, Observation time; 0.3 sec 174

Table C-13: Responses of frosted glass experiment for each clothing level and distortion degree (D=4, D=8 and D=12)/Actor skin actor tone (type II)/observation duration 0.3s 176

Table C-14: Responses of frosted glass experiment for each clothing level and distortion degree (D=16 and D=20)/Actor skin actor tone (type II)/observation duration 0.3s...177

Table C-15: Responses of frosted glass experiment for each clothing level and distortion degree (D=4, D=8 and D=12)/Actor skin actor tone (type VI)/observation duration 0.3s 178

Table C-16: Responses of frosted glass experiment for each clothing level and distortion degree (D=16 and D=20)/Actor skin actor tone (type VI)/observation duration 0.3s..179

Table C-17: Responses of frosted glass experiment for each clothing level and distortion degree (D=4, D=8 and D=12)/Actor skin actor tone (type II)/observation duration 3.0s 180

Table C-18: Responses of frosted glass experiment for each clothing level and distortion degree (D=16 and D=20)/Actor skin actor tone (type II)/observation duration 3.0s...181

Table C-19: Responses of frosted glass experiment for each clothing level and distortion degree (D=4, D=8 and D=12)/Actor skin actor tone (type VI)/observation duration 3.0s 182

Table C-20: Responses of frosted glass experiment for each clothing level and distortion degree (D=16 and D=20)/Actor skin actor tone (type VI)/observation duration 3.0s..183

Chapter 1. The conflict between daylight and visual privacy

1.1 Introduction

The essential purpose of home design is to offer a healthy environment for the residents. Poor natural light conditions inside the house could have a negative impact on occupants' lives and worsen mental and social components of their quality of life. Libya is a sunny region, endowed with clear skies, homes are expected massively to espouse natural light. However, cultural factors in Libya (and some other Muslim countries) require female privacy to be maintained through window screens. This reduces indoor house exposure to daylight, and reduced daylight exposure can lead to female health problems. When females are outside and visible to the public, they may choose to wear clothing that hides their appearance. This means that even if they are exposed to sunlight outside of buildings, they will not gain greatly from it because the hijab clothing prevents it from reaching their bodies (Alagöl et al. 2000). The window is the primary source of indoor natural light (Phillips,2004). Window treatments in Libya, such as roller shutter and wood louver shutters, block the natural light and the view to outside the home when they are closed for privacy purposes.

The research reported in this thesis relates to measuring visual privacy through different window treatments. More specifically, it concerns window treatments that obscure outside views into the home, allowing Libyan women to be more flexible with their clothing modesty levels, giving them more opportunity to be exposed to daylight.

1.2 Problems associated with clothing and privacy screens

Controlling visual exposure is linked to the freedom offered by hijab clothing, as indicated by Rahim (2015) when he addressed women's desire to behave and dress as they prefer, without having the worry of being seen or judged by others. There are two problems associated with the use of window screens and clothing for privacy. The first problem is the potential effect on thermal comfort. If women are covered up when visually exposed to the outside, they are more likely to suffer thermal discomfort due to the high humidity and temperature levels in the summer season in Libya. The second problem is that while using a window screen may have the advantage of reducing direct solar radiation to a room, it also reduces natural ventilation. In both cases there is the disadvantage of reducing the health benefits of regular exposure to daylight.

1.2.1. Influence of daylight reduction on health

Access of daylight into the indoor living space has a significant influence on residents' health through regulation of the circadian rhythm and generation of vitamin D. Sufficient daylight is necessary for functional needs as well as for biological and psychological requirements (Figueiro, et al., 2011). One of the most important consequences of the daylight reduction is disorder of sleep and wake (Figueiro et al., 2021). Daylight can provide a robust circadian stimulus of the right colour, amount, timing and period (Figueiro, et al., 2011). A study by Figueiro et al., (2021) indicated in relation to the impact of the morning light on circadian timing, sleep cycle and performance that the circadian clock regulates the timing of large-scale changes of biological functions, such as the timing of the sleep process and wakefulness during the day. Furthermore, Boubekri et al. (2014) found that employees who sat near windows, and so received more light during the day, were more active overall, slept longer, and had better sleep quality than their colleagues who worked in offices without windows.

Daylight is the visible effect of sunlight rays. Radiation is affected by the nature of window treatments, and it is possible to achieve transmittance or absorptance or reflectance (Lechner,2014). The human body produces vitamin D when skin is exposed to the sun's ultraviolet rays, which trigger vitamin D synthesis (Engelsen, 2010). However, sunlight consists of both ultraviolet UVA, and UVB, the UVB rays triggering the synthesis of vitamin D (Engelsen, 2010). The question then is whether clothing and window glassing material block the needed UVB rays.

1.2.2. The daylight screening of clothing

The human body needs vitamin D to maintain calcium and phosphorus in the bones and teeth. Bone diseases such as osteoporosis are more common when vitamin D is less than the average level (Grant and Holick,2005). Studies indicate that vitamin D deficiency is rising dramatically in Arabic countries such as Middle Eastern countries and Saudi Arabia (Alshahrani et al., 2013; Buyukuslu *et al.*, 2014; Mishal, 2000). Vitamin D deficiency has been identified as a more significant problem for females than for males; Mishal (2000) conducted an experimental study to evaluate the effect of different clothing styles on women's vitamin D levels, with the research finding that women whose bodies were totally or near totally covered by hijab dresses had significantly lower vitamin D levels than men, in summer and winter. One reason for this is the methods used for maintaining privacy (clothing and window screens). For example, in Saudi Arabia, where female privacy is also of concern, this deficiency could be caused by various factors, such as consciously avoiding the sun and wearing traditional outdoor clothes. Alshahrani et al. (2013) suggested thirty minutes of sunlight exposure is sufficient to fulfil the human body's daily requirement for vitamin D. Consequently, wearing clothing that reduces exposure to sunlight means this period must be longer.

These studies indicate that covered women have deficient vitamin D levels and higher risk of vitamin D deficiency. In so doing they alert public health practitioners and educators to advise people, in particular women wearing covering dress styles, to take precautionary measures by finding ways to achieve healthy indoor and outdoor lifestyles, within the framework of their religious and cultural requirements. Alagöl et al. (2000) carried out a clinical study to investigate the efficiency of vitamin D synthesis in 48 premenopausal women for three different types of dress worn in summer. Their results showed that vitamin D levels the in women were dressed so that their skin was exposed to the daylight were 44% lower than usual, while in women were only the face and the hands were exposed to the sunlight 60% vitamin D levels lower than the average level.

Finally, all the women had their whole body covered (Khimar) had lower than normal vitamin D levels. Loomis (1967) and Alagöl et al. (2000) demonstrated that for each square centimetre of white skin, 6 IU of vitamin D is produced during each hour of exposure to sunlight. Since the recommended daily dose of vitamin D is 200-400 IU, adequate exposure of the skin of the face and hands to sunlight might provide the regularly needed vitamin D. On the other hand, women who wear hijab clothing have less skin exposure to the sun, approximately 80 to 90 per cent less than the women who wear regular clothes.

To provide evidence in support of this view, Table 1.1 shows the percentages of surface area of different parts of the body in m2 in relation to the total body area of females (te Biesebeek et al., 2014). When applied to a woman in the 25 years age group, as shown in Figure 1.1, exposing her hands and face will produce 11.6 % of the total required vitamin D dose, which corresponds to 550 IU of V.D. In this case, women wearing the hijab should be exposed to sunlight for about one hour a day. In contrast, in the third image the woman is dressed in a style that reveals more than half of the total surface area of her skin to sunlight, thereby exposing five times more than with the scarf hijab clothing in the first image. This means that when wearing clothing that reduces exposure to sunlight, the period of exposure to the sun must be longer.

Table 1-1: The surface of body parts of female age 25 y. Body part areas m^2 presented by US-EPA (2011c) reported as percentages of the total surface by (J.D. te Biesebeek et al., 2014).

Body parts	m^2	%
Head (Inc. face and neck)	0.13	6.8%
Hand	0.082	4.9%
Feet	0.113	6.8%
Arms (exl. hands)	0.227	13.7%
Legs	0.533	32.1%
Eyes ≈1/4 hand*	0.020	1.2%
Face ≈ hand*	0.082	4.9%
Neck ≈ hand*	0.082	4.9%
Chest ≈ 2 hands*	0.164	9.8%

* Eyes, face, neck, and chest have been estimated based on hands size, as calculated by (EPA 2011c) and (te Biesebeek et al., 2014)

Hands and face areas exposed 11.6% | Hand, head and arms exposed 26.8% | Hands, face, arms and legs exposed 61%

Figure 1-1: Estimate of percentages of skin exposure for women wearing different types of clothing, based on (Table 1.1)

Due to increased indoor living and insufficient UV exposure, it is becoming increasingly difficult for modern individuals to be exposed to natural light. According to Kecorius et al. (2018), people spend an average of 84 percent of their time indoors throughout the day. Experimental research has tested UVB radiation in different types of glass, including common coloured glass. Duarte et al. (2009) found that all types of glass completely blocked UVB rays. However, Serrano and Moreno's (2020) investigation showed that this is not a sufficiently precise position, since people with pale white skin (type I on the Fitzpatrick scale (ARPANSA, 2020), exposed behind smoked glass, acquired enough UVB for vitamin D3 production after 30 minutes. On the other hand, people with light brown skin (Fitzpatrick type III) would require around 50 minutes.

1.3. Summary

The physical living environment that is insensitive to residents' cultural demands (such as visual privacy) may have a detrimental long-term influence on the residents since it may lead to a change in lifestyle that is not similar to the intended way of life (Hashim et al., 2006).

There is no doubt that Hijab, whether implemented by clothing or screen, is required according to the Holy Quran. Indeed, Libyan women desire modesty in clothing even if they are not wearing full Hijab clothing (e.g., wearing just a headscarf). Due to socio-cultural factors in Libya, women spend a significant amount of time at home. As a result, the only place where they can get sunlight is inside their dwellings. Therefore, the indoor living space must be designed in a way that provides a healthy habitat for women, as natural light is necessary for their health and wellbeing. Many researchers agree with the above claim that daylight level needs to be considered as well as maintaining privacy when designing indoor living spaces at home. The conflict between daylight and privacy in Libya is a problem found in other countries that have the same cultural requirements and environmental aspects, as has been argued by Shatwan (2017) and Aljawder and El-Wakeel (2020).

While Aljawder and El-Wakeel (2020) assessed cultural and personal factors that influence people’s need for visual privacy and daylight in Bahraini dwellings, Shatwan (2017) considered visual privacy in terms of women's need for daylight. The study measured the daylight level in modern flats in Saudi Arabia, concluding that in most of the examined flats there was a major lack of daylight due to different factors such as glass type, exterior obstruction, and window size.

In addition, the aspect of investigating how the used technique to windows can influence the visual privacy into buildings has not been considered and documented widely in research studies. Therefore, the current research focuses on measuring the degree of visibility through different window treatments. Determining the required type of window treatment to meet the accepted degree of privacy will allow clarification of the task of aligning this with Muslim women's need for sufficient daylight to maintain their health and wellbeing.

1.4. Research aim

This research aims to investigate the design of privacy offered by different levels of clothing and the extent to which this privacy can be maintained by window treatments rather than changes in clothing.

1.5. Thesis structure

The thesis is split into seven chapters. Chapter 1 provides background and explanation of the impact on women’s health of daylight reduction which is caused by the need for privacy as provided by clothing or privacy screens. Chapter 2 is a review of literature about approaches to meeting visual privacy needs and experimental studies investigating the privacy obtained with different types of window treatment. Chapter 3 describes a novel scale developed to assess privacy of clothing by different cultural groups. Two experiments were conducted to investigate the design of window treatments so that sufficient privacy was obtained. Chapter 4 describes the method used in these experiments. The first experiment, visual privacy investigated by horizontal blinds and the second experiment visual privacy investigated by frosted glass. Chapters 5 describes the results and analysis of the first and the second experiment. Chapter 6 the discussion of the three experiments 1,2 and 3. Finally, Chapter7 presents the study's conclusions and limitations.

Chapter 2. Literature Review

2.1. Introduction

This research focuses on the trade-off between the use of clothing or window screens to maintain sufficient visual privacy. This is a particular problem for women from certain religious faiths (in this research, the focus was on Muslim women from Libya) who are required to dress for modesty in situations where they may be visible to males other than those of their immediate family. This stipulation persists even when in their own home in case they are observed by a male located outside the house. A desire to wear more relaxed clothing when at home can be met if window screens are used to prevent observation from outside. Doing so, however, obstructs daylight, which has detrimental effects such as reducing the health benefits of exposure to daylight. This literature review clarifies the different approaches to maintaining visual privacy. The first part explores how scholars have applied the concept of visual privacy to Muslim inhabitants; it identifies what is deemed important in the context of visual privacy, and how it can be measured. For the current research, it was essential to find a scale to measure visual privacy quantitatively. The second part reviews window treatment and solutions for sustaining visual privacy whilst permitting daylight. The third part presents the methods employed to gather evidence through a review of studies investigating window treatment that have quantitatively assessed the degree of visibility.

2.2. Residential visual privacy

The idea of residence (or dwelling) extends beyond the physical area occupied by people for rest, food, and sleep to satisfy their psychological, social, and cultural needs (Taha, 2010). One of the principles of design psychology is to create designs based on human behaviour and satisfaction (Zhang, 2007) . Studies show that the occupant's satisfaction in residential buildings was affected by satisfaction with view to outside (Abd-alhamid et al., 2020; Abd-alhamid, Kent and Wu, 2022; Jamrozik et al., 2019) and visual privacy (Al-birawi, 2019), natural light has also a significant effect on occupants' behaviour and satisfaction. The design of a successful window is an optimisation challenge between these aspects, as is the case with most decisions a building designer must make. To address the challenge, minimum and maximum performance requirements for each function of the window must be established.

The degree of satisfaction in relation to visual privacy is subjective and differs between people (Rapoport 2005) depending on factors such as age, attitude, level of life, gender, location, interactions with neighbours, and how much privacy is needed (Newell 1995). Evidence based on cultural differences in the design of public and private spaces suggests that while private life at home in the West (for example, the United Kingdom) revolves around "personal privacy and home-centred living" (family members should keep others out of their allocated personal zones), the design of East Asian homes (for example, Japan) revolves around "family privacy and family-centred living" (Ozaki, 2002). Visual privacy in some cultures is a sort of privacy sought by members of people that seeks to maximise personal interactions between or among its members, corresponding to visual privacy and intimacy with family as defined by Altman (1977). Muslim society traditionally is family intimacy inside the house and practicing everyday activity without being observed or judged by others (Othman, Aird and Buys, 2014).

In Islamic societies, visual privacy is regarded as one of the most critical design aspects that contribute to user satisfaction (Offiah, Opoko and Adeboye, 2013). Behavioural norms (such as avoiding looking into other people's homes, dressing modestly and using physical elements such as indoor and outdoor walls, partitions, curtains, and blinds) are significant components of visual privacy (Rahim,2015). Design of the house is also a strategy used by architects to maintain visual privacy, through such as orientation of rooms' locations, windows screens, balconies, and doors. On the other hand, urban setting characteristics, such as the site plan, the height of the surrounding residential units, setbacks, and land use, have a strong impact on the degree of visual privacy (Pedersen & Frances, 1990).

Planning in the majority of the Middle East and North Africa is a combination of two different schools of thought: Western law and Islamic culture (Emhemed, 2005). Islamic culture considers visual exposure, which is generated by windows, to be harmful and, consequently, an abuse in Muslim law that is necessarily to be avoided. The placement of doors and windows in Muslim houses is affected by the need to avoid visual exposure.

The placement of the windows in Muslim houses, as exemplified by Basim (1986), provides limited solutions. In the left and right hand images in Figure 2.1 the window is located above the pedestrian who is in the street. This might be a good location for providing daylight (depending on the screen dimensions and the height of the nearby buildings), and this is also an acceptable condition in terms of privacy; however, it provides a poor view for the occupant to outside. In addition, level variation may not be possible between outside and inside, and for the three conditions, others will still be able to look in from a high adjacent building.

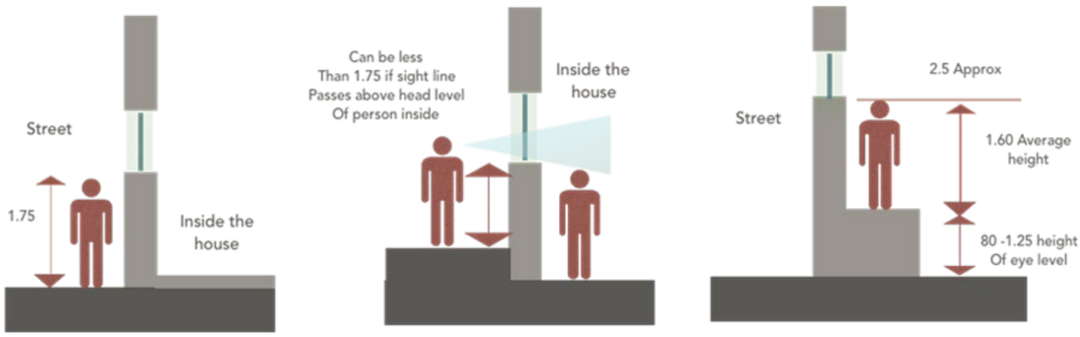


Figure 2-1: Examples of window locations, outdoors and indoors at ground level, with differences that provide satisfactory privacy. Details re-drawn after Basim (1986)

Before there were building codes in Libya, building heights depended on application of Islamic ideals rather than any law or rule, and buildings were designed to maintain visual privacy in residential areas. In current Libyan building and planning for residential areas, legislation is intended to preserve visual privacy (Emhemed, 2005). Yards and setbacks provide appropriate light, air, control sound, and visual privacy to provide interior spaces and prevent crowding. Setbacks are applied differently depending on the density of the residential area. The Libyan Planning and Building Act of 1969 provides examples of the various setback regulations (front, side, and rear). However, these setbacks were not necessary for traditional Libyan homes because the courtyard functioned as a sufficient solution for providing natural light and visual privacy. The setback for the front yard in a low-density area of a house for a single family should be 4 meters; in addition, a side yard should have a 3m minimum setback and the back yard should have a 3-meter minimum setback. The height of a residential building next to a public road should be no greater than 1.75 times the space between its parallel sides (Emhemed, 2005). Figure 2.2 shows the visual exposure scenarios for residential buildings in a high-density area.

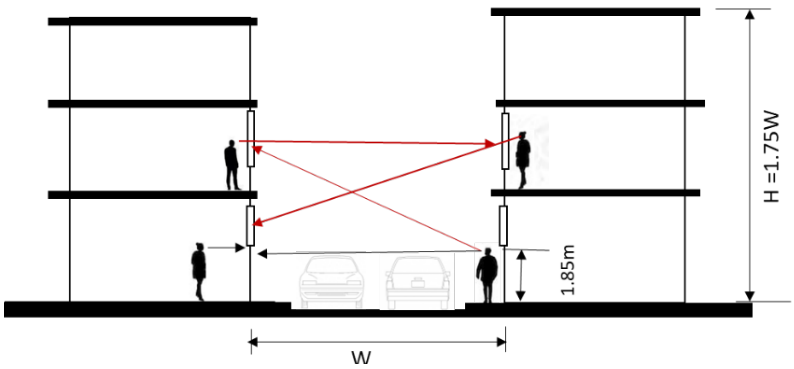


Figure 2-2: Residential building in a high-density area in Libya: the height of the building is 1.75 times the width of the road. Three visual exposure scenarios from a short distance from the pedestrian eye to the house and from level to level. The height of the window on the ground floor is above the pedestrian's eyesight level, in this case, no visual exposure for the ground floor from the pedestrian

For the residential buildings in low-density areas, such as villas (a common house type in Libya), as shown in Figure 2.3, the window on the ground floor is covered by the fence, where the worst scenario of visual exposure is between windows on the first floor as viewed from the opposite house. Fencing in residential buildings is an aspect of the privacy regulating mechanism in Libya. Based on the 1969 Act, as reported by Emhemed (2005), the upper fences that face the street should be constructed with Mashrabiyya and the tops of fences between neighbouring plots should not be higher than 1.80 meters. However, this height is insufficient to protect the yard’s interior privacy from passers-by, and the Mashrabiyya is a window screen rarely used in Libya, with people instead choosing to adjust and increase the height of their fences.

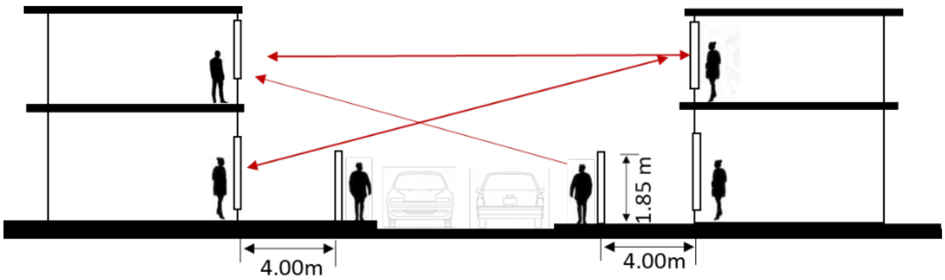


Figure 2-3: Residential building in a low-density area in Libya: The setback for the front yard of a house (villa type) is 4m. Three visual exposure scenarios from a long distance from the pedestrian eye to the house and from level to level. The height of the fence is 1.85m, in this case no visual exposure from the pedestrian in the street.

2.3. The need for visual privacy

Residential visual privacy refers to the ability to perform everyday activities in one's own home without being observed by others (Hashim et al., 2006; Al-Kodmany, 1999). A dominant factor in the design of dwellings in Libya is the need to maintain residential visual privacy for females against observation by people who are not direct family members, known as 'non-mahram'. Direct family members, known as 'mahram', include '*their husbands, fathers, sons, husbands' fathers, husbands' sons, brothers, brother's sons, sisters' sons, or small children who have no carnal awareness*' (Al-Kodmany, 2000).

The need for visual privacy differs from culture to culture, and even varies from one group to another because of the effect cultural differences have on privacy (Altman, 1977). The concept of privacy in Libyan and other Muslim societies was based on gender norms, the position of women, and the separation of genders (Rahim, 2015; Elmansuri and Goodchild, 2021).

The arrangement and the design of residential spaces allow the female family members to carry out their daily activities in privacy (Emhemed, 2005; Hashim et al., 2006). Behavioural norms and physical elements are regulating mechanisms for visual privacy that were identified in a case study by Rahim (2015) which found that curtains, screens and blinds, and architectural elements such as doors and windows are important visual privacy regulating mechanisms.

Findings indicate that visual privacy is primarily required in the context of housing for three reasons: to allow for freedom in clothes, freedom in activities, and control over information about the home (Rahim, 2015). Behaviour norms regarding visual privacy were found to regulate visual privacy mechanisms in case studies conducted in Malaysia (Hashim et al., 2006; Othman, Aird, and Buys, 2015). Hijab clothing is one such behaviour norm and is described as "appropriate clothing" by Rahim (2015), while the need for freedom of visual access, whether through flexible or relaxed clothing, is termed "inappropriate clothing ". Some respondents showed a strong preference for maintaining visual privacy by making changes to their behaviour and to the physical elements of the house. It is widely stated that when the curtains are opened, female house members will tend to dress according to Islamic requirements (Hashim *et al.*, 2006). However, findings by Rahim, (2015) indicate that while some female respondents do not consider visual exposure to a car passing in front of residences to be a concern, this is not the view of those who fully observe Islamic practice on covering their "aura" (the parts of the body that should not be seen by others based on Islamic principles).

The literature has shown a shortage of investigation related to aspects of female privacy in Libya, such as how female family members dress according to Islamic rules when they are exposed to outside. However, studies on privacy have shown that one of the reasons for housing modification in Libya is to achieve the required level of privacy. Elmansuri (2018) stated that female visual privacy was debated openly, and female privacy is intimately linked to the requirement to wear appropriate clothing in public, whereas the women's relaxation area is regarded as the private domestic zone: "*I use a complete veil in public...feel relaxed here without the Veil and Abaya...more freedom at home..*.".

2.3.1. Women's clothing (cultural aspects)

In the context of dwellings, people need privacy for three main reasons: conducting everyday activities, controlling information about the house, and freedom of clothing (Rahim, 2015). In physical terms, visual privacy in Islam is based on the need to maintain female modesty (Besim, 1996). Modesty is inextricably linked to the concept of clothing and can be sustained by choosing to wear clothing that covers specific regions of the body and/or is sufficiently loose-fitting to avoid revealing details. The hijab is the most widely worn Islamic veil in Muslim nations, and in Muslim communities in Western nations, including Europe and North America (El-Geledi and Bourhis, 2012). The term 'hijab' refers to the concept of covering, as well as the modest clothing worn by Muslim women (Hwang and Kim, 2020). There is no universal type of hijab worn by all Muslim women (Shirazi, 2010). Many of them dress modestly in accordance with religious requirements. Some wear a scarf that covers their hair, but not their faces and hands, along with a loose robe that covers all parts of their body (Figure 2.1 left). Conversely, some conservative Muslim women wear the Niqab which also covers the face and head, but leaves the eyes exposed, as depicted in Figure 2.1 (right). Others wear different clothing based on whether they follow Islam as a way of life.

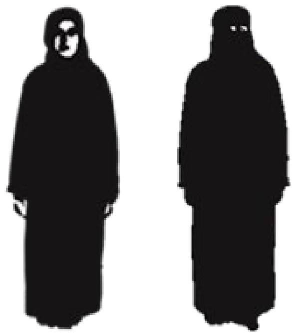


Figure 2-4: Full body clothing worn by Muslim women; the left-hand image shows the hijab covering the body but leaving the hands and face exposed. The right-hand image shows a Niqab, a hijab covering the hands and face, as well as the body with only the eyes visible

Variations in the clothing preferences of Muslim women are affected by factors such as looking fashionable, feeling comfortable (Nam et al., 2007), and modesty. These are influenced by age, education (Bachleda, et al., 2012), marital status (Boulanouar, 2010), and cultural aspects. Kelly (2010) identified other factors influencing clothing choices, particularly for Muslim women, such as location, occasion (daily life or special events), audience (single-sex or mixed), as well as personal preference and family norms. Physical modesty, defined by Othman, Aird and Buys (2015), as expressed through clothing, is considered an important aspect of protecting women's bodily privacy while still allowing social activities (Hochel, 2013).

2.3.2. Measuring privacy by clothing

In studies investigating women's clothing preferences, some researchers have chosen to focus on specific features associated with modesty. These studies have characterised clothing according to Islamic principles for Muslim females as follows: the amount of head coverage (eyes, face, and neck), body coverage (arms, legs, and hands), and the looseness or tightness of clothing. The ability of variations in clothing to provide modesty has been investigated using written descriptions of clothing and images portraying degrees of skin exposure and looseness.

Shafee (2020) considered the appearance of the clothing of female Muslims living in London (UK) in two situations: (i) inside the house where they are potentially visible to non-family members, and (ii) outside the house. The aim was to investigate the personal and social problems associated with hijab dresses. The participants consisted of 265 women wearing veils, and who responded to a text survey questionnaire. The survey comprised questions eliciting demographic information and items covering personal problems related to the effect of the degree of clothing on daily activity (e.g., whether they felt hot and sweaty when their faces were covered, or their hair or neck was covered with a scarf). The questions related to participants' clothing were not reported; however, during data collection, the researcher affirmed that each participant's appearance aligned with their responses. The classifications of clothing levels reported in Shafee's (2000) study focused mostly on skin coverage, particularly in relation to whether a headscarf was worn. Table 2.1 presents the clothing classifications used in previous studies. For Shafee (2000), the shadowed grey boxes indicate a high level of skin coverage, although the scale did not include categories in terms of looseness (body shape). Nevertheless, Shafee described the dress of non-veiled participating women as being modest, but did not provide any details on the degree to which the skin was covered.

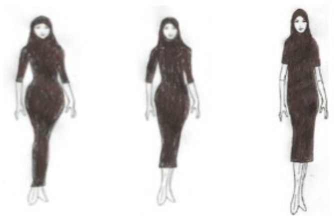
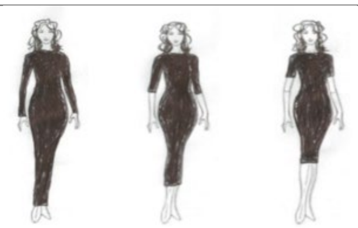
Bachleda et al. (2012) also conducted a text-based survey, in this case describing four clothing styles commonly worn by Moroccan women in public settings. These were the four combinations of headscarves (worn and not worn) and dress length (short or long) (Table 2.1). These clothing options were presented to a sample of 950 Muslim women in Morocco and compared with demographic determinants of clothing preference such as age and religion. The chosen clothing corresponded to the most regular type of clothing worn in a public space, but the study did not consider the type of clothing worn inside the house.

To evaluate Muslims females' modesty, Albrecht *et al.* (2014) studied the clothing preferences of female Muslim students in South Africa using clothing scales based on line-drawing images. The clothing portrayed by the images ranged from modest (traditional Islamic clothing covering the entire body, and loose fitting) to Western clothing (with little coverage of the arms and legs and tight-fitting clothing). The images were numbered 1 to 9 as shown in Table 2.2. The questionnaire was completed by 200 Muslim female students who were asked: 'Which image is the most reflective of the fit and coverage of your clothing?' However, the designs of the line-drawn or figural stimuli scale were based on these students. Thus, the clothing levels represent a particular society where certain levels have been described as an integration strategy (headscarf with Western garments; headscarf with loose-fitting top and tight pants) and cannot be readily applied to a larger community of Muslims.

Table 2-1: Studies employing clothing scales to investigate personal and cultural aspects affecting modesty among female Muslims; four main categories have been used: skin ccoverage, looseness and tightness,top length, and headscarf worn.

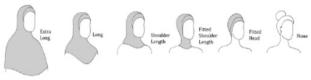
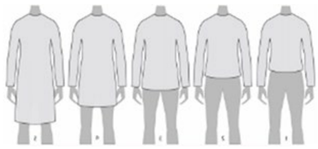
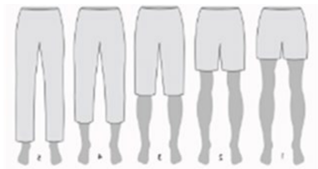
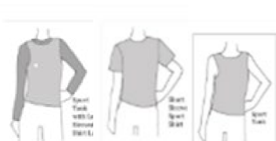
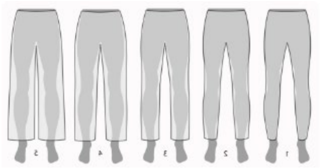
Authors	Type of clothing Scale:	Clothing categories													How the topic related to privacy	
		Skin coverage							Looseness and tightness			Top length			Modesty and the degree of clothing used	Privacy (clothing outside vs inside the house)
		Head Scarf worn	Eyes	Face	Neck	Hand	Arms	Legs	Tight	Mid	Loose	Short	Mid	Long		
Shafee (2020)	Text	with	Y	Y	Y	Y	Y	Y	Y	Y	Y			Y	Other categories were described as clothing types (jackets, blouses)	Clothing investigated outside and inside the house
		without			Y		Y	Y	Y	Y			Y			
Bachleda et al. (2014)	Text	with							Y		Y				No degree of skin covering; the clothes covering the arms and legs were described as a type of clothing such as traditional Jilbab, t-shirt, skirts, and jeans.	N/A
		without							Y		Y					
Albrecht et al. (2014)	Images	with			Y		Y	Y	Y	Y			Y	Y	Some clothing levels are mixed between western and head scarf.	N/A
		without			Y		Y	Y	Y	Y			Y	Y		
Moaddel (2013)	Images	with	Y	Y	Y										No progressive change in clothing levels	N/A
		without	Y	Y	Y											
Erickson (2017)	Images	with			Y		Y	Y	Y	Y	Y	Y	Y		The scale missed some of the highest degrees in terms of face covering and top length.	N/A
		without			Y		Y	Y	Y	Y	Y	Y	Y			

Table 2-2: Clothing scale created by Albrecht et al. (2014) that divided clothing into three groups for comparison: traditional Muslim dress, Western dress, and a mixed group (headscarf with Western dress) named Integration

Clothing definition	Illustration of variations in clothing
Traditional Muslim: headscarf with modest dress (traditional hijab); this highest extent still shows the shape of the body.	 1 2 3
Western: Headscarf with Western dress (Integration strategy)	 4 5 6
Integration: no headscarf with tight-fitting dress with three sleeve and dress lengths (Western dress)	 7 8 9

Erickson (2017) focused on the design of modest sportswear for students in high school in the United States. A clothing scale was used to investigate cultural and other standard requirements for sports uniforms. The scale classified clothing depending on the body parts, starting from the head, and then proceeding to the top and the bottom of the body. Table 2.3 presents the classifications created by Erickson. The clothing scale covered all categories for Muslim female dress, except that the highest level regarding the length of the top clothing was immediately below the knees due to the standard requirements for the sports uniform. There were six levels of head covering, five levels of length of top clothing, five levels for the bottom (leg covering), and three levels of arm covering. To maintain modesty, looseness was treated by using an extra layer of top silhouettes. A questionnaire was designed to assess mobility and comfort needs for female students. Four questions were included in the clothing scale, the question on modesty being: ‘Which (top) would your parents approve of you wearing as part of a sports uniform? ‘The question related to modesty was therefore linked to their parents’ beliefs. The questions were the same for all types of clothing.

Table 2-3: Clothing scale created by Ericsson (2017); six categories of clothing were created for different parts of the body (head, top, and bottom). For modesty, the top was divided into three classifications: one representing skin coverage, and the others for length and looseness. There were two categories of bottom clothing: one representing the skin covering, and the other the degree of looseness.

Clothing categories	Body parts	Number of levels
Headscarf levels		6
The length of the top		5
The length of the bottom		5
The length of the top sleeve (skin coverage), adding further layers for the top in order to maintain modesty		3
The looseness of the top		5
The looseness of the bottom		5

Meanwhile, the hijab has different meanings in terms of the type of covering. Some believe that it only refers to a head covering, while others feel that a hijab indicates a head covering accompanied by loose-fitting clothing (Boulanouar, 2006). Moaddel (2013) developed a scale based on images of six female head coverings to investigate the appropriate style of dress for women in public in seven Muslim countries (Middle

Eastern countries), but not including Libya. Moaddel's headscarf scale ranged from 1 (very conservative), the highest level of head coverage, to 6 (the most liberal style), the lowest degree of head coverage, as presented in Figure 2.4. The headscarf selections were based on existing women's styles in those countries. The question was 'what style of dress is appropriate for women in public?'

1 2 3 4 5 6

Figure 2-5: Headscarf scale created by Moaddel (2013) showing the six levels of head covering used to investigate modesty preferences in public space

2.3.3. Limitations of previous clothing scales

Regarding the clothing choices scale for Muslim females, the headscarf is the basic classification used by studies investigating cultural aspects (Moaddel, 2013; Shafee, 2000).

A limitation of the clothing scales used by Shafee (2000) and Bachleda et al. (2014) is that they used text descriptions. These may not be sufficiently informative and, as indicated by Moaddel (2013), using a scale based on images could be a more effective method in questionnaire investigations. Such images could be a more efficient way of measuring and understanding people's opinions, and by giving these pictures to the respondents, the number of questions can be reduced from six to one.

The scale by Bachleda et al. (2014) requires new images based on the four clothing levels, rather than a progressive change in such levels. Furthermore, there are not enough intermediate steps or a wide enough range, and the degree of variation between the clothing levels is not consistent. However, clothing options were presented to a sample of Muslim women in Morocco. A long robe named the 'djellaba', without a headscarf, is a common style in Morocco and other societies, but does not exist in Libya. Similarly, in the study by Albrecht et al. (2014), the clothing scale used represented specific types of societies.

Albrecht et al. (2014), on the other hand, created an ordinal scale to represent modesty. Nevertheless, there was inconsistency in the variation between pairs of images on this scale, although the intention was to depict nine combinations of skin exposure and looseness. Additionally, there were inadequate interpretations of the Integration strategy and a lack of cultural consideration regarding the Integration group (Western clothing with headscarf) used, and this strategy did not yield better results. Furthermore, the clothing scale consisted of line-drawn or figural stimuli which inadequately represent ‘a morphological change in natural populations’ (Swami et al., 2008). Using images of real females is more realistic, and does not lead to the same problems with ecological validity as line-drawn or figural stimuli (Shafran and Fairburn, 2002).

Using the head only, not the body, Moaddel (2013) does not utilise an incremental scale. For example, between veiled and non-veiled women is one step, but it is possible to create variations for body coverage in terms of modesty on more than one level.

The scale by Erickson (2017) covered all the classifications stated above. However, the scale has shortages in long clothing such as long robe which is considered the traditional Muslim female dress in many Muslim societies. This was due to standard requirements for sports uniforms.

2.3.4. Muslim females' clothing and visual privacy inside the home

Differences in the choice of modest clothing for Muslim women outside and inside the house reflect their desire for privacy, while inside the house when they are near the window. Only Shafee (2000) considered this issue, using a text survey question related to Muslim female clothing, although the difference in the clothing level between the inside and outside was not the focus of the study. Using survey questionnaires, Shafee reported that clothing choices regarding head and face coverings were higher in public than the house in terms of body and head covering. Although inside the house, the degree of clothing was lower in front of males who were not family members, women still desired a level of modesty with respect to covering their head and body. This difference was also evident in the classification of the clothing in public spaces which was detailed in terms of covering the face, neck, chest, and hands. The degree of looseness preferred inside the house was not mentioned.

Bachleder's (2014) findings did not support a difference in Moroccan women's choices based on modesty, rather it indicated other factors, namely comfort and the appropriateness of clothing for the body. In addition, Erickson (2017) and Albrecht et al. (2014) examined specific social contexts which did not examine privacy related to modest clothing inside the house. Although Moaddel (2013) studied headscarf-wearing by Muslim women in over seven Muslim countries and confirmed the wearing of modest clothing by these women in public spaces, no indication was given of practice in private spaces.

Another approach to maintaining privacy is that of window treatment. Indeed, the hijab, or headscarf means curtain or 'barrier of spatial dimension' (Ruby, 2006). The next section reviews the different types and techniques of window treatment employed to reduce the conflict between daylight and privacy.

2.4. Window treatment

Window treatment involves fixing materials either around the window or directly to the glass with the aim of providing solar shading, insulating to reduce heat transfer, or obscuring the view for privacy (Braun, 1981). In general, this allows environmental factors associated with windows such as admittance of daylight, ventilation, view, and visual privacy to be appropriately controlled. In defining these types of treatment, the following criteria are addressed: style of window treatment, whether it is adjustable (e.g., capable of being raised or lowered) or movable, and the impact on daylight and ventilation.

2.5. The effect of the degree of window treatment on daylight

Daylight is the visible part of global solar radiation, situated between infrared and ultraviolet (Louis et al., 1993). Daylight in the indoor living space has a significant influence on residents' health through regulation of the circadian rhythm (Figueiro et al., 2011) and generation of vitamin D. Types of window treatment such as reflective glass and roller shades that are opaquer to reduce direct solar radiation can also significantly reduce the admittance of daylight to an interior space. Lechner (2014) compared the shading coefficients (SC) of external and internal treatment types, explaining that 'the shading coefficient (SC) is a number that varies from 0 to 1. A value of 1.0 indicated that there is no additional treatment (single clear glass). A value of 0 is a total blockage of all solar radiation.' (Table 2.4)

Table 2-4: Shading coefficient for different types of window treatment (Lechner, 2014).

Types of window treatment		**Shading coefficient (SC)**
Interior treatment	Horizontal blind	0.45-0.65
	Roller shades	0.25_0.60
	Curtains	0.40_0.80
External treatment	Horizontal fins	0.10_0.60
	Vertical fins	0.10_0.60
	Wood shutter	Not reported
	Roller shutter	Not reported
Glassing	Clear glass	1.00
	Tinted glass	0.50_0.80
	Reflective	0.20_0.60
	Frosted glass	Not reported

To classify types of window treatment with regard to visual privacy and daylighting, they are divided into three categories:

1. External window treatment; for example, mashrabiyya, wood louver shutter, roller shutter.
2. Internal window treatment such as horizontal blind and traditional sudare screen.
3. Treated glass; for instance, tinted, reflective, and frosted glass.

A range of selected types of window treatment, that address the issues raised, is now described.

2.6. External window treatment

Exterior window treatment is installed outside the window and may be hinged above or to the side so that they it be moved. Figure 2.3 presents some examples of external window treatment used in Libyan dwellings. Some can be moved; for instance, by pulling down the roller blind to provide shading, but this simultaneously affects the daylighting, ventilation, and view/privacy. Roller shutter and wood louvers shutter are types of external window treatment commonly used in Libya. The perforations in the roller shutter and louvers in the wood louver shutter cannot be adjusted.

The mashrabiyya is an example of an external window treatment used traditionally for both privacy and for solar shading. This is usually a fixed window treatment which reduces direct solar radiation and improves the distribution of natural diffused light.

The distinct advantage of all types of exterior treatment is that they stop sunlight before it reaches the glass surface, keeping the build-up of heat to a minimum (Lechner, 2014). For solar control, exterior treatment may reduce the solar heat gained by more than 80% (Laouadi, 2010).

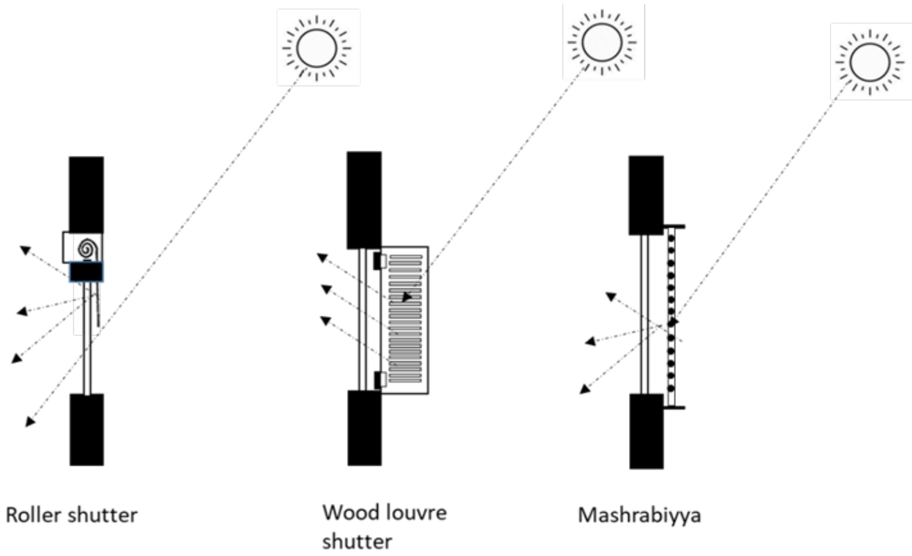


Figure 2-6: Three types of external window treatment; mashrabiyya reduces direct solar radiation, and improves the distribution of natural diffused light. The louver shutter reflects the light upwards if the slats are opened. The perforation in the roller diffuses the light, but when the shutter is opened, the light is transmitted directly inside.

2.6.1. Wood shutters, a previous adaptive window treatment in Libya

The wooden shutter is an external window treatment known as Al-rowshan which was commonly used in most houses in Libya between the 1950s and 1960s (Gabril, 2014). The screen consists of two, three, or four hinged panels depending on the window size. Each panel comprises small horizontal fixed slats, firmly arranged at angles of 30 to 60 degrees (Gelil et al., 2015). Regulation of ventilation and daylight is therefore achieved by moving the entire panel rather than adjusting the slats. The left photograph in Figure 2.4 presents a wood shutter comprising three panels; the slats in this example are opened downwards, a condition that is optimal for blocking direct sunlight, but impedes airflow for ventilation (Gelil et al., 2015). In the middle photograph, the shutter is completely closed which is the typical condition in which to maintain privacy as it provides a very dark interior. The right photograph depicts the condition where occupants rotate the panels for ventilation.

Figure 2-7: Photograph of types of external wood shutter window treatment in Libya. Left: the fixed slats are opened downwards, which is optimal for direct sunlight and privacy. Middle: this provides a very dark interior. Right: for ventilation and daylight, the panels of the screen can be rotated

Gelil et al. (2015) examined the effect of the fixed slats of the wood shutter on the direction of the sun's rays and ventilation (Figure 2.5). The results revealed that when occupants close the shutters for shading or privacy, it impedes fresh air, blocks the view, and results in a dark interior when illuminated only by daylight.

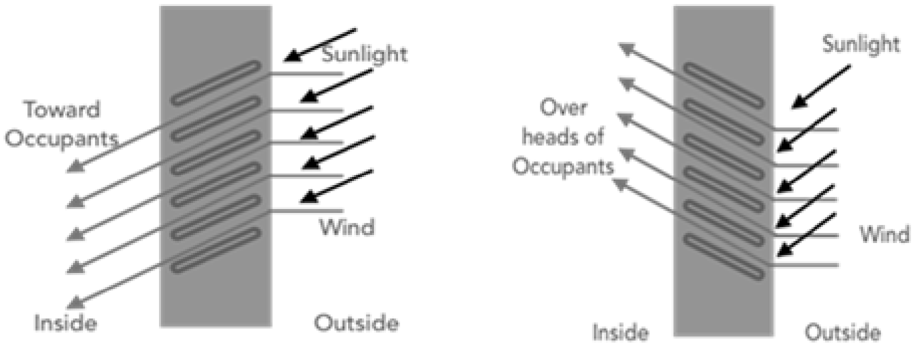


Figure 2-8: Diagram of the wooden shutter commonly used in Libya; the slats are angled at 30 to 60 degrees. Analysis by Gelil et al. (2015) shows that, in the diagram on the left, when the direction of the slats is optimal for ventilation, while in the diagram on the right, when the position is optimal for sunlight, it limits ventilation

2.6.2. Roller shutter

Roller shutters (Figure 2.6) are widely used in contemporary houses in Libya. This shutter is made of fixed horizontal slats composed of plastic or aluminium and separated by perforated channels to allow both light and air to pass through. The roller shutter is operated manually by rolling the shutter up or lowering it down. When rolled up, the shutter fits into a small box above the window so that it is not obstructed.

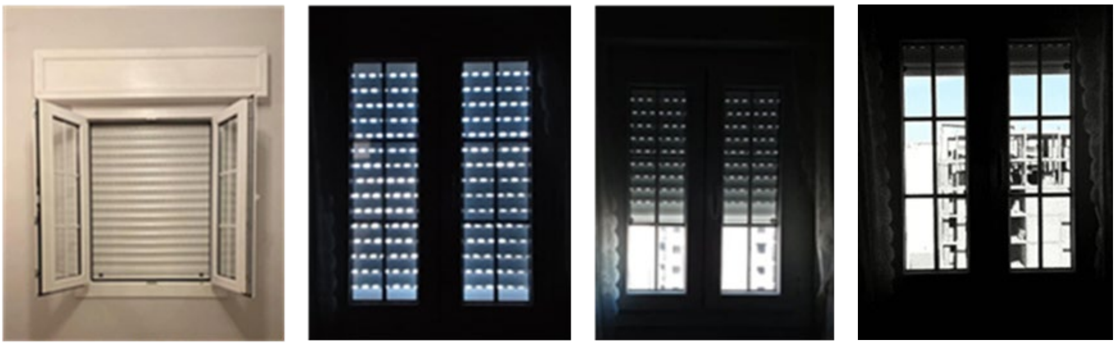


Figure 2-9: The most common window treatment in Libya (roller shutter), the four roller shutter conditions show the effect of the perforations on the illuminance level inside the room: 1) the roller shutter is fully closed when the light is switched on; 2) the shutter is closed with open perforation; 3) the shutter is partly closed; 4) the shutter is fully opened.

Exterior roller shutters can help to reduce thermal overheating in the summer, and heat loss via windows in the winter (Laouadi, 2010). The effect on daylight has not yet been reported when the screen is in the closed position, as shown in the left photograph in Figure 2.7 which is the typical position in Libya for visual privacy. Ariosto et al. (2019) reported that the roller shutter design typically blocks light rather than filtering it.

2.7. Interior window treatment

The types of interior window treatment presented in Figure 2.7 are installed inside the window and, except for fabric curtains, are not commonly used in Libyan residences. Curtains made of opaque or diffusing material are widely used for decoration in Libya and operated by moving the right-hand and left-hand parts of the curtain to cover or expose the glass. Roller curtains that can be rolled up, leaving the windows open to radiation and viewing if desired, and rolled down to maintain privacy have recently been used in Libya, but are currently less popular than external wood shutters and roller shutters. Types of window treatment such as horizontal blinds can be adjusted as a means of controlling sunlight and visual privacy. An advantage of interior treatment types is that they tend to be less expensive than external treatment because they do not need to withstand exposure to the exterior environment.

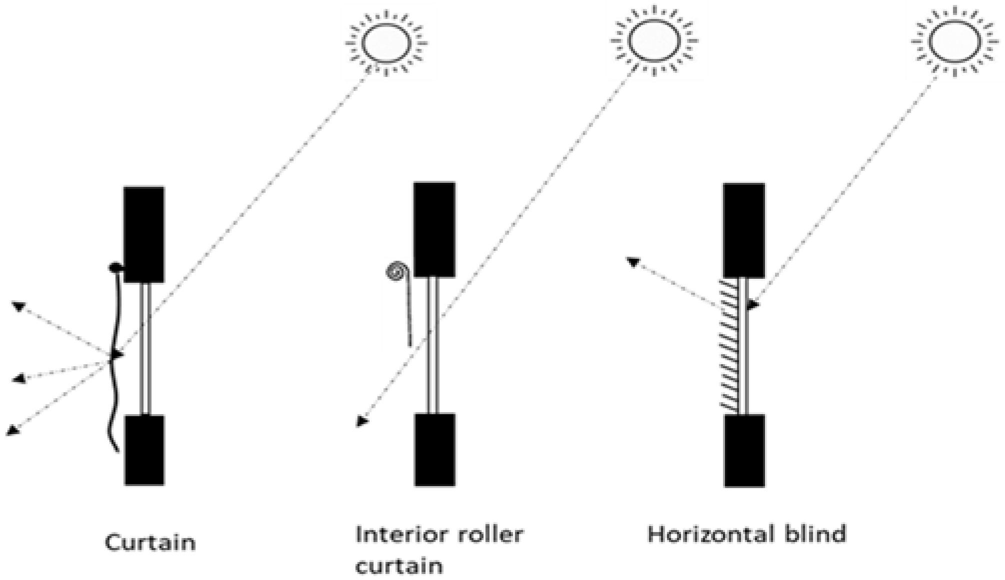


Figure 2-10: Fabric curtains and fabric roller curtains are common types of interior window treatment in Libya. Sudare is a an interior roller used in Japan to control visual privacy and the outside view, and also for shading and ventilation. The horizontal blind is a commercial window treatment with slats that can be adjusted for daylight and visual privacy.

Horizontal blinds are a commercial type of window treatment. One benefit of these is their ability to redirect the sunlight into deeper areas of the space (Chan and Tzempelikos, 2013). The user can compromise between the amount of outside visibility and daylight transmission by adjusting the angle of the slats. They are usually composed of aluminium, wood, or vinyl, and come in a range of colours and finishes. Wood and vinyl blinds can be as thick as $^{1}/_{4}$ inch, but aluminium blinds are normally thin (between 6 and 9 gauge) (Ariosto et al., 2013). The horizontal blind can be raised up completely to the top to permit complete light transmittance through the window. It can also be adjusted to open in a horizontal position which permits partial light transmittance or adjusted to the vertical position to achieve almost complete blockage of transmittance (Figure 2.8).

Figure 2-11: Horizontal blind: three opening conditions. In the left-hand image, the blind is raised completely to the top. In the middle image, the slats are in the horizontal position. The right-hand image shows the slats adjusted to the vertical position to completely block the view

Previous studies investigated heat and light transmission through different slat angles (Kim and Park, 2012), solar redirection (Chan and Tzempelikos, 2013), the degree of blind opening (not the slats), and position; for example, quarter, half and completely opened (Zhang and Barrett, 2012). However, visual privacy has not yet been considered.

Tzempelikos (2008) studied a range of horizontal blind geometries in relation to positioning the rotation angle of blind slats from 0° (horizontal, fully open) to 90° (vertical, slats tightly closed without gaps) when occupants want to guarantee privacy. Figure 2.9 displays the typical horizontal blind. As shown, the distance between the centres of two sequential slats at a horizontal position is equal to the slat width, L = 50 mm, which is the typical blind slat width. The opening area (H) of the slats extends from the end of the upper slat to the upper surface of the lower slat. The opening area from outside the window is the apparent height of the slats (H). The slat angle is defined as the angle between the slat and the normal plane. One advantage of horizontal blinds is that redirection of daylight into deeper parts of the room can be achieved by redirecting the slat angle up or down (Chan and Tzempelikos, 2013). Two slat directions, upward facing and downward facing, influence light transmittance (Chantrasrisalai and Fisher, 2004).

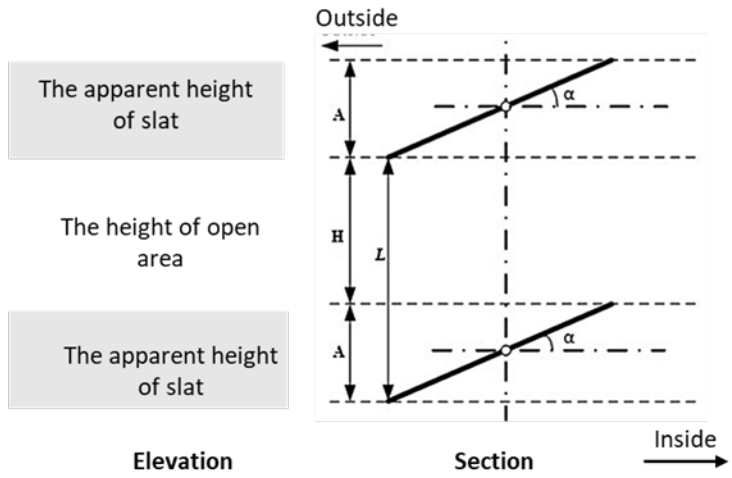


Figure 2-12: The dimensions used for calculating the opening area: the height of the opening area (H), the apparent height of slat (A), the height of the slat (L)

Changes in the slat angle and depth affect visibility (and hence privacy) when viewed from the side, while direction of the slat angle, upward facing (left diagram) or downward facing (right diagram), provides a similar opening area (Figure 2.10).

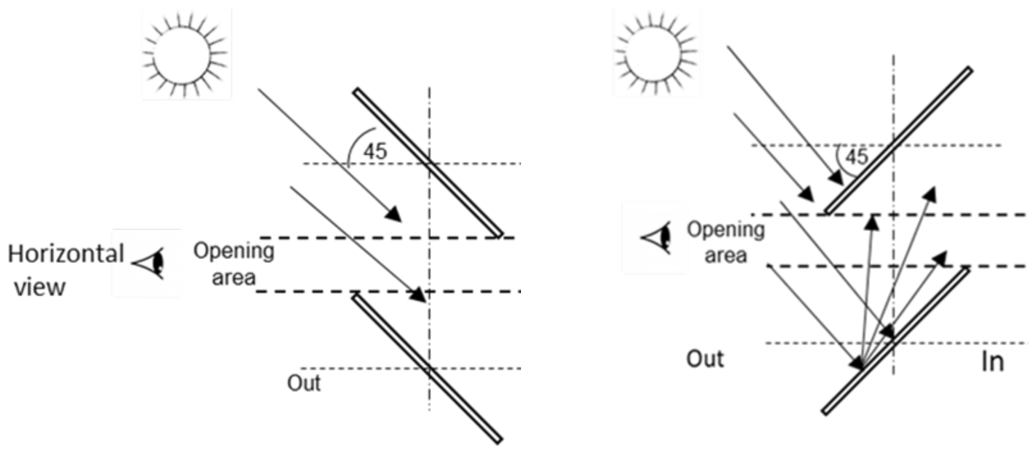


Figure 2-13: The effect of the direction of the slats on solar radiation and the degree of opening area: left, upward-facing (direct solar) and right, downward facing (protects from direct solar); while downward-facing provides a uniform light, both directions give a similar degree of view, whether from outside or inside

In general, daylighting performance is better measured using diffuse transmittance (Lechner, 2014). The downward direction angle is recommended to protect against direct solar transition (Chan and Tzempelikos, 2013) and provides diffuse transmittance, as depicted in the right-hand diagram (Figure 2.11). When light rays pass through a material without any change to their direction or colour, this is known as direct transmission. When light beams are widely dispersed, diffuse transmission is effective in obscuring the light source and producing a uniform light on the interior surface. The given example (Figure 2.10) also illustrates the influence of slat direction (tilt angle – 45° upward facing and 45° downward facing) on the sunlight, and the resulting opening area. The daylight illuminance on the desktop for the slat angle 45° upward provided 35% illumination, while the illuminance level when the blinds in the test room were at a 45° downward tilt was 30% (Galasiu and Macdonald, 2004).

2.8. Previous research on window treatment and visual privacy

The mashrabiyya shown in Figure 2.11 placed in front of the window consists of a perforated wooden screen. It is, however, rarely used in Libya, and is more commonly found in Tunisia, Jordan, Egypt, and Saudi Arabia (Bagasi, Calautit and Karban, 2021). Previous studies have recommended the mashrabiyya for visual privacy as it allows occupants, particularly women, to look outside without being seen, and does not obstruct natural light and ventilation (Hashim et al., 2006; Al-Kodmany, 1999).

Figure 2-14: Example of mashrabiyya screening in the old city of Jeddah, Saudi Arabia; photograph © Wajdi Atwah, used with permission

Previous studies have investigated the daylight and ventilation characteristics of mashrabiyya (Ahmed Sherif et al., 2012 a,b; Sabry et al., 2014; Sherif et al., 2010; Gelil et al ., 2015). For instance, Sherif et al., (2012a) used daylight simulation to identify the minimum perforation percentages that provide adequate illuminance in residential living spaces. Changes in the depth and geometry of mashrabiyya were then examined by Sherif et al. (2012b). The traditional mashrabiyya is no longer a common choice, with a survey of Middle Eastern households suggesting that it is considered difficult to clean, expensive, and out of date (Aljawder and El-Wakeel, 2020).

A physical experiment was conducted by Kotbi (2019) to design mashrabiyya (Figure 2.12) for a girls' school in Saudi Arabia. The goal was to provide daylighting that reduces energy consumption while preserving visual privacy.

Figure 2-15: The mashrabiyya model designed and investigated by Kotbi (2019)

The scale used by Kotbi consisted of symbols and figures to match the visual acuity of children. Six symbols (duck, star, vehicle etc.) of different sizes were placed behind the screen, as shown in Figure 2.13. The main variables tested in this experiment were the percentages of perforations and axial tilting of the screen. The images were sized according to the distance, based on the worst case in school. The responses were recorded after the researcher had rotated the mashrabiyya manually until the participant identified the number of the image; the angle of the image was then recorded. The accepted visual privacy was measured when the participant could not identify the image of the symbols behind the screen.

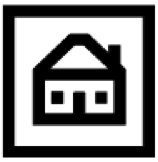
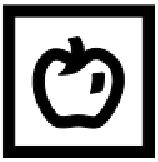
1	2	3	4	5	6
					
Boot Shoe	Car Vehicle Truck	House building Home	Apple Cherry	Star	Duck Bird Chick

Figure 2-16: Scale figures used by Kotbi (2019) to investigate visual privacy and daylight using mashrabiyya

Lighting conditions were also considered by using a sky dome to regulate the differences between the light inside and outside the screen model. Sufficient privacy was achieved at 50% of the percentage of perforations in mashrabiyya when the targets were placed 6 m away. In this study, daylight simulation was widely conducted, and the main findings in terms of visual privacy and daylight were provided by tilting screens 52º with 90% perforation from the horizontal. The sample comprised 28 participants from two different backgrounds, a Middle East origin or a Muslim country; however, there were no significant differences between the two groups, and no differences between males and females.

Sudare is a traditional Japanese blind made from horizontal bamboo slats. The characteristic sudare form makes it possible to see through them to objects outside the house. The sudare is used as both an interior and exterior treatment (Figure 2.14), as well as to divide interior spaces to permit different functions and levels of privacy. The degree of opening in the sudare screen cannot be adjusted, so variation in the sudare effect is achieved by rolling the screen up and down. A study by Hariyadi and Fukuda (2017a, b) investigated four different sudare parameters regarding the level of visibility from outside. The left-hand diagram in Figure 2.14 depicts the sudare's opening area and diameter characteristics. Four levels of opening area (20, 10, 5, and 2.5 mm) and different diameters and degrees of colour were tested.

Figure 2-17: Sudare: window treatment used in Japan and Indonesia, inside (left) or outside (right) the building (image adapted from Hariyadi and Fukuda (2017a)

This study was conducted in two parts: the first being a physical experiment (Figure 2.15), and the second an experiment using images (Figure 2.16). The physical experiment was conducted in the laboratory. Questionnaires were completed by 121 participants to assess the visibility value through the screen by observers simulating the person outside. The person being observed in the other room simulated the occupant inside the building, named the object. The amount of illumination in the observer's room was fixed at 900 lux to simulate the degree of daylight outdoors, while the extent of lighting in the observer's room changed from 31 to 876 lux, simulating artificial lighting inside a building. In this experiment, observers were asked to rate each condition on a scale of 0 to 6. An assessment of 0 meant the object could not be seen, and 6 meant the object could be seen clearly (identifying the detail and the colour).

The second part (Hariyadi and Fukuda, 2017 b) aimed to improve the accuracy of the first experiment by using images (Figure 2.16). In this experiment, scale figure guidelines were presented beside each image to offer participants the same sensation of comparison.

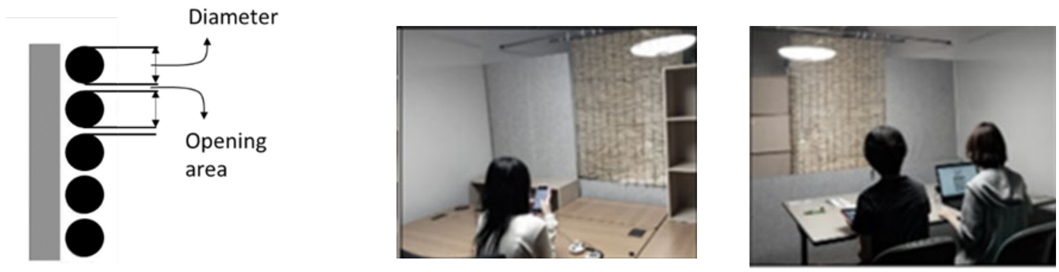


Figure 2-18: Physical laboratory experiment by Hariyadi et al. (2017); two rooms were divided by a sudare screen. The left-hand image shows the object room which contained the person who was being observed; the right-hand image depicts the room containing the test participants who were required to look into the other room.

The sample comprised 211 participants. There is no indication of how participants looked at the images or how many photos were presented. The distances between observer and screen and between 'object' and screen were similar to those in the physical experiment. However, the exact distance was not indicated because the images were displayed on the computer screen.

Figure 2-19: Visual privacy experiment by Hariyadi and Fukuda (2017 b). Images were taken from the physical experiment, and the same experiment was repeated using images. On the left side, a figure guideline was placed beside each image to provide the participant with the same sensation of comparison.

Hariyadi and Fukuda tested several variables (materials and colours) in both experiments. No degree of opening was determined by this study, as the comparisons made were between different types of sudare. This study was therefore unable to determine the optimal sudare configuration for usage as a window screen because each one has different characteristics such as the diameter and colour of the slats. The results obtained by Hariyadi and Fukuda indicate that the main factor influencing visibility is the illuminance ratio. Moreover, comparisons of the distribution of visibility values in the physical experiment and the digital images revealed a similar trend (Figure 2.17).

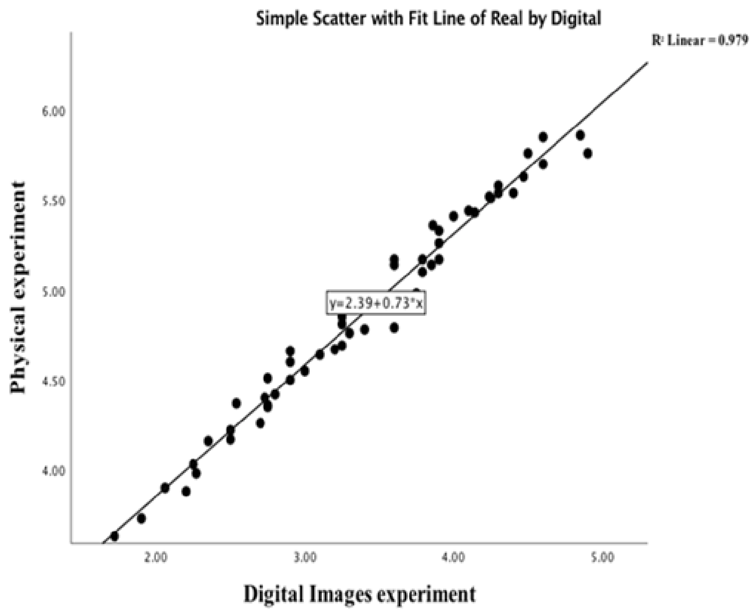


Figure 2-20: Correlation coefficients computed by researcher to assess the relationship between Hariyadi and Fuchida's real and digital images experiments

In a third study, Oe et al. (2021) examined the effect of the locations of two types of window screens on the view to the outside. Three positions of screen covering (up, middle, and down) and two degrees of coverage (translucent screen and dark screen) were examined. A combination of the translucent and dark screen, randomised partly with no screen coverage, is presented in Figure 2.18.

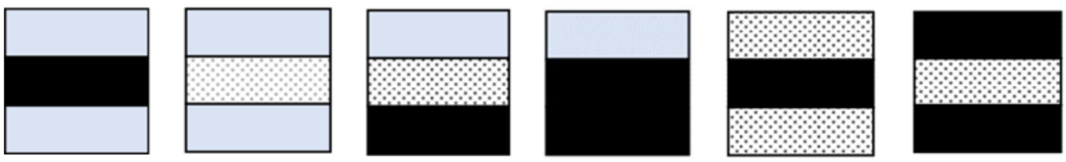


Figure 2-21: Six examples of screen treatment and positions used to investigate the view to the outside and visual privacy by Oe et al. (2021) (dark screen and translucent screen randomised with zero screen coverage)

An interior space was used in a laboratory to simulate a living room, with the window placed in an artificial sky. The model was of a 1 to 4 scale. Fifteen participants observed the view outside through a peephole in the front wall and evaluated the target (doll) beyond the window (Figure 2.19). The evaluations of visibility in this experiment were from 1 (invisible) to 5 (visible). The doll in this experiment was therefore not used to measure privacy inside the room; the pedestrians outside the door were simulated in order to evaluate the view outside.

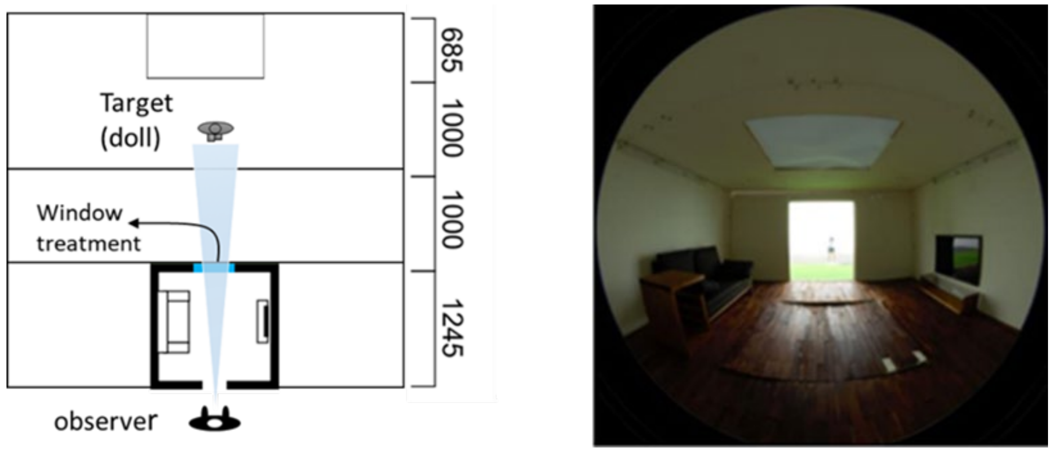


Figure 2-22: Living room model used by Oe et al. (2021) to evaluate the ability to see a doll outside the window; the left-hand image is the ground floor plan, and the right-hand image is a photo of the experiment taken through the peephole used by participants to evaluate the view of the doll

One limitation of Oe et al.'s (2021) study is that visual privacy was not measured physically. Instead, it was estimated by the participants from indoors, and there is no indication as to whether the participants changed their position or observed the room from outside. The clear procedure that was introduced in this experiment was to assess the view to the outside. The quantitative prediction of visual privacy was based on the visibility inside, assuming a proportional link between them regardless of the window coverings.

The difference between the light outside and inside affected the visibility values. When someone inside the dark room was looking out in the daytime, this condition was the same in the experiment. At the same time, the light conditions outside and inside the model differed with values of 1000 lux outside, stimulated by the artificial sky, and 100 lux for the living room illuminance. However, the evaluations of visual privacy and view outside were made from the same place, namely from inside the room.

2.9. Glass treatment

Window glazing enables variation of the light transmittance, solar radiation, allows vision and spectrum of daylight within the house. Different types of glass have different characteristics. The literature showed three basic parameters are used to evaluate glassing material in terms of daylight and visual access: Reflection, Transmission, and Absorption, which are caused by the interaction between light and a glass surface. Diffusion (also called scattering) can be involved in all three processes (Novotny *et al.*, 2019). The diffusion of light, as it passes through material, causes haze, resulting in poor visibility and/or glare (Novotny *et al.*, 2019). Haze can be created by the material itself, as a result of the process, or by the surface roughness, as in frosted glass (Chen et al., 2016).

The most common types of windows used in residential buildings in Libya are clear and tinted glass, while reflective glass has also been used recently to maintain privacy. The frosted glass is used in spaces such as bathrooms and some occupants use it in the kitchen. It is usually covered by curtains due to its inefficiency in maintaining visual privacy, especially at night when turning on the interior light.

Clear glass transmits daylight effectively, with a typical visible transmittance (VT) of 0.88, but it also permits a considerable amount of heat into a building. Tinted glass reduces visible light (Li and Tsang, 2008),it is crucial for maintaining visual privacy and it can be used to cut down on the solar heat (Elaiab, 2014). The VT of tinted glass is between 0.23 and 0.51 (Duarte *et al.*, 2009; Li and Tsang, 2008). Reflective glass absorbs more heat than tinted glass but has infrared reflecting characteristics, along with slightly lower VT (Li and Tsang, 2008).

Frosted glass is a well-known treatment for windows, particularly in places that need high levels of privacy. The frosting effect is caused by exposing the flat glass to a chemical and thermal treatment (Kleiner, 2022). The etched surface created by this process produces different sizes and shapes of crystals (Tillotson, 1917). The roughness of the frosted glass surface and the haze (transparent or semi-transparent) that affect light transmittance are two physical variables produced by the frosting process (Chen et al.,

2016) which impact visual privacy. There are no definitive parameters for frosted glass concerning visual privacy, as no degree of frosting in frosted glass has been reported. Studies by Kleiner (2022) and Chen et al. (2016) attempted to standardise the frosting to control the light reflectance. Kleiner (2022) used a chemical process to produce a quality surface which enhanced the inhomogeneous size distributions of the structures that occur throughout the frosting process. Chen et al. (2016) developed a new frosted glass surface with organised frosting (Figure 2.20). The microchemical process for their experiment identified the ratio between the height and the width for the etching in the frosted glass surface to control the light reflectance. This method could produce a useful parameter that might provide an organised structure for varying the degree of frosting in frosted glass when investigating visual privacy.

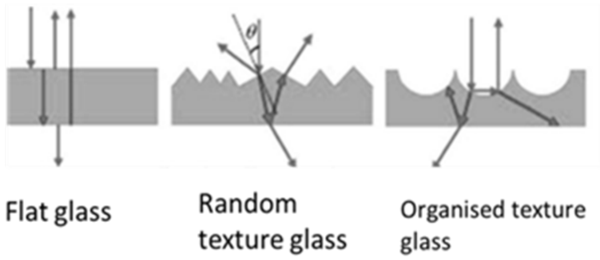


Figure 2-23: Characteristics of the random texture frosted glass (middle) orientated toward the light compared with the flat glass (left) and the organised frosted glass (right), as developed by Chen et al. (2016). The reflectance of the regular texture glass is considerably reduced due to repeated reflectance of the light.

The maximum value of etch (frosting degree) achieved by Chen et al. (2016) produced a maximum haze value of 73%, compared with the haze value of 85% for the random texture of frosted glass. Figure 2.21 displays the difference in terms of visibility between the developed frosted glass and the more effective random frosted glass texture.

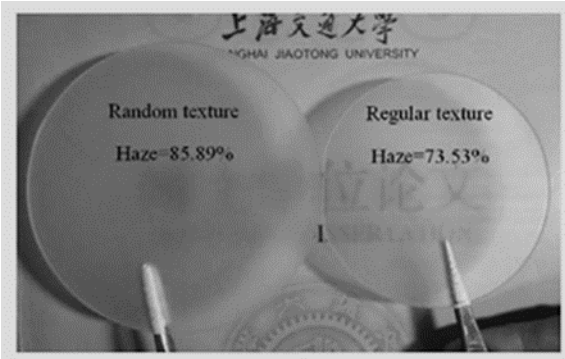


Figure 2-24: The 'haze' characteristics of organised and random frosted glass textures (Chen et al., 2016); the random texture achieves greater haze (85%), which is sufficient for visual privacy, compared with the texture of the organised frosted glass (73% haze).

2.10. Summary

The review of literature in this chapter has highlighted the fact that research evaluating the conflict between visual privacy and daylight through window treatment is limited. A common approach to investigating such treatment is to examine solar shading and the view to the outside. Relatively few studies have investigated window treatment and the extent of visibility of people inside when viewed from the outside.

The literature review in this study was divided into two parts; the first sought to identify what is important in the context of visual privacy and how it can be measured. The review of qualitative research indicated that visual privacy is needed in order for female members inside the house to behave and dress as they please, without being seen or judged by strangers. Moreover, visual privacy for Muslim females might be maintained by wearing modest clothes or by window screening. The first part of this chapter, therefore, focused on Muslim women's clothing as a fundamental variable to achieve two main objectives. First, to find evidence as to whether differences in Muslim women's choices of modest clothing for outside and inside the house were associated with their desire for visual privacy; and second, to identify a quantitative measure or scale of modesty of clothing for application in this research. Previous studies have utilised Muslim women's clothing (text and images) to investigate social and personal problems. This has been categorised according to Islamic guidelines, but these categories vary according to local environmental and cultural aspects. Three basic categories of Muslim women's clothing were identified: head covering, body covering, and the degree of clothing looseness.

The second part of the chapter reviewed the types of window treatment and their impact on daylight. Again, it was important for this study to find parameters with which to measure visual privacy and daylight quantitatively. In Libya, external screens made of wood and roller shutters have been used, but neither of these can be adjusted for daylight and visual privacy purposes. It has been reported that wood shutters block the daylight and ventilation. Although there is a lack of empirical evidence regarding the roller shutter, its perforations are smaller in size than those of the wood shutter. Most of the types of window treatment, to some extent, prevent daylight from accessing the interior space. Evaluations have been performed for exterior and interior window treatment to assess how to obtain a useful amount of daylight while maintaining privacy. The slats in the horizontal blind, for example, can be adjusted to provide different degrees of opening, but while various studies have examined the effects of slat rotation and direction on sunlight rays, none has reported on the level of privacy. Frosted glass, a commercially treated glass, which is available in the market, provides different degrees of frosting and visual transmittance, and is also widely used in window treatment. It could also be a sufficient treatment for reducing the conflict between daylight and visual privacy. However, once again, no empirical evidence related to visual privacy has been reported and no parameters have been found to enable the degree of visibility provided by the frosted glass to be measured.

Window treatment and daylight are environmental aspects that can be evaluated quantitively. However, clothing and visual privacy are cultural requirements which have been investigated qualitatively. The present research was designed to add to the existing body of knowledge through the use of two distinct methods. First, a survey sought to identify the threshold of acceptable privacy and what is acceptable to females in terms of their clothing when they are visible to strangers. It was important to find empirical evidence as to whether there are any differences between the amount of clothing needed by Libyan females when inside the house close to the window and potentially visible by strangers, and the degree of relaxed clothing when they are just with family members. This included surveying different nationalities to identify what they prefer to wear in different contexts. The second method involved conducting laboratory experiments to identify the various types of window treatment that provide an acceptable standard of visual privacy in relation to Muslim females' clothing. Third, a daylight simulation was undertaken to determine the screen that provides an acceptable level of visual privacy. The first of these methods, a survey questionnaire, is discussed in the following chapter. The survey was created to answer the study topics outlined above. Two hypotheses were formulated to investigate the effect of window treatment on the visual identification of clothing levels.

2.11. Research hypotheses

H1. Variation in clothing levels in some cultures is associated with the need for visual privacy inside the home.

H2. Variations in the degree of window treatment affect the visual identification of clothing levels.

Chapter 3. Developing a scale to measure the privacy offered by clothing

3.1. Introduction

The literature review presented in Chapter 2 highlighted the importance of visual privacy for Muslim females, and being able to control their exposure to strangers' eyes by treating the windows or changing their behaviour, for example, by dressing in more clothing. This was the primary focus of qualitative research employed in various social surveys utilising focus groups, interviews, and questionnaires (Kodmany, 1999, 2017; Rahim, 2015; Aljawder & El-Wakeel, 2020). (Elmansuri & Goodchild, 2021). However, these findings have not been validated with experimental evidence. This chapter reports a novel pictorial scale developed to measure the privacy offered by different degrees of clothing, and an experiment conducted using that scale to determine the degree of clothing associated with the privacy expected in different contexts.

3.2. Investigating variations in female clothing in different contexts

Changes in the level of clothing worn by Muslim females are typically driven by varying interpretations of religious and cultural requirements regarding modesty (Akou, 2004). For example, the Abaya and Khimar are types of hijabs (see Section 2.2.1) commonly worn in public areas in Saudi Arabia, while female clothing (hijab or without hijab) varies in Libya and other Muslim nations. One potential approach to investigating visual privacy is to ask females what degree of modesty in clothing is acceptable when they are seen from outside the house by strangers. Direct observation is not possible due to the fact that it is strongly against cultural and ethical norms to observe people, especially women, in their homes (Al-Kodmany, 2017). One method for identifying variations in clothing as a measure of privacy is to use a clothing scale. Studies by Bachleda, Hamelin, and Benachour (2012) and Shafee (2020) demonstrate the need, or expectation, in some countries to preserve female modesty through the use of clothing which includes the ability of others to see certain bodily details (hair, skin, and body shape). Therefore, a novel clothing scale was designed based on these three variables (hair, skin, and body shape) which ranged from a low degree of accepted privacy in clothing to a high degree.

3.2.1. Clothing scale

The clothing scale was created to allow respondents to state the degree of clothing they would wear to maintain privacy in a range of contexts. The aim was to extend previous work by Albrecht et al. (2014) to evaluate modesty among Muslim females. However, the clothing levels designed by Albrecht et al. (2014) represented a certain society (see Table 2.2), as they were based on the clothing style of female Muslim students on the university campus in South Africa where some clothing levels were described as an ‘integration strategy’ (headscarf with Western garments) and (headscarf with loose-fitting top and tight pants). This style cannot be applied to a large community of Muslims.

The clothing scale created in the current study extends from clothing coverage that is likely to be considered culturally acceptable to that which is likely to be acceptable in a range of situations. Furthermore, the clothing scale Albrecht et al. (2014) employed consisted of line-drawn or figural stimuli which inadequately represent ‘a morphological change in natural populations’ (Swami et al., 2008). Using images of real females is more realistic and does not generate the same problems with ecological validity (Shafran & Fairburn, 2001).

The illustrations for the scale were obtained by the researcher taking photographs of an actor in a studio at the University of Sheffield. The clothing scale created extends from clothing coverage with each variable changing by one step (in either degree of skin exposure or tightness of fit) from the previous step. The images were manipulated using Photoshop software. In this experiment, the images of the actor were cropped from the background without any changes in colours or shades for the clothes. Figure 3.1 presents an example of clothing level 6.

Consent (included in the A_1) was obtained to use the photographs for research purposes such as illustration, analysis, the thesis, and journal publications.

Figure 3-1: An example of the image used in the first experiment. Left: the original image, photographed in the studio. Right: the cropped image used in the clothing scale

As shown in Figure 3.2, a ten-point scale of images was created which ranges from shorts and t-shirt (more significant amount of skin exposed, clothing is relatively tight fitting) to the khimar (whole body covered except for the eyes, loose fitting).

Clothing levels from 1 to 4 are increasingly revealing, and include a short-sleeved shirt, leggings, and shorts. These would typically only be worn in private in Libya. Clothing levels from 5 to 7 represent typical clothes that are worn inside the home in Libya, including long-sleeved shirts and trousers. Clothing level 8 depicts a style of dress that is common in Libya – the 'Jilbab' which is full length with a loose-fitting outer layer. Clothing level 9 includes the 'Abaya' which is a dress that covers the whole body except for the hands and face. The 'Abaya' represents 'modest dress' according to the great majority of scholars (Shadid, Koningsveld & Id, 2005). Clothing level 10 is commonly called the 'Khimar' which is a dress that covers the whole body, the hands, and the face except for the eyes; this degree of coverage is required in public according to the strictest scholars only (Shadid, Koningsveld & Id, 2005). These steps are described in detail in Appendix from A_1 to A_4. The degree of skin exposure was calculated (see section 1) based on the percentages of body parts for females aged 25 years (Te Biesebeek et al., 2014).

	1	2	3	4	5	6	7	8	9	10
										
Parts of body covered by clothing										
Trunk (chest, hips and thighs)	X	X	X	X	X	X	X	X	X	X
Shoulders		X	X	X	X	X	X	X	X	X
Lower legs			X	X	X	X	X	X	X	X
Sternal region				X	X	X	X	X	X	X
Arms					X	X	X	X	X	X
Neck						X	X	X	X	X
Hair						X	X	X	X	X
Face										X
Hands										X
Percentage of skin exposure	61%	47.7%	31.7%	26.8%	16.6%	11.7%	11.7%	11.7%	11.7%	1.2%
Tightness of clothing										
Loose								X	X	X
Mid					X	X	X			
Tight	X	X	X	X						
The length of Top clothing										
Long								X	X	X
Mid					X	X	X			
Short	X	X	X	X						

Figure 3-2: Scale developed to investigate the impact of clothing level on perceived privacy; each step represents a gradual change in skin exposure and/or the tightness of clothing to create a step change in privacy. The order of these steps relates to what is acceptable and unacceptable in Muslim society.

3.2.2. The questionnaire

The questionnaire was designed to measure privacy by recording responses to clothing levels required by females in different contexts. The design of questionnaires using clothing scales in social and cultural studies is limited. The question regarding the clothing scale, using images by Albrecht et al. (2014) which are related to identity is:

‘Which image is the most reflective of the fit and coverage of your clothing?’ For the current study, all items on the demographic questionnaire were created for research purposes, beginning with a brief demographic section consisting of questions on age group, nationality, and time spent in the UK (Figure 3.3). The second part is a set of questions about female clothing levels in different contexts. Figure 3.4 presents the questions related to the clothing scale images that were printed on A3 paper. Respondents were asked to pick their level of clothing based on three basic questions about suitable clothing in relation to privacy in four different contexts:

A. Outside their home

B. Inside their home, visible only to family members

C. Inside their home, but potentially visible to pedestrians/neighbours outside

D. Inside their home, in this case the female is assured that she is visible to pedestrians/neighbours outside.

The clothing scale and the questionnaire were pre-tested with 10 women to determine whether the degree of clothing in the scale covered their choices, and to assess whether the questions were clear and easy to understand. Regarding the clothing scale question, the last two questions (C and D) were similar to each other because, when we pre-tested the questions, some participants gave different responses according to whether they were sure someone had observed them from outside the house. Furthermore, to make it clear that the clothing scale question was not about thermal comfort, a note was added indicating that their clothing choices should be those made during the summertime.

Measuring the desired degree of visual privacy

Demographics and Personal Information		
Personal code	Date	Place

- Where are you from? (Please tick the appropriate answer)

Libya	Saudi Arabia	Europe
☐	☐	☐

- In which age group are you?

18 to 29 years	30 to 39 years	40 to 49 years	50 + years
☐	☐	☐	☐

- What is your current marital status?

Married	Divorced	Separated
☐	☐	☐

- In what country were you born?

…………………………………………………………………………………

- If you were not born in the UK, for how long have been living in the UK?

Less than one year	from 1 to 5 years	from 5 to 10 years	more than 10 years
☐	☐	☐	☐

- Have you ever lived abroad in another country, which has a different culture?

☐ Yes. ☐ No comments………………

- If yes, how long did you stay there?

Less than one year	from 1 to 2 years	from 3 to 5 years	more than 5 years
☐	☐	☐	☐

Figure 3-3: Demographic questions used to investigate the degree of clothing coverage required to maintain privacy in different contexts

The University Of Sheffield.

Project name: Daylighting and privacy

Principal Investigator: Intisar Husain

Participant personal code :................

Date :.........../............/..............

In the four given situations, what type of clothing are you happy be seen in? (Please tick the appropriate image) please answer according to your habit whilst living in UK.

	1	2	3	4	5	6	7	8	9	10
A. Outside in a public space.	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
B. Inside your own home, stood near a window, and visible to a non-family member outside the window	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
C. Inside your own home, stood near a window, potentially visible to non-family member outside the window	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
D. Inside your own home, visible only to family members	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

Figure 3-4: The clothing scale used to investigate the degree of clothing coverage required to maintain privacy in different contexts

3.2.3. Test sample

Ninety female respondents living in the UK were recruited. They were drawn from three home contexts (Libya, Saudi Arabia, and Europe) to test assumptions regarding visual privacy and clothing, with 30 from each location. All respondents were living in Sheffield when the experiment was conducted. The focus of this work was on Libyan females, the Saudi and European respondents recruited as a means of validating the Libyan responses. It was expected that the Libyan and Saudi women would have similar responses due to the similarity of their cultural backgrounds. Conversely, the European sample was expected to have a low privacy threshold in all settings, and thus would provide a means for validating the responses.

The sample included Libyan women aged 18 to over 50, Saudi Arabian aged 18 to over 50, and European aged 18 to 29). The Libyan and Saudi respondents were drawn from a wide range of ages to represent the population. However, the European sample was drawn from young people only (18-29). The 30 to 39, 40 to 49 and + 50 age groups for European respondents were excluded because the numbers of participants were lower than the average of the same age in Libyan and Saudi groups.

Strategies were incorporated into the proposed privacy questionnaire by taking into account the impact of the respondents' ethnicity or religion. The bias caused by socially desirable responses can create a mismatch in the observed relationships between actual behaviour and participants' responses (Tourangeau, 2007). Females' answers may not be realistic in front of others, and they could regard this behaviour as socially unacceptable. Therefore, participants were approached personally, and individually questioned by the researcher to ensure their responses were not affected by the views of other females. It was also important for participants to understand that the questionnaire would be anonymous to reduce the possibility of socially acceptable responses (Song et al., 2015).

Another strategy was to include females who dressed in different levels of clothing. Therefore, religious buildings were avoided to prevent bias, as most women there will potentially follow strict Islamic requirements, wearing clothing that represents a high level of modesty. This also allowed the researcher to vary the appearance of female participants from completely contemporary clothing to a classic Islamic appearance, as suggested by Dunkel et al. (2010). Meetings with the Libyan women occurred within the Libyan community in public places such as cafés, shops, friends' houses, or parks. Saudi women were students at the University of Sheffield, although some were recruited during the national Saudi Arabia day event in Sheffield in order to find respondents of different ages and education levels. European women were recruited from the university library, neighbours, and at a café in the city centre.

The structure of the questions was simple to understand, and clear. Participants who consented to participate received information sheets regarding the study and then signed a consent form. Ethical approval for this experiment was received from the University of Sheffield Research Ethics Committee on 24 July 2018.

3.3. Results

Overall, the results revealed a difference in the degree of clothing coverage for all groups according to whether they are outside or inside the house (whether they are alone with family members or visible from the outside). Figure 3.5 presents the clothing coverage levels of women from three different origins in the four contexts: A, B, C, D.

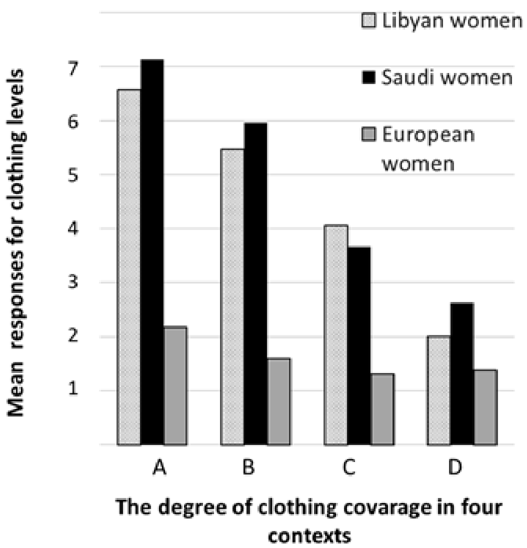


Figure 3-5: The mean level of clothing coverage of women from three different origins in four contexts: A, B, C, D

Question 1, context (A): Clothing outside their house.

Question 2, context (B): Clothing inside their house, standing near a window, and potentially visible to non-family members.

Question 3, context (C): Clothing inside home, standing near a window (in this case the female is sure that someone is outside).

Question 4, context (D) Clothing inside their home, visible only to family members.

3.3.1. Does clothing matter for visual privacy?

Table 3.1 presents the mean and median responses regarding clothing levels for females from three different origins (Libya, Saudi Arabia, and Europe). For Libyan women, while clothing level 6 (a headscarf, arms, and legs, fully covered by a jacket and trousers) was the mean expectation when inside the home, but visible to a stranger. This could be relaxed to level 2 (tighter-fitting clothing, greater degree of skin exposure) when visible only to members of the family. For women from Saudi Arabia, a nation with stricter controls on female modesty, the mean clothing level, when visible to a stranger, increased to 7. For European women, the median responses were clothing level 2 when visible to strangers, and clothing level 1 when visible only to the family.

Table 3-1: Descriptive statistics for the clothing scale questions regarding the desirable clothing levels for females from three different origins (Libya, Saudi Arabia, and Europe)

Questions and contexts	Libyan			Saudi			European		
	Mean	Median	S. de	Mean	Median	S. de	Mean	Median	S. de
Question 1, context (A)	6.3	6.0	1.13	7.13	7.0	1.67	2.17	2.0	1.14
Question 2, context (B)	5.43	6.0	1.40	5.93	6.0	1.87	1.6	1.0	0.81
Question 3, context (C)	3.87	4.0	1.85	3.67	4.0	1.97	1.23	1.0	0.67
Question 4, context (D)	1.93	2.0	0.86	2.11	2.0	1.24	1.27	1.0	0.58

A Kolmogorov-Smirnov normality test was performed to test whether the data were normally distributed. This revealed that the frequency distributions, mean, and median for Question 1 (situation A: clothing worn outside the house) for the three groups were within 0.5 which means they were normally distributed. A visual analysis of the Q-Q plots indicates that the deviation from normality was not large for Saudi women. However, the significance according to Shapiro-Wilks was p = 0.01 for the Saudi Arabian, and p> 0.00 for the Libyan and European women. Therefore, responses to Q1 were not normally distributed. For questions 2, 3, and 4, the responses were not normally distributed. (See Appendix from A8 to A11). To test for differences using non-parametric tests (rather than parametric).

One hypothesis was presented in chapter section 2.10 and is tested in the next section. The first hypothesis in this study is: Variation in clothing levels in some cultures is associated with the need for visual privacy inside the home.

Table 3.2 presents the results of a Kruskal-Wallis test conducted to reveal whether there was a statistically significant difference between groups in every condition. The results suggested significant differences (p<0.05) between groups in the level of clothing coverage across all four contexts of visibility to the public, and also in the condition where they are with family members.

Table 3-2: Significant differences between the three groups in relation to the four contexts

Groups	**Significant differences based on Kruskal -Wallis Test**			
	Q1	Q2	Q3	Q4
Libyan women				
Saudi Arabia women	p<0.001	p<0.001	p<0.001	p<0.001
European women				

To compare the differences between the two groups, as presented in Table 3.3, a Mann-Whitney test was conducted. The differences for comparisons 2 and 3 were significant for both Libyan and Saudi women versus European women in the four contexts (p < 0.01 for both cases). In comparison 1, there were no significant differences in the three conditions of visibility to the public: Q1 (p = 0.114), Q2 (p = 0.193), Q3 (p = 0.554), while in the fourth condition, where the women were visible only to family members, a significant difference was found (p<0.001). Both Libyan and Saudi women were predicted to desire equal levels of clothing in public space. However, for condition 4 alone, no significant difference was found because both Libyan and Saudi women have more freedom in their dress when they are visible only to family members. This test was a validation question to test whether women from different countries of origin would give different responses, which was confirmed.

Table 3-3 :Comparison of groups regarding levels of privacy in clothing in different contexts using the Mann-Whitney test

Mann-Whitney test	**Significant difference in every condition. Asymp. Sig**			
Groups	**Q1**	**Q2**	**Q3**	**Q4**
Comparison 1 (Libyan vs Saudi women)	*p*=0.114	*p*=0.193	*p*=0.554	*p*<0.001
Comparison 2 (Libyan vs European women)	*p*<0.001	*p*<0.001	*p*<0.001	*p*<0.001
Comparison 3 (Saudi vs European women)	*p*<0.001	*p*<0.001	*p*<0.001	*p*<0.001

3.3.2 The desirable clothing for Libyan women in different contexts

The main focus of this study, related to visual privacy, and stated that Libyan Women require a higher degree of clothing coverage when visible to the public. Table 3.4 presents a comparison of variances between the four contexts: Q1, Q2, Q3, and Q4 to identify whether the Libyan women desired a higher level of privacy in clothing. According to a Friedman test, the differences were significant for all comparisons ($p<0.01$). Using a Wilcoxon test, the result for comparison 5 reveals a significant difference between context A, the level of clothing inside the house where the female is close to the window and visible to the public, and C, where the female is visible only to family members.

In the case of comparison 1, Libyan women reported a lower degree of privacy in modest clothing than in public. However, they still cover the whole body with less formal clothes, in contrast to outside the house.

Table 3-4: Levels of privacy in clothing for Libyan women in different contexts. **Comparisons 1** is the difference between clothing level outside the house and inside the house close to the window where females visible to strangers, and **comparison 5** is the difference between clothing level inside the house close to the window and clothing level when females only visible to family members

	Q1	Q2	Q3
Q2	**Comparison 1** Q1-Q2 *p*>0.001 Median =1		
Q3	**Comparison 2** Q1-Q3 *p*>0.001 Median =3	**Comparison 4** Q2-Q3 *p*>0.001 Median =2	
Q4	**Comparison 3** Q1-Q4 *p*>0.001 Median =5	**Comparison 5** Q2-Q4 *p*>0.001 Median =4	**Comparison 6** Q3-Q4 *p*>0.001 Median=2

3.4. Summary

The clothing scale was created to test the hypothesis that visual privacy is culturally associated with women's clothing. The primary target was to assess the level of clothing Libyan women need to maintain privacy in different social contexts. The experiment confirmed that:

- When inside, near a window, and visible to a stranger, the median clothing level was 6 (loose clothing, hands and face visible, mid-length arm covers, trousers).
- When inside and visible only to family members, the median clothing level was 2 (tight clothing, t-shirt and shorts are permitted, consequently more skin exposed to daylight).

The results from this experiment will be used in the second stage of the research, which explores the degree of window obscuration needed (e.g., the degree of blind opening or density of frosting if frosted glazing is used) to maintain sufficient privacy.

Chapter 4. Method: Window visual privacy experiments

4.1. Introduction

As described in chapter 1, the desire to achieve female privacy in the home using clothing or window treatments devices raises a conflict between privacy and the health benefits of exposure to daylight. It was demonstrated in chapter 3 that different levels of clothing are associated with different degrees of privacy. The current chapter describes the method used in two experiments conducted to investigate the privacy offered by two types of window treatments, horizontal blinds and frosted glass.

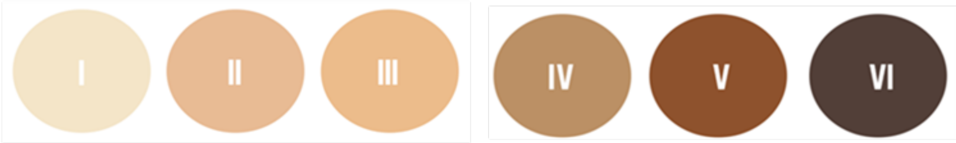
4.2. Apparatus

Privacy was investigated by asking test participants to evaluate the level of clothing worn in a series of digital images projected onto a screen. This approach was adopted, rather than using real windows and window treatments, to enable the rapid transition between the various levels of the independent variables while maintaining close control of the other factors. The results from previous work (Hariyadi & Fukuda, 2017 b) suggest that digital images are a suitable proxy for evaluations using physical apparatus.

The test images comprised actors wearing varying degrees of clothing, with the actors placed behind simulated window treatments. Variations in the setting of each window treatment were used to examine the effect of changes in window treatments on the ability to discriminate the target person's clothing.

The actors were two females. One had a light skin tone and was originally from Italy and the other had a dark skin tone and was originally from Jamaica. Figure 4.1 shows the classification of skin type, according to the Fitzpatrick scale (2020). Actor 1 has a skin tone which would be classified as white (approximately type II of the Fitzpatrick scale) to medium white (type VI); this skin is found in people with a tone between white to medium white, with brown eyes and dark hair, mostly from Southern and Central Europe. Actor 2 can be classified as having skin from dark brown (class V) to black (class

VI) with dark eyes and dark hair; such people are almost always of African or East Indian or Native American origins (D'Orazio et al., 2013).



Light, pale white	White,	Medium white to olive	Olive, mid_ brown	Brown, dark brown	Very dark brown (black)

Figure 4-1: A numerical classification scale for human skin colour by Fitzpatrick. The current work used two actors. The first actor's skin tone is fair, between (II) and (III). The second actor's skin tone is dark brown to black (V to VI).

The same dark clothing was worn by both actors to explore the influence on privacy judgements of the contrast between their skin tone and their clothing. The two actors were photographed by the researcher in a photography studio, wearing the same seven levels of clothing (Figure 4.2). These ranged from clothing level (1): shorts and a t-shirt (a more significant degree of skin exposed, relatively tightly fitting), to clothing level (7): long trousers, medium length top, long arm coverage, and a head scarf (the whole body covered except for the face and hands, medium loose fitting). For the actor skin type II, these are the clothing levels 1 to 7 from the first experiment (section 3.2). The primary target in the clothing scale experiment was to ask Libyan women about the level of clothing coverage needed to maintain visual privacy in different social contexts.

Images of the actors were embedded into a background scene (Figure 4.3), intended to represent a typical domestic interior scene. The test images thus simulated a person outside the house looking to the inside through a window. The background scene was photographed by the researcher in a real living room during the daytime with the room lit by natural light and all interior lighting switched off.

Figure 4-2: The seven clothing levels used in the two experiments investigating window privacy. Top row – actor 1, bottom row – actor 2. The two actors are wearing the same level of clothing, from left (a high degree of skin exposure, tight fitting) to right (the whole body covered, loose fitting)

The experiments were conducted in a laboratory (with the lighting switched on, to simulate the observer being located in natural daylight). Luminances are provided here to aid consideration of application. With no obstruction by window treatment, luminances on the face were approximately 170 cd/m^2 for the actor of skin type II and 120 cd/m^2 for the actor with skin type VI, and the centre of the torso had a luminance of 130 cd/m^2. To each side of the actor in the central position was a dark surface on their left (TV screen, 140 cd/m^2) and a lighter surface on their right (wall, 165 cd/m^2). The simulated blinds had a luminance of 300 cd/m^2. The Illuminance in the laboratory in horizontal plane (close to the projector screen) was 606 lux and vertical (participant's view) was 470 lux (see the appendix Tables from B1 to B6 the illuminance level of the test images for horizontal blind experiment and appendix Tables from C1 to C6 for the frosted glass experiment) .

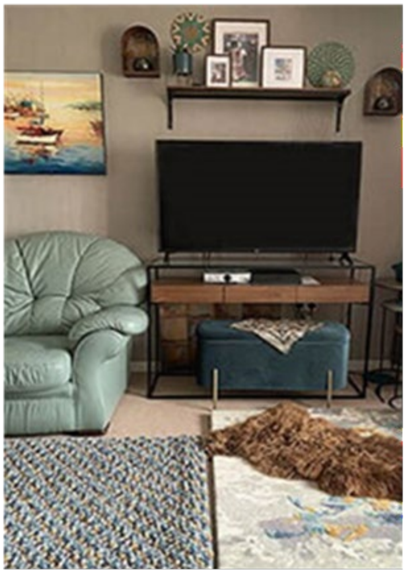


Figure 4-3: The living room scene used as a background

The test participants were seated and conducted the experiment individually whilst facing the target images. Figure 4.4 shows example photographs of an experiment in progress. The target images were displayed on a sheet of white paper on a white wall using an LCD data projector. Images of both of the actors wearing the seven clothing levels (1-7), shown in Figure 4.2, were printed on a sheet of A3 paper for test participants to use as a reference during trials.

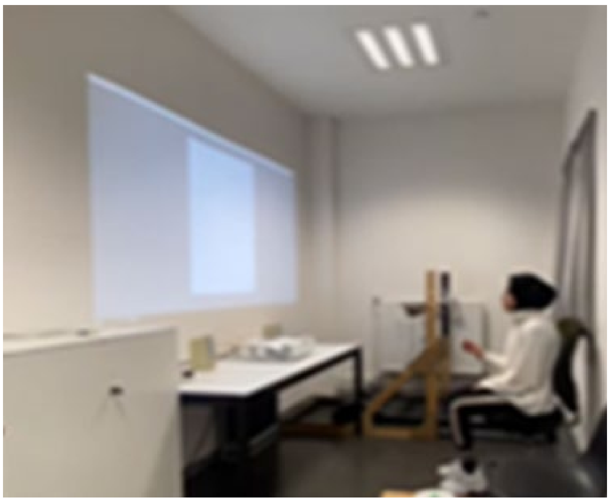


Figure 4-4: Example photographs of an experiment in progress. The participant sits facing the wall onto which the test images were projected. The image shows trial of the category rating procedure.

4.3. Horizontal blinds experiment

Horizontal blinds are a commercial type of window treatment. By adjusting the angle of the slats, the user can make the compromise between the degree of visibility from outside and daylight transmission; when the angle of the blinds set to 0° (horizontal) the person onside is visible to those outside: when set to 90° (vertical) the person inside is not visible to those outside but also daylight is excluded (Figure 4.5).

Figure 4-5: An example of a horizontal blind; two degrees of angles are illustrated: left - fully closed, or 90° (vertical slats), and right - completely opened, slats 0° (horizontal)

4.3.1. Blind settings

The ability to see through the window depends on the angle to which the blind slats are rotated. The geometric characteristics of blinds include the angle of tilt, their depth and spacing.

In this experiment, the blind opening was characterised by the degree of the free area rather than the slat angle. This was done for two reasons. First, the direction of the slat angle (upward and downward facing) and the depth relative to the position of the sun influence the light transmittance (Chantrasrisalai, & Fisher, 2004). The slat's direction and depth also affect visibility (and hence privacy) when viewed from the side, but a similar opening area and views are provided when the line of sight of the observer is parallel to the window (see section 2.6). Second, the dimensions, in proportion to the blind/window height and opening area, can be converted to image pixels.

Figure 4.6 shows the basic dimensions calculated to define the free area. This assumes the observer's line of sight is perpendicular to the window. The height of the free area (H) is the height of the window not obscured by the blind, which is the distance from the end of the upper slat to the upper surface of the lower slat. While the slat width (L =50mm being the height of slat for the popular blind screen) is defined as the length of a straight line running from one end of the slat to the other.

The ideal range of blind openings used in a trial would extend from those giving near a 0% (angle 90˚ fully closed) to near a 100% (horizontal angle 0˚) chance of being able to identify the clothing level if viewing from outside. For example, when the blind is 100% open, 50mm is the maximum possible gap size. In this experiment, the highest opening (free area 60%), is predicted to provide a 100% chance of being correct. This opening level faces a slat angle (α=23.6˚), which produces (H=30mm) the height of the free area, and (A=20mm) the apparent height of the slat.

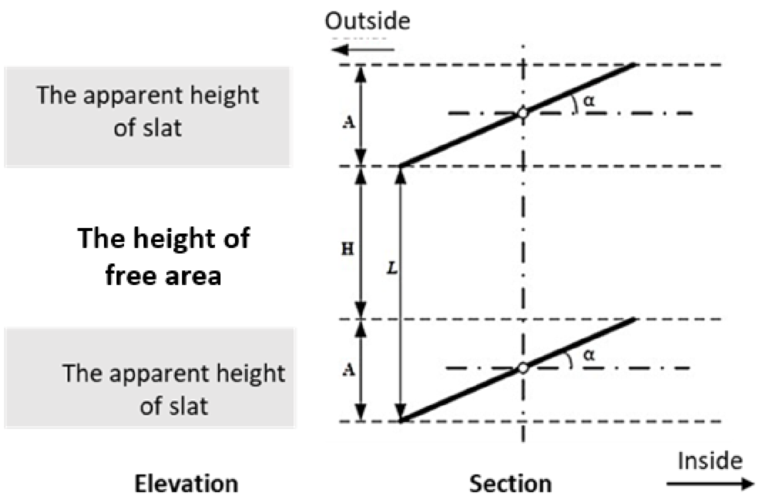


Figure 4-6: The dimensions used for calculation of the height of opening area, 30 mm (H), and 20mm the apparent height of the slats, an example showing the highest opening area to outside (60%), which is provided by α=23.6˚ (slat angle)

The relationship between the slat angle and opening area (free area) is shown in Figure 4.7. The diagram produces an equal interval between the apparent height of the slat and the height of the free area given by the slat angle (α=30).

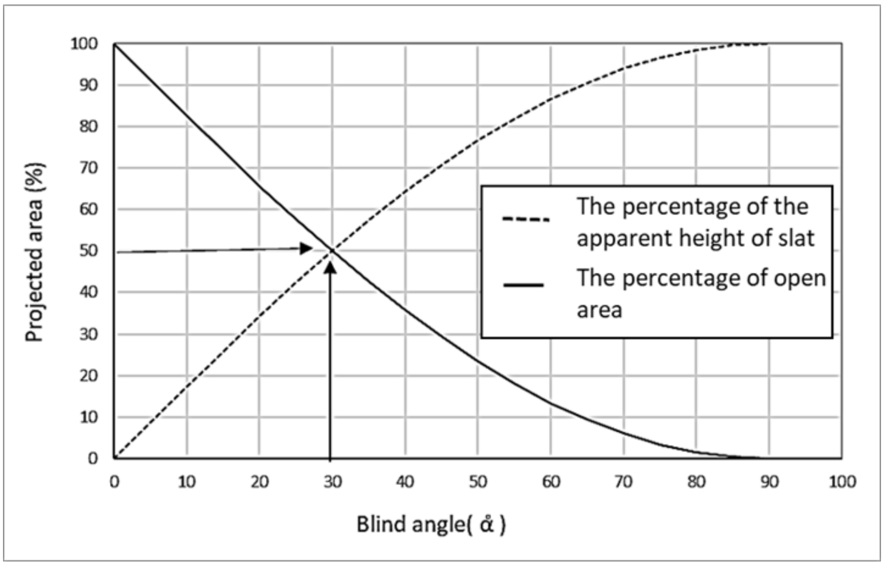


Figure 4-7: The relationship between the slat angle and opening area (free area) and closing ratio. The trend shows the blind angles from 70 to 100˚ with a blind opening of less than 10%. For opening levels of about 50% or more, it was very easy to identify the clothing level. This opening was 30-degrees˚.

A series of images was created (using actor 1, clothing level 2, and a grey background) to explore the range of blind opening levels. In the first place, these were observed only by the researcher. Figure 4.8 shows an example for the free areas of 5% and 80% for the actor skin (type II).

Figure 4-8: Examples of free areas of the blinds tested by researcher to identify range of blind opening levels used in the main experiment. Two free areas, the left 80% and the right 5%, the actor skin tone (type II), clothing level 2

The free area obtained with different blind angles varied, in 5% steps, from 5% to 80%. Observations were made only by the researcher (see figure B1 in appendix B). It was apparent that, for free areas of about 50% or more, it was very easy to identify the clothing level but, for a free area of about 5%, the clothing level was difficult to assess. These observations revealed a further potential problem: the contrast between the actor's skin and the clothing made it apparently easy to identify changes in the clothing level: it was from these observations that a decision was made to add the second actor, having a darker skin tone and thus a lower contrast between their skin colour and the clothing. Repeating these same observations with actor 2, it became apparent that correct identification was easy until a blind opening level of 60% was reached.

4.3.2. Blinds gap and target size and resolution

Depending on the viewing distance, there is a fixed relationship between the real size of a feature (e.g., the gap) and its size in pixels on the image. In optometry human visual acuity is assessed using visual acuity charts such as the Snellen chart (Snellen, 1862) or the Landolt's (1899) chart. Visual acuity refers to the ability to see fine spatial details clearly. The minimum visible (or minimum identifiable) resolution is the smallest angle size of a point, or the minimum angular width of a line required for it to be seen. The visual size of the smallest gap the observer can resolve is the minimum angle of resolution MAR (Figure 4.9). The Log MAR Optotype is a set of Modern test chart characteristics used to measure visual acuity, and the size-acuity calculation is the same as on Snellen's (1862) and Landolt's (1899) charts. The characters on the acuity chart diminish in size in a similar way, using the logarithm of the MAR 0.1 steps.

The logarithmic progression of the letter sizes leads to more consistent measurements, as the letters on each successive line are (r) times larger than those of the previous line. The primary idea behind these charts is that a human eye with normal visual acuity may identify a detail within a viewing of 1 minute of arc angle, named the Minimum Angle of Resolution (MAR) (Jackson and Bailey 2004).

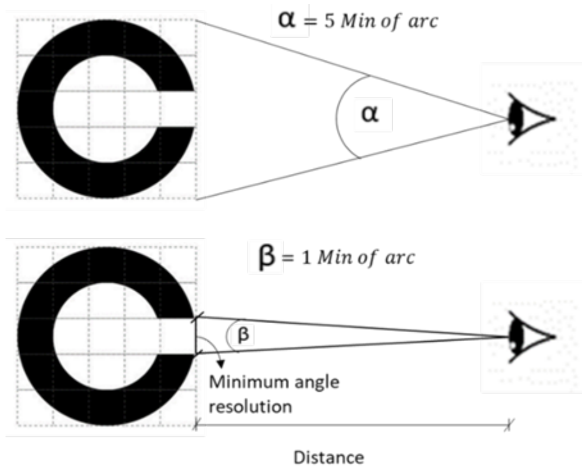


Figure 4-9: the viewing angle of Landolt's (1899) letter stroke, Minimum Angle of Resolution. The human eye with normal visual acuity may identify a detail within a viewing of 1 minute of arc

In this experiment, observations were made using the Log MAR principle with five blind opening levels: 6%, 11%, 19%, 34% and 60%. This range has a one-log unit interval from the lowest to the highest setting; the intervals follow the same progression as used in Log MAR. From the largest blind opening of 60%, the reduction in the size of the opening is uniform with a constant ratio of 0.25 log unit steps or 1.7783.

Using the logarithm of the MAR in 0.1 steps, as shown in Figur4.10, this would give 14 blind opening sizes, from 60% to 6%, whereas 0.25 log unit would give 6 sizes, as shown in Figure 4.11. Table 4.1 presents the angles (α) corresponding to each degree of openness.

The blinds represented in this work were of depth 50 mm, at spacings of 50 mm, the depth and spacing being that of blinds in the authors' office, which are not atypical. The slats were assumed to be of negligible thickness and opaque following research of Chantrasrisalai and Fisher (2004).

The slats were light grey rectangles drawn in Photoshop (95% lightness, R=240, G=240 and B=240) to provide a layer which could be chosen at random and placed over the actor and background image.

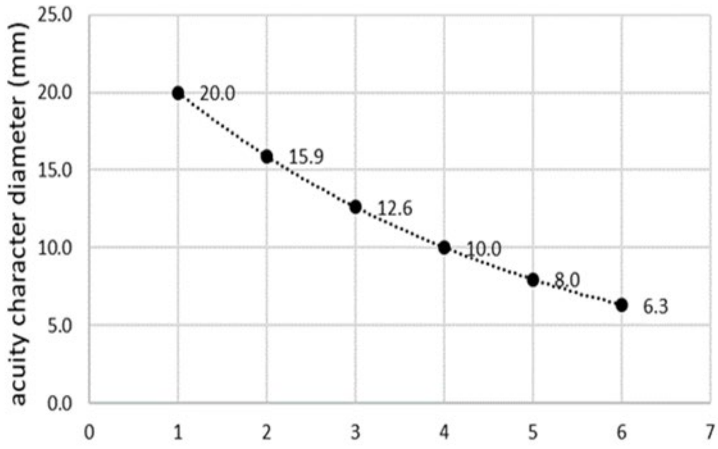


Figure 4-10: The reduction in the sizes of the blind openings. Using the Log MAR 1.0 log unit acuity principle provides 24 sizes

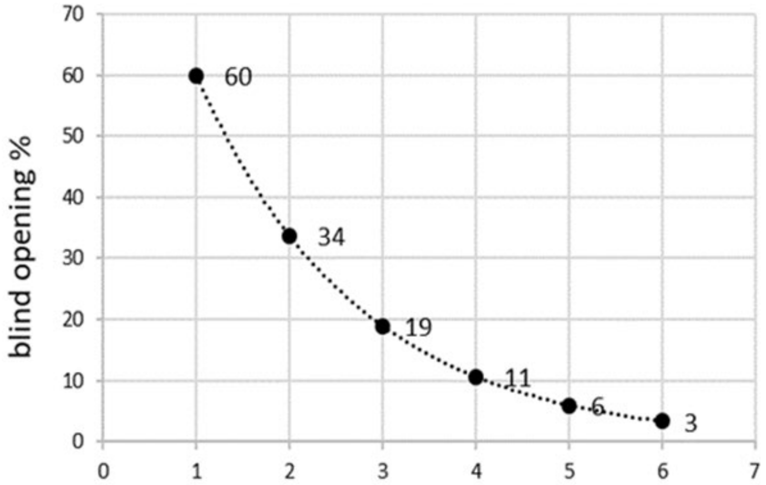


Figure 4-11:The reduction in the sizes of the blind openings using 0.25 log unit provides 6 blind opening areas

Table 4-1: The reduction in the sizes of the openings and the slats, from the largest opening of 60% to the smallest opening of 3%, in uniform steps, with a constant ratio of 0.25 log unit steps. The left column is the angle (α) corresponding to each degree of openness.

Slat angle (α)	Gap/opening area (mm)	The apparent height of slat (mm)	Blind % open
23.6	30.0	20.0	60
41.3	16.9	33.1	34
54.1	9.5	40.5	19
62.9	5.3	44.7	11
70.1	3.0	47.0	6
75.9	1.7	48.3	3

There is no approach that systematically classifies distances between buildings in relation to visibility (Kotabi, 2019). However, Shach-Pinsly et al. (2011) categorised distances less than 10 m as having high levels of visual exposure from outside. In the current work the target was scaled to present 4 m from the observer, with both at approximately the same horizontal level. This would represent a pedestrian walking along the pavement and looking through a ground floor window.

The photos in the laboratory also were resized to match the height of the actor, which is 1700 mm and 23.99 in visual size; this gives a visual height of 850mm (739 pixels) in the laboratory at a 2000 mm distance from the participant's chair to the projected target image on the wall (Figure 4.12).

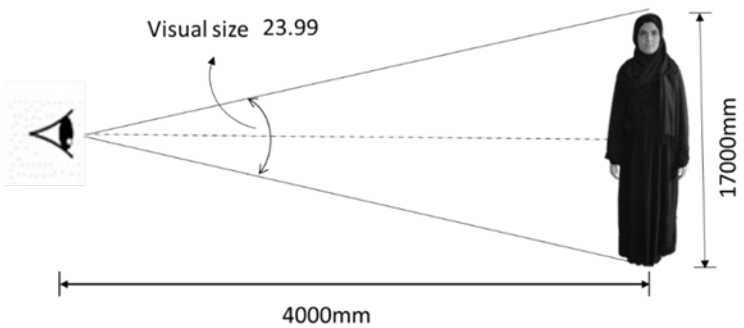


Figure 4-12: The visual size and the distance from the participant's chair to pedestrians and the absolute target size

Figure 4.13 shows the window width and height calculation, and the sizes for the image (background scene and blind) using the same calculation as for the actor, based on the spreadsheet. The simulated window width and height (background scene and blind) is 1525 mm x 2015 mm, which gives 763 mm (663 pixels) x 1008 mm (875 pixels) on the wall. The projected area on the wall was 2210 mm width x 1250 mm height, the width size provides two images side by side for the paired comparison trial.

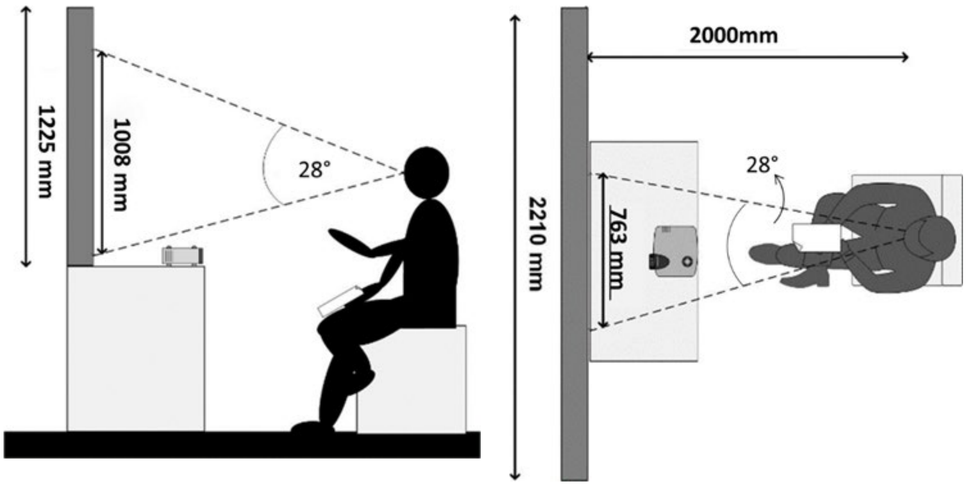


Figure 4-13: The dimensions of the projected area on the wall (required target size (mm) and the distance from observer to wall)

4.3.3. Setting up the images

In trials, a repeated series of images presented to a test participant. Doing so with the actor in the same location might lead to some visual cues about clothing being exaggerated. To mitigate this, the actors were placed in one of three horizontal positions (Figure 4.14). Furthermore, the horizontal blinds were placed in one of two vertical positions so that a closed blind did not always obstruct the same features of the actor in successive images. Overall, this required six photographs of each actor for each clothing level. During the trials, only one of these six images was presented, chosen at random from the set of six. After saving the transparent image backgrounds as PNG files, a software program was set up to build all combinations of the actor images needed. The program can also display different combinations of the blind openings and the actors against the background, as well as control the horizontal/vertical positions of the blind and actor images. Figure 4.14 shows an example of the actor with three horizontal offsets (the x-axis position of the actor) and two vertical offsets of the blinds (the y-axis position of the blind).

Blind opening _34%_Actor skin type_ II_ Clothing level _2_Actor horizontal offset _X= 200px left

Blind opening 34%_Actor skin type _II_ Clothing level_ 2_Actor horizontal offset _X=Zero

Blind opening _34%_Actor skin type_ II_ Clothing level_ 2_Actor horizontal offset=200px Right

Blind opening _34%%_ Actor skin_ II_ Clothing level _2_ blind vertical Offset y=25mm (eyes visible)

Blind opening _34%%_ Actor skin_ II_ Clothing level _2_ blind vertical Offset _y=0 mm (eyes hidden)

Figure 4-14: Illustration of variations in position for the horizontal blinds experiment. The top row shows the three variations in horizontal location of the actor. The bottom row shows enlarged details of the face to show changes in vertical position of the blind. In these images the blind is set to a free area of 34 %, the actor has skin type is II and is wearing clothing level 2)

A pilot study with ten participants was conducted to confirm the experimental design. In the appendix B, the test variables, and the results of the pilot study.

Test variables Privacy against being observed from outside was controlled using horizontal window blinds. Observers were asked to identify the degree of clothing worn by actors presented in a series of photographs. The actors wore several different degrees of clothing and were placed behind horizontal blinds with different degrees of openings (free area). Figure 4.15 shows test images used for the two actors.

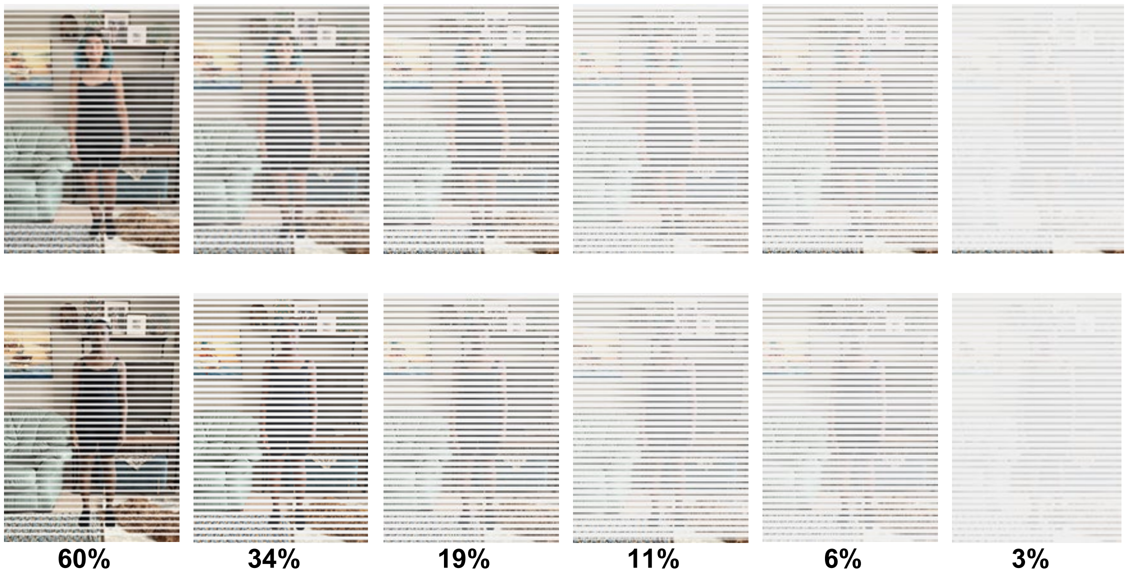


Figure 4-15: Examples test images for investigating visual privacy offered by horizontal blinds. The two rows show the two actors, and in each case, they are wearing clothing level 1. The six columns show different levels of free area, ranging from 3% to 60% with intervals of 0.25 log units. In these images the actors are placed at the middle horizontal position (X=0). The vertical position of the blinds are set to eyes visible (top row) and eyes hidden (bottom row)

There were six levels of horizontal blind opening, as characterised by the proportion of free area, ranging from 3% to 60% with constant intervals of 0.25 log units. The percentage free areas used here represent blind angles of 75.9˚,70.1˚,62.9˚,54.1˚,41.3˚ and 23.6˚ for percentage free areas of 3%, 6%, 11%, 19%, 34% and 60% (presented in Table 4.11). As mentioned above this range was chosen, following pilot study with the expectation of extending responses from chance level to 100% correct identification of clothing level.

4.3.4. Procedure

Evaluations were given using a category rating procedure with the images (84 for the horizontal blinds) observed separately for a limited duration. Two observation durations were used, 0.3 s and 3.0 s, to explore the degree to which this mattered. The shorter duration represented a typical gaze fixation (Jovancevic-Misic and Hayhoe, 2009)or, a brief glance, and the longer duration represented a more purposeful stare. After each presentation, test participants were required to identify the level of clothing worn by the actor using the clothing scale (Figure 4.2, clothing levels 1 to 7).

Table 4-2: Examples of the horizontal blind experiment to assess the effects of different variables

Variable	Test variables	Number of levels
Actor/skin type	II and IV	2
Clothing	Level (1) least clothing coverage, (2,3,4,5) middle, level (6,7) fully covered	7
Blind opening (free area%)	3, 6, 11, 19, 34, 60	6
Observation duration	0.3s,3.0s	2

For trials involving a particular test participant, 42 photographs for every actor (6 blind settings x 7 clothing levels) were used as the target images. There were six versions of each of the 42 combinations of clothing level and blind opening area for each actor, these giving slight variations in the horizontal location of the actor and the vertical position of the blinds (see section 4.3.3). For each presentation, one of the six variations was drawn at random.

Forty test participants were recruited for this experiment (25 females, 15 males, approximate mean age 31 years) presents in Table 4.3. Participants received £10 for taking part, upon completion of the experiment. Corrected-to-normal visual acuity was confirmed at the start of trials using a Landolt ring acuity test. Ethical approval for this experiment was received from the University of Sheffield Ethics Committee 17/09/2019.

Table 4-3: Horizontal blind experiment. Sample Group Demographics: Gender and Age

Age group		Gender		
		Males(n)	Females(n)	Total
1	18_29	7	13	20
2	30_39	6	9	16
3	40_49	2	3	4
4	50_59	_	_	_
Total number of participants		15	25	40

For each participant, at the beginning of each test session, 20-minute learning sessions were held in which to describe and confirm the participants' understanding of the differences between the seven clothing levels. learning sessions were included to practise with the clothing levels before starting the actual experiment. First, one actor was presented wearing all of the clothing levels without any background. Second: a sample of actor's images was displayed against the background, and two levels of free areas 34% and 6%. Third; the actors were randomized and the presentations were continued until four images in sequence had been identified by the participant correctly.

After the learning session, evaluations were given using a category rating procedure. While viewing the images, the presentation was paused until a response was entered. The stop screen would not change until the researcher recorded a response, then the participant had a two-second delay before the next image was shown. After each presentation, test participants were required to identify the level of clothing using the clothing scale. In a test session, there were two blocks of category rating trials: (0.3 s) and (3.0 s). The order in which the blocks were used was randomised.

4.4. Frosted glass experiment

Frosted glass is an alternative solution to maintain visual privacy used in this study. Whereas blinds reduce visibility of people inside the house using opaque material to stop the flow of light, frosted glass diffuses the flow of light. It was considered that frosted glass might offer acceptable privacy whilst maintaining a greater amount of daylight than when using horizontal blinds.

Three approaches to establishing variations in frosted glazing were considered. One of the main approaches for finding frosted glass parameters is to review publications on a subject related to daylight simulation. It was possible to find parameters for frosted glass in the software library database using daylight simulation programs. Radiance is a proven tool for lighting simulation. Radiance offers material types that characterise reflectance and visual transmittance properties with various degrees of detail, e.g. the optical properties (Reinhart and Andersen, 2006). Visual Transmittance (Tvis) is used to illustrate the percentage of the visible portion of the solar spectrum that is transmitted through the glazing. A Tvis of 1 indicates that no visible light is prevented from entering through the window, whereas a Tvis of 0 indicates that no visible light passes through the window (Ariosto and Memari, 2013). Using Radiance materials as a method would have needed additional work in order to apply it to the existing images; additionally, the process of using this software means that it takes a long time to render these images.

The second approach is to look for the databases among the frosted glass manufacturers. When categorising various glassing materials, findings on some factory websites (https://www.glassfilms.eu/) revealed five degrees of frosted glass; two metrics were discovered: *"Visible light reflectance* (per cent) and *Visible light transmittance"*. However, there are no clues as to whether the values of the degrees of visibility through this sort of glass.

Furthermore, publications of glassing materials science were reviewed to determine frosted glass parameters. The frosting process and the light characteristics were also reviewed. The visual characteristics of frosted glass were found to be important for investigating light characteristics. When the light and the glass interact, then the main basic evaluation factors that affect optical properties are: Reflection, Transmission, and Absorption (Novotny *et al.*, 2019). Diffusion is another main factor (called scattering) (Novotny et al., 2019) in terms of its effect on visibility. The diffusion of light as it passes through the material causes haze, resulting in poor visibility and/or glare (Novotny et al., 2019). Haze can be created by the material itself, as a result of the surface roughness (Chen et al., 2016), produced when exposing the flat glass to a chemical and thermal treatment (Kleiner, 2022). Haze is a spectral transmittance that was calculated by Wildner and Drummer (2014) (see section 2.8). For the value of visibility, the degree of haze (%) achieved by Chen et al. (2016) is 85% (see Figure 2.19, section 2.8), and Novotny et al. (2019) reported haze degrees for four types of frosted glass: 49.6%, 50.7%,60.4 % and 61.5% (see Figure 2.20, section 2.8), the highest haze or the heist degree of visibility.

However, the materials needing to be tested in visual privacy investigations are not common materials in the market. Moreover, this method requires two additional works, firstly to enable use of the existing images and secondly the additional work needed to provide the glass samples.

The third approach is to use Photoshop software filters and layers as the image layers have been used for the blind experiment. A filter is a process that alters the shade and colours of pixels in some way to affect the appearance of an image (Kirsch and Geller, 2006). Filters in Photoshop can be used to change an image's brightness and contrast, as well as add textures, tones, and other effects. The main task when reviewing the literature on frosted glass experiments is to use the existing digital images method (clothing scale) along with a blind screen experiment. The advantage of using Photoshop filters is that they are quicker, and it is unnecessary to create new images and the apparatus is the same and the procedure similar to those for the blind screen experiment. The disadvantage of using this method is that the distort filters geometrically distort the image, creating 2D effects. Although the last updated version (Dec 2021) provided 3D effects, review of the Photoshop filter effects references indicated there is no relationship between materials in Photoshop and Radiance library materials, which would limit the study in terms of daylight.

4.4.1. Setting up the images

A series of comparison tests were conducted to simulate the frosted glass filter in Photoshop with real glass samples (real frosted glass ordered from a glass factory) to create a series of test images, which was done for some images by projecting the actor images onto a projector screen and photographing the images through layers of the frosting sample (see Figure C_1 in appendix C). Frosting was also simulated using distortion levels in the frosted glass filter in Photoshop. Once the optimal distortion had been established in trials, the characteristics of this (e.g., light transmittance) could be estimated for Filters in Photoshop to provide a preview of many of the special effects. One category of effect is a frosted glass filter, which makes an image appear as if it were being viewed through different types of glass.

Distortion, Scaling, and Smoothness settings are the main variables that control the frosting effect of the image, using the sample as a benchmark. The distortion level is the principal variable in the frosted glass filter in this experiment.

Figure 4.16 shows the changes in the distortion levels or blur degrees from 1 to 20, which increase or reduce the value of visibility. A series of improvements and presentations were made to examine the images of the actors with different levels of distortions and clothing, the main aim was to identify the distortion level, the range of distortion levels extended from 100% correct identification of clothing level to chance level.

Smoothness is other variable in frosted glass filter in Photoshop. The smoothness levels range from 1 to 10. Figure 4.17 presents a comparison between two different smoothness levels (1 in the left image and 2 in the right image). The selected smoothness level was 2 this is due to the deformation as shown in Figure 4.17 in the left image, where the smoothness level 1. More than this level 2 gives a deformation to the image and fails to produce a similar effect as the frosted glass.

In addition, for reality simulation, parallel presentations were made using actual frosted glass film and by creating multiple degrees of frosting by layering the film sample in front of the projected images on the wall.

Figure 4.18 shows an ideal view for the smoothness level 1 on the left and 2 on the right, compared with the sample of a frosted glass film in the middle. All three images were projected on the wall in the laboratory and photographs were taken under the same condition (light on). The result shows that the smoothness shading 1 did not present a similar result to the real frosted glass. Based on the comparisons, the optimal smoothness is level 2.

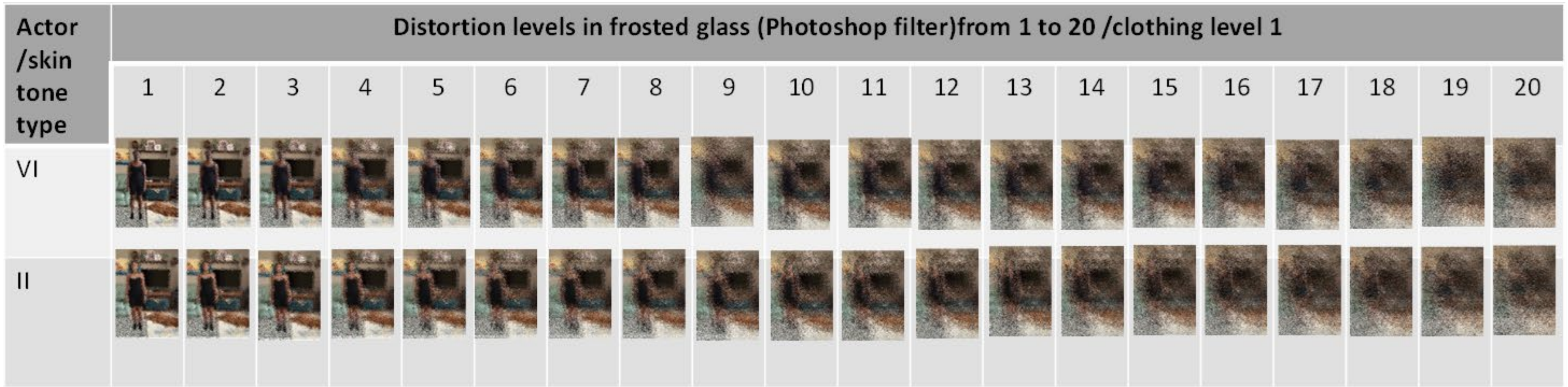


Figure 4-16: The range of distortion levels in frosted glass filter in Photoshop softwere.presentations have been made to identify the distortion levels used in the frosted glass experiment.The two rowa show two actors skin tone(VI and II type) , they are wearing clothing level 1.

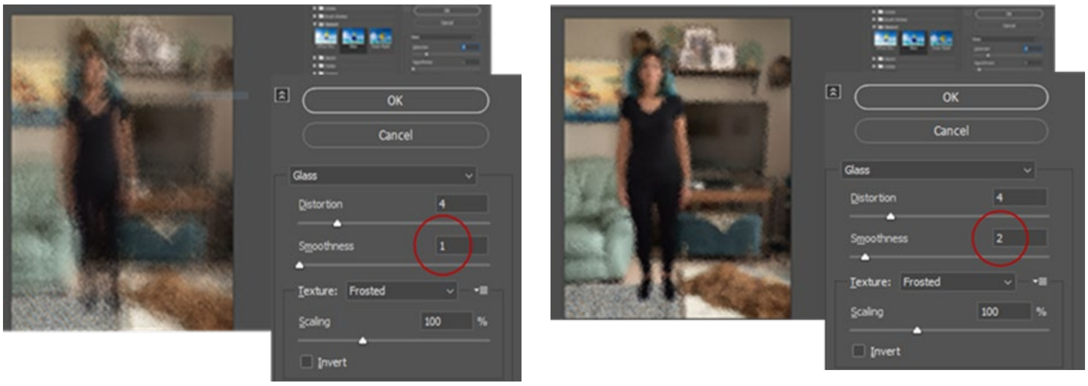


Figure 4-17: Frosted glass filters in Photoshop Software. Example for Distortion level (4), Scaling 100%, presenting a comparison between two different smoothness levels (2, 1). Clear deformation can be seen in the image on the left.

Figure 4-18: A comparison of real frosted glass, in the middle, and layered film samples of two different smoothness levels: left image (1) and right image (2).

Scaling is the third variable available in the frosted glass filter in Photoshop, with a value from 50 to 200. The example in Figure 4.19 shows three different scaling levels (Sc) in the frosted glass filter in Photoshop: 50%,100% and 200%. In the three cases, the distortion level was fixed at 4 and the smoothness was fixed at 2 (as a result of the preview comparisons). To simulate reality in the test images, the scaling was maintained at 100%.

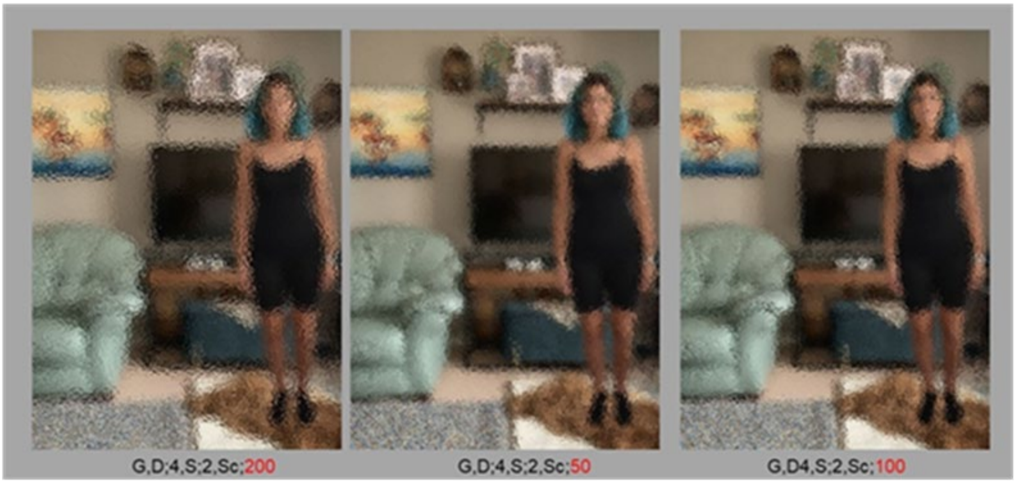


Figure 4-19: The right-hand image has a 100% scaling filter and was selected for the test images in the experiment, since it provides the ideal or average frosting.

A pilot study was conducted to assess the distortion levels, which is the primary variable affects visual privacy) and how the distortion affects the visibility rating; in addition, how the actor's skin is influenced by the distortion and the probability of adding or decreasing the distortion level for each actor. Therefore, it was anticipated that the outcomes of this pilot study would reveal whether or not this distortion range is appropriate. The variables tested and the result for the pilot study can be found in appendix C.

4.4.2. Test variables

The experiment took place in the lighting laboratory at the University of Sheffield. Within the laboratory, a test area was set up. The target images were produced by a data projector. Observers were asked to identify the degree of clothing presented in a series of photographs (Figure 4.20). Actors with varying degrees of clothing were located behind simulated frosted glass.

Five distortion levels were examined, ranging from 4 to 20, in steps of four distortion units. For each test participant in the trial, 35 photographs for every actor (5 distortion degrees x 7 clothing levels) were selected at random from the set of 210 images and used as the target images (Table 4.4).

4 8 12 16 20

Figure 4-20: Examples of test images for investigating visual privacy offered by frosted glass. The two rows show the two actors, and in each case, they are wearing clothing level 1. The five columns show different levels of distortion level, ranging from (4 to 20) in steps of four distortion units. In all images, the actor is placed in the middle of the three horizontal locations.

For each of the 35 conditions, there were five versions of each photograph, giving slight variations in the horizontal location of the actor, with one variation being drawn at random for each presentation.

Table 4-4: All possible combination ratings of variables categories in trial for the frosted glass experiment.

Variable	Test variables	Level
Actor/skin tone	Dark and light skin actors	2
Clothing level	Level (1) least clothing covered), (2,3,4,5) middle, level (6,7) fully covered	7
Distortion degrees (D)	4,8,12,16,20	5
Observation duration	0.3s,3.0s	2
Total of images	70 from 210 images	

4.4.3 Procedure

The program used for the trials of the frosted glass images was similar to the horizontal blinds experiment except for the preparation of the images. For the blind experiment, the images were presented separately as sequences of layers, and the program built all combinations of the actor images at the moment demanded. The images in the frosted glass experiment were built as fully frosted images (the actor in front of the background edited by a frosted glass filter). For repetitions of the trial images, the actor was placed in two horizontal positions (right and left). The images' preparation (e.g., size in pixels and distance) was similar to that of the blind images.

Thirty test participants were required (Table 4.5) for this experiment (16 females, 14 males, approximate mean age 36 years). Corrected-to-normal visual acuity was confirmed at the start of trials using a Landolt ring acuity test.

Evaluations were given using a category rating procedure with 70 images observed separately for a limited duration. Two durations were used: 0.3 s and 3.0 s. After each presentation, the test participants were required to identify the level of clothing using the clothing scale

Table 4-5: Frosted glass experiment. Sample Group Demographics: Gender and Age

Age group		**Gender**		
		Males(n)	Females(n)	Total
1	18_29	5	6	11
2	30_39	2	4	6
3	40_49	7	5	12
4	50_59	_	1	1
Total number of participants		14	16	30

4.5. Summary

Two experiments were conducted to compare the privacy provided by two types of window treatments - horizontal blinds and frosted glass. Privacy was investigated using digital images projected onto a screen, to enable rapid and repeatable transition between levels of the independent variables and to enable control over other factors. The images comprised two actors with varying degrees of clothing. The images were layered behind simulated window treatments, with these set to different levels of privacy control, to examine the effect of changes in window treatment on the ability to discriminate the target person’s clothing.

The experiments were conducted in a laboratory in which the interior lighting was switched on to simulate observations during daytime. The horizontal blinds characterised by the percentage of free area (i.e., percentage of window area not obstructed by blinds in the plane of sight) ranging from 3% to 60% with intervals of 0.25 log units. The frosted glass was simulated using the distortion function in Microsoft Photoshop, the distortion ranging from 4 to 20 in steps of four distortion units. For each experiment, two pilot studies were done to assess the test variables. Evaluations were given using a category rating procedure with the images (84 for the horizontal blinds, 70 for the frosted glass) observed separately for a limited duration. Forty test participants were recruited for the horizontal blinds experiment and 30 for the frosted glass experiment.

The following chapter will present the results and analysis for the test variables, such as the significant effect of changes for every clothing level on the visibility rating. Furthermore, it will test the hypotheses, such as the contrast between the actor's skin tone and the clothing and the observation duration.

Chapter 5. Results: Window visual privacy experiments

5.1. Introduction

This chapter presents the results of two series of experiments carried out using the method described in chapter 4. These results are presented separately for the experiments using horizontal blinds and frosted glass. Statistical analyses of these results were carried out to determine whether changes in window treatment level had significant effect on the ability to discriminate the level of clothing worn by the actors behind those window treatments, and whether the ability to identify clothing level was affected by the actors' skin tone or the duration of observation (see the raw results Tables from B7 to B14 in appendix B).

5.2. Horizontal Blinds

For each level of free area and clothing levels, there were 42 target images for each actor. The 84 images of the two actors with different skin types were presented randomly in two separates category-rating trials. In each trial, the images were presented at 0.3 s and 3.0 s observation duration.

For each single observation, the responses were recorded as the numbers of the clothing level from 1 to 7, for each combination of actor skin tone type (II and VI), and observation duration (0.3 s, 3.0 s), averaged across the 40 participants. In Tables 5.1, 5.2 the results show median rating responses. Figure 5.1 represents a different degree of blind opening (free area%) and shows the median response of test participants plotted against the actual clothing level.

The median response for all clothing levels for the actor with skin type II at 0.3s observation duration shown in Table 5.1 tends to be the middle level of the rating scale (4) at free areas of 3%, indicating arbitrary evaluations, as also shown in Figure 5.1, where the line of median responses for clothing levels is approaching the horizontal line.

Table 5-1: Median frequency of clothing level responses through different blind openings for actors' skin tone types II and VI at observation duration 0.3 sec. Note: for these data, chance frequency is 4 (the desired level of privacy). Shaded numbers mean incorrect identification of clothing levels by participants.

Actor/ skin tone type	Blind opening (Free area %)	Median frequency of clothing level responses						
		1	2	3	4	5	6	7
II	3%	4.00	4.00	4.00	4.00	5.00	4.00	5.00
	6%	2.00	3.00	3.00	3.00	4.00	5.00	6.00
	11%	1.50	3.00	3.00	3.50	4.00	5.00	5.00
	19%	1.00	2.50	3.00	3.50	4.00	6.00	6.00
	34%	1.00	2.50	2.50	3.00	4.00	6.00	6.00
	60%	1.00	2.00	3.00	4.00	5.00	6.00	7.00
VI	3%	4.00	5.00	4.00	4.00	4.00	5.00	5.00
	6%	2.50	3.00	3.00	3.00	4.00	5.00	5.00
	11%	3.00	4.00	4.00	3.00	4.00	5.00	4.00
	19%	2.00	3.00	3.00	3.00	4.00	5.00	6.00
	34%	1.00	3.00	3.00	3.00	4.5	6.00	6.00
	60%	1.00	3.00	3.00	4.00	5.00	6.00	6.00

While the median rating for all clothing levels with the same actor tends to be more accurate with a higher free area of 60%, this is also indicated in Figure 5.1, where the correct identification of clothing level appears as a line of slope 1.0.

For the actor with skin type VI, the median responses of clothing levels at the lowest free area of 3% for is similar to the actor with skin type II. However, the median responses for the actor with skin type VI tend to be less accurate at the highest free area of 60%, this appears in Figure 5.1, where the line of the median responses of clothing levels is slightly deviating from the slope 1.0 line. An unexpected finding, at the free area of 11%, where the median responses of clothing levels tend to be a middle level of the rating scale (4) compared with a lower free area at 6%, where the median responses are supposed to be with less accuracy. This appears in Figure 5.1 where the slope line is near to be horizontal.

Tables 5.2 shows median rating responses for clothing level at observation duration 3.0 s. The median responses for clothing levels at 3% free area were lower than rating scale (4) compared with observation duration 0.3 s for the actor with skin type II. In contrast to earlier finding during duration 0.3 s, all clothing levels tended to be correctly identified at free areas of 6% and greater, with the actor with skin type II.

However, in some higher free areas for the actor with skin type VI, some clothing levels still not easy to identify in particular the median responses for clothing level 7 at all free areas were less than the actual level, except at the highest free area, 60%, it was correctly identified.

Table 5-2: Median frequency of clothing level responses through different blind openings for actors' skin tone types II and VI at observation duration 3.0 sec. Note: for these data, chance frequency is 4. Shaded numbers mean incorrect identification of clothing levels by participants

Actor/ skin tone	Blind (Free area)	Median frequency of clothing level responses						
		1	2	3	4	5	6	7
II	3%	3.00	3.00	3.00	4.00	4.00	5.00	6.00
	6%	1.00	2.00	3.00	4.00	5.00	6.00	7.00
	%11	1.00	2.00	3.00	3.00	5.00	6.00	7.00
	19%	1.00	2.00	3.00	4.00	5.00	6.00	7.00
	34%	1.00	2.00	3.00	4.00	5.00	6.00	7.00
	60%	1.00	2.00	3.00	4.00	5.00	6.00	7.00
VI	3%	3.00	4.00	4.00	4.00	5.00	4.00	5.00
	6%	1.00	2.00	3.00	3.50	5.00	6.00	6.00
	%11	1.00	3.00	3.00	3.00	5.00	6.00	6.00
	19%	1.00	2.00	3.00	4.00	5.00	6.00	6.00
	34%	1.00	2.00	3.00	4.00	5.00	6.00	6.00
	60%	1.00	2.00	3.00	4.00	5.00	6.00	7.00

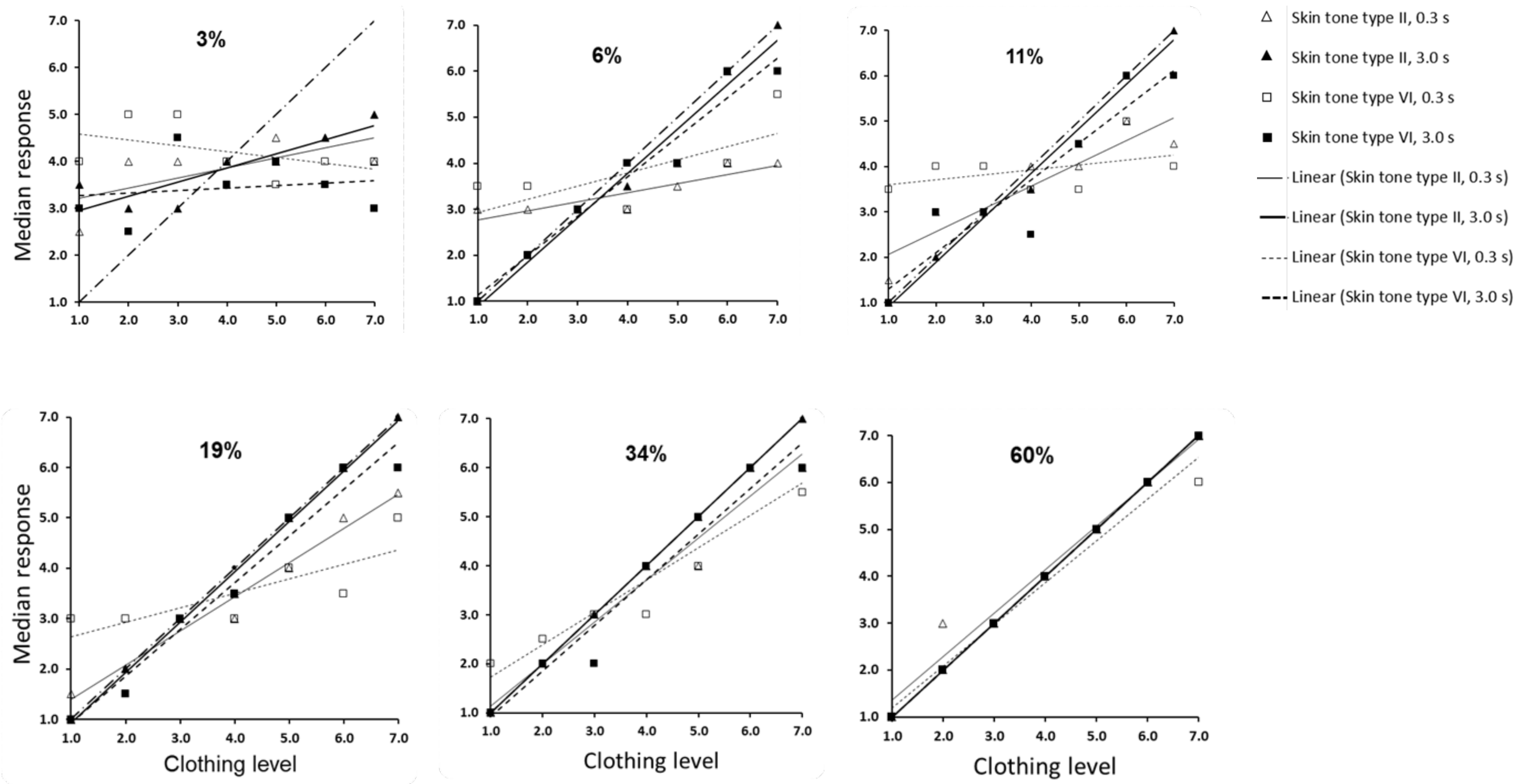


Figure 5-1: Median clothing level response plotted against actual clothing level for the six levels of free area (% shown in each graph). These results are for the two actors: a white skin tone (type II) and a dark brown to dark skin tone (type VI) and the 0.3 s, 3.0 s observation durations. The dot-dash line indicates the ideal response for correct identification of clothing level

5.2.1. Effect of clothing level

This section investigates differences in clothing level identification, for horizontal blinds. The frequency distribution of the responses for the effect of blind opening (free area on visibility value was investigated using a range of statistical and graphical measures for each combination of actors, duration (see appendix B Tables from B15 to B20). The data did not suggest that the sample was drawn from a normally distributed population for horizontal blind (and similarly for the frosted glass data see the appendix C Tables from C7 to C12). Thus, statistical analysis was carried out using nonparametric tests.

For each level of blind opening (% free area) and for each combination of actor and observation duration, the Friedman test was used to compare responses to each clothing level. The results shown in Table 5.3 indicate that for free areas of 6% and more, there were statistically significant effects ($p<0.001$) for both observation durations and both actors. The differences were not observed to approach non-significance until the free area was lowered to 3%, while the difference remained significant for the actor with skin type II for the longer observation duration.

Table 5-3: Significance of differences between reported clothing levels as tested using the Friedman test for different percentages of free area of horizontal blinds, for the two actors and the two observation durations.

Actor/skin tone	Duration (s)	Blind opening (percentage free area)					
		60%	34%	19%	11%	6%	3%
II	0.3	$p<0.001$	$p<0.001$	$p<0.001$	$p<0.001$	$p<0.001$	$p=0.054$
	3.0	$p<0.001$	$p<0.001$	$p<0.001$	$p<0.001$	$p<0.001$	$p<0.001$
VI	0.3	$p<0.001$	$p<0.001$	$p<0.001$	$p<0.001$	$p<0.001$	$p=0.066$
	3.0	$p<0.001$	$p<0.001$	$p<0.001$	$p<0.001$	$p<0.001$	$p=0.022$

Note: Significance based on Friedman test means a correct visual identification of the clothing level worn by the actors behind the window treatment and consequently insufficient privacy.

The slope coefficient was tested using a T-test based on the line of best fit and basic linear regression to see if the slopes varied from zero (Table 5.4). In all cases, the slopes deviated considerably from horizontal (p<0.001) for free regions of 6% or higher. With the 3.0 s observation, the slope was substantially different from zero for both actors but did not change significantly for the 0.3 s observation.

Table 5-4: Significant differences of the slope of the regression line from zero for different percentages of free area of the horizontal blind, for the two actors and the two observation durations.

Actor /skin tone	**Duration (s)**	**Blind opening (free area %)**					
		60%	34%	19%	11%	6%	3%
II	0.3	p< 0.001	p< 0.001	p< 0.001	p< 0.001	p< 0.001	p=0.098
	3.0	p< 0.001	p< 0.001	p<0 .001	p< 0.001	p< 0.001	p< 0.001
VI	0.3	p< 0.001	p< 0.001	p< 0.001	p< 0.001	p< 0.001	p=0.72
	3.0	p< 0.001	p< 0.001	p< 0.001	p< 0.001	p< 0.001	p=0.008

For additional analysis, the Wilcoxon test was applied. For each free area, pairs for each clothing level were compared for each actor's skin tone type II, at observation duration 0.3 s. The pairwise clothing levels comparisons in Table 5.5 show that clothing level 1 differs significantly from all other clothing levels for skin tone II and VI actors. For all the other clothing levels, the results indicate significant differences between them in terms of visual discrimination, except for clothing levels 2,3,4 and 6 at the lowest free areas, 6%,11%, and 19%, for both actors. The significance of differences in discrimination across clothing levels also rises with increasing the free area to 34% and 60%.

Table 5.6 shows the pairwise comparisons across clothing levels for the skin tone type VI actor. The pairwise comparisons show similar result to actor II, clothing level 1 differs significantly from all other clothing levels for skin tone VI. The result suggests less significant differences between some clothing levels, such as 6 and 7, at high free areas of 34% and 60%, where the visual discrimination between these levels of clothing is still at chance level.

Table 5-5: Pairwise clothing level comparisons for each blind opening, actor skin tone (type II) and observation duration 0.3 sec using Wilcoxon- Asymp. Sig. (2-tailed) Significant at P< 0.05.

Distortion degree	Clothing level	1	2	3	4	5	6
6%	**2**	*p*=0.006					
	3	*p*=0.009	*p*=0.474				
	4	*p*=0.002	*p*=0.525	*p*=0.320			
	5	*p*<0.001	*p*=.029	*p*=0.016	*p*=0.386		
	6	*p*<0.001	*p*<0.001	*p*<0.001	*p*=0.002	*p*=0.011	
	7	*p*<0.001	*p*<0.001	*p*<0.001	*p*<0.001	*p*=0.002	*p*=0.491
11%	**2**	*p*=0.002					
	3	*p*=0.001	*p*=0.990				
	4	*p*<0.001	*p*=0.750	*p*=0.003			
	5	*p*<0.001	*p*<0.001	*p*<0.001	*p*=0.136		
	6	*p*<0.001	*p*<0.001	*p*<0.001	*p*<0.001	*p*=0.002	
	7	*p*<0.001	*p*<0.001	*p*<0.001	*p*=0.005	*p*=0.023	*p*=0.292
19%	**2**	*p*=0.008					
	3	*p*<0.001	*p*=0.230				
	4	*p*<0.001	*p*<0.001	*p*=0.038			
	5	*p*<0.001	*p*<0.001	*p*<0.001	*p*=0.007		
	6	*p*<0.001	*p*<0.001	*p*<0.001	*p*<0.001	*p*=0.008	
	7	*p*<0.001	*p*<0.001	*p*<0.001	*p*<0.001	*p*<0.001	*p*=0.120
34%	**2**	*p*<0.001					
	3	*p*<0.001	*p*=0.005				
	4	*p*<0.001	*p*<0.001	*p*<0.001			
	5	*p*<0.001	*p*<0.001	*p*<0.001	*p*<0.001		
	6	*p*<0.001	*p*<0.001	*p*<0.001	*p*<0.001	*p*<0.001	
	7	*p*<0.001	*p*<0.001	*p*<0.001	*p*<0.001	*p*<0.001	*p*<0.001
60%	**2**	*p*<0.001					
	3	*p*<0.001	*p*=0.005				
	4	*p*<0.001	*p*=0.004	*p*=0.002			
	5	*p*<0.001	*p*<0.001	*p*<0.001	*p*<0.001		
	6	*p*<0.001	*p*<0.001	*p*<0.001	*p*<0.001	*p*<0.001	
	7	*p*<0.001	*p*<0.001	*p*<0.001	*p*<0.001	*p*<0.001	*p*<0.001

Table 5-6: Pairwise clothing level comparisons for each blind opening, actor skin tone type (VI) and observation duration 0.3 sec using Wilcoxon- Asymp. Sig. (2-tailed) Significant at P< 0.05.

Distortion degree	Clothing level	1	2	3	4	5	6
6%	**2**	*p*=0.034					
	3	*p*=0.023	*p*=0.908				
	4	*p*=0.034	*p*=0.500	*p*=0.276			
	5	*p*<0.001	*p*=0.179	*p*=0.172	*p*=0.007		
	6	*p*<0.001	*p*=0.013	*p*=0.005	*p*<0.001	*p*=0.093	
	7	*p*<0.001	*p*<0.001	*p*<0.001	*p*<0.001	*p*=0.003	*p*=0.169
11%	**2**	*p*=0.002					
	3	*p*=0.001	*p*=0.990				
	4	*p*<0.001	*p*=0.011	*p*=0.003			
	5	*p*<0.001	*p*<0.001	*p*<0.001	*p*=0.136		
	6	*p*<0.001	*p*<0.001	*p*<0.001	*p*<0.001	*p*=0.002	
	7	*p*<0.001	*p*<0.001	*p*<0.001	*p*=0.005	*p*=0.023	*p*=0.297
19%	**2**	*p*=0.045					
	3	*p*=0.041	*p*=0.230				
	4	*p*=0.007	*p*=0.766	*p*=0.050			
	5	*p*<0.001	*p*=0.004	*p*<0.001	*p*=0.002		
	6	*p*<0.001	*p*<0.001	*p*<0.001	*p*<0.001	*p*=0.241	
	7	*p*<0.001	*p*<0.001	*p*<0.001	*p*<0.001	*p*=0.006	*p*=0.023
34%	**2**	*p*<0.001					
	3	*p*<0.001	*p*=0.152				
	4	*p*<0.001	*p*=0.401	*p*=0.009			
	5	*p*<0.001	*p*=0.003	*p*<0.001	*p*=0.001		
	6	*p*<0.001	*p*<0.001	*p*<0.001	*p*<0.001	*p*<0.001	
	7	*p*<0.001	*p*<0.001	*p*<0.001	*p*<0.001	*p*<0.001	*p*=0.763
60%	**2**	*p*<0.001					
	3	*p*<0.001	*p*=0.483				
	4	*p*<0.001	*p*=0.013	*p*<0.001			
	5	*p*<0.001	*p*<0.001	*p*<0.001	*p*<0.001		
	6	*p*<0.001	*p*<0.001	*p*<0.001	*p*<0.001	*p*<0.001	
	7	*p*<0.001	*p*<0.001	*p*<0.001	*p*<0.001	*p*<0.001	*p*=0.340

5.2.2. Effect of observation duration

For horizontal blind Wilcoxon test results in Table 5.7 suggest that the effect of observation duration on the identification of clothing levels tends to be at chance level for both actors at a free area of 3%. The test further suggests that observation duration has a significant effect on categorical identification for the actor skin tone II, in particular, at lowest clothing level 1 and 2 also at the highest degree of skin coverage level 7, at four of the six blind opening levels: 6%,11%,19%,34%. However, the results on the effect of observation duration for the skin tone II are not consistent across clothing levels 3,4,5,6 at blind opening levels of 6%,11%,19%,34% and 60%.

Regarding the influence of observation duration, Table 5.7 shows different results for skin tone VI. Longer observation time leads to significant effect on categorical identification of clothing levels for most of the blind opening levels for VI actor, except for some of the high clothing levels, such as 4,5 and 6, the observation has no significant effect, in particular in the free areas from 6% to 60%.

5.2.3. Effect of skin tone

For horizontal blind, the Wilcoxon test was used to examine differences between actors (II and VI) based on participants' responses for each clothing level and for each percentage of free area and observation duration. When the actors' data at 0.3 s and 3.0 s observation are considered separately using Wilcoxon test, as shown in Table 5.8, results for the lowest free area do not suggest that skin tone has a significant effect on categorical identification for any of the seven clothing levels during 0.3 s and 3.0 s observations, which may be because the identification of clothing levels for this area is at chance level. Clothing levels 1 and 2 (lowest levels of skin coverage) at free areas 6%,11%,19%, and 34%, have the most significant effect on actors' visual identification compared with clothing levels 3,4,5,6 and 7.

Table 5-7: Significant differences in the effect of observation duration (0.3 sec and 3.0 sec) on visual discrimination between clothing levels through different horizontal blind free areas for actor skin tone types II and VI. Wilcoxon- Asymp. Sig. (2-tailed).

Actor/ skin tone	Blind free area (%)	Clothing level						
		1	2	3	4	5	6	7
II	3%	Not significant						
	6%	*p*<0.001	*p*<0.001	*p*=0.221	*p*=0.700	*p*=0.103	*p*<0.001	*p*=0.001
	11%	*p*<0.001	*p*=0.004	*p*=0.545	*p*=0.169	*p*=0.566	*p*=0.064	*p*<0.001
	19%	*p*=0.001	*p*=0.043	*p*=0.191	*p*=0.294	*p*=0.022	*p*=0.002	*p*<0.001
	34%	*p*=0.180	*p*=0.003	*p*=0.001	*p*=0.004	*p*=0.016	*p*=0.305	*p*=0.001
	60%	*p*=0.317	*p*<0.001	*p*=0.071	*p*=0.011	*p*=0.107	*p*=0.134	*p*=0.034
VI	3%	Not significant						
	6%	*p*<0.001	*p*=0.011	*p*=0.019	*p*=0.660	*p*=0.058	*p*<0.001	*p*=0.001
	11%	*p*<0.001	*p*=0.005	*p*=0.006	*p*=0.002	*p*=0.077	*p*<0.001	*p*<0.001
	19%	*p*<0.001	*p*<0.001	*p*=0.016	*p*=0.630	*p*=0.346	*p*<0.001	*p*=0.002
	34%	*p*=0.003	*p*<0.001	*p*=0.866	*p*<0.001	*p*=0.001	*p*=0.109	*p*=0.002
	60%	*p*=0.045	*p*<0.001	*p*=0.025	*p*=0.003	*p*=0.046	*p*=0.653	*p*=0.001

For clothing level 1 at blind opening free areas of 6%,11%,19%,34% the significant differences between actors were (*p*=0.024, *p*<0.001, *p*=0.012 and *p*=0.032) respectively. For clothing level 2, at the same free areas, the differences between actors were (*p*=0.046, *p*=0.003, *p*=0.033 and *p*=0.016) respectively. At the higher degrees of clothing coverage, mainly 3, 4,5,6,7, and free areas 6%,11%,19%,34%, actor’s skin tone did not have a significant influence. Neither did the Wilcoxon test suggest that changing the actors has a significant effect on categorical identification of any clothing levels for the highest blind opening, 60%, except for clothing level 7.

As shown in Table 5.8, at observation duration 3.0 s, the Wilcoxon test did not suggest that actor’s skin tone has a significant effect on visual identification for clothing levels

1,2,3,4,5,6 in most of the blind free areas. The one exception is that when the two actors were compared at clothing level 7 and blind openings 6%,19%,34% and 60%, significant differences were observed between the actors (p=0.023, p<0.001, p<0.001 and p=0.003) respectively.

Table 5-8: Significant differences for the effect of actor's skin tone type (II and VI) on visual discrimination of clothing levels through different horizontal blind free areas at 0.3 sec and 3.0 sec observation duration using Wilcoxon- Asymp. Sig. (2-tailed).

Duration (s)	**Blind (Free area %)**	Clothing level						
		1	2	3	4	5	6	7
0.3	3%	Not significant						
	6%	p=0.024	p=0.046	p=0.195	p=0.078	p=0.989	p=0.581	p=0.793
	11%	p<0.001	p=0.003	p=0.010	p=0.814	p=0.297	p=0.029	p=0.124
	19%	p=0.012	p=0.033	p=0.978	p=0.972	p=0.562	p=0.290	p=0.826
	34%	p=0.032	p=0.016	p=0.571	p=0.864	p=0.596	p=0.437	p=0.010
	60%	p=0.564	p=0.056	p=0.314	p=0.146	p=0.606	p=0.527	p<0.001
3.0	3%	Not significant						
	6%	p=0.509	p=0.629	p=0.434	p=0.573	p=0.851	p=0.095	p=0.023
	11%	p=0.031	p=0.007	p=0.928	p=0.006	p=0.398	p=0.166	p=0.107
	19%	p=0.257	p=0.783	p=0.275	p=0.604	p=0.557	p=0.584	p<0.001
	34%	p=1.00	p=0.166	p<0.001	p=0.058	p=0.366	p=0.109	p<0.001
	60%	p=1.00	p=0.480	p=0.317	p=0.102	p=0.705	p=0.059	p=0.003

5.3. Frosted Glass

The frosted glass was presented with five levels of distortion. The seven levels of clothing were evaluated with each level of distortion, and across the two actors this involved the evaluation of 70 images. These were presented in random order. There were two blocks of trials, with observation durations of 0.3 s and 3.0 s.

For each single observation, the responses were recorded as the numbers of the clothing level from 1 to 7, for each combination of actor skin tone type (II and VI), and observation duration (0.3 s, 3.0 s), averaged across the 30 participants. (see the raw results Tables from C7 to C14 in appendix C).

The results are shown in Tables 5.9 and 5.10, and Figure 5.2. Note: the degree of frosting in frosted glass will be described as the distortion level. Table 5.9 summarises the median responses for the seven clothing levels tested through different levels of distortion for frosted glass for the two actors at 0.3 observation duration. Higher visual privacy was achieved at distortion level 20 for the actor with skin type II, where median response for all clothing levels for the actor with skin type II tends to be the middle level of the rating scale (4). This is shown in Figure 5.2 the line of median responses for clothing levels is nearly to be identical to the horizontal line. In addition, with the same actor, the median rating for all clothing levels is more accurate at lowest distortion level of 4.

Meanwhile, the threshold of the desired level of privacy for the actor with skin type VI emerged at distortion level 16, particularly at the highest median of clothing levels but the median levels did not achieve middle level of the rating scale (4). However, the median responses for the actor with skin type VI tend to be less accurate at the lowest distortion level compared with the actor with skin type II.

The median responses for clothing level 1 were also high for the actor skin tone (type VI) at distortion levels 12,16 and 20, and at all distortion levels for clothing level 2. For visual privacy, this means that there was a tendency to see actor type VI as wearing a higher clothing level, although this would not be considered to offer sufficient privacy. An unexpected finding regarding the type VI actor was incorrect identifications for some clothing levels such as 2 and 7 at the lowest degree of distortion, level 4.

Table 5-9: Median frequency of clothing level responses through different distortion levels for actors' skin tone types II and VI, observation duration 0.3 sec. Note: for these data, chance frequency is 4. Shaded numbers mean incorrect identification of clothing levels by participants.

Actor/ skin tone	Distortion level	Median frequency of clothing level responses						
		1	2	3	4	5	6	7
II	D=4	1.00	2.00	3.00	4.00	5.00	6.00	7.00
	D=8	1.00	3.00	3.00	3.00	5.00	6.00	7.00
	D=12	1.00	2.00	2.00	4.00	5.00	5.50	6.00
	D=16	1.00	2.50	3.00	3.00	4.00	5.00	4.00
	D=20	4.00	4.00	4.00	4.00	4.50	5.00	4.00
VI	D=4	1.00	3.00	3.00	4.00	5.00	6.00	6.00
	D=8	1.00	3.00	3.00	4.00	5.00	6.00	6.00
	D=12	2.00	4.00	4.00	4.00	5.00	5.00	5.00
	D=16	2.50	4.00	3.00	3.50	4.50	5.00	4.50
	D=20	4.00	4.00	4.00	4.00	5.00	4.50	4.00

Table 5.10 shows similar results for the effect of 3.0 s observation duration on visual privacy, which was achieved at the highest degree of distortion, level 20. A higher clothing identification were found at lowest distortion level 4 and 8 Figure 5.2 also shows no apparent difference can be observed between the median responses line of the lowest distortion degrees, 4 and 8, and the line of actual clothing levels (a line of slope of 1.0). In contrast for the actor with skin type VI, the median of clothing level at lowest distortion levels 4 and 8 tend to be less accurate than the actor with skin type II.

At distortion degree 12, differences can be observed between actors and between observation duration lines in terms of correct identification of clothing levels. At this distortion degree and 0.3 s duration there is an apparent divergence of the line of the actor VI from the line of slope of 1.0.

Table 5-10: Median frequency of clothing level responses through different distortion levels for actors' skin types II and VI, observation duration 3.0 sec. Note: for these data, chance frequency is 4. Shaded numbers mean incorrect identification of clothing levels by participants.

Actor/ skin tone	Distortion level	Median frequency of clothing level responses						
		1	2	3	4	5	6	7
II	D=4	1.00	2.00	3.00	4.00	5.00	6.00	7.00
	D=8	1.00	2.00	3.00	4.00	5.00	6.00	7.00
	D=12	1.00	2.00	3.00	4.00	5.00	5.00	6.00
	D=16	1.00	3.00	3.00	4.00	5.00	5.00	5.00
	D=20	3.00	4.00	4.00	4.00	5.00	4.00	4.00
VI	D=4	1.00	2.00	3.00	5.00	5.00	6.00	6.50
	D=8	1.00	3.00	3.00	4.00	5.00	6.00	6.00
	D=12	1.00	3.50	3.00	3.00	5.00	5.00	6.00
	D=16	2.50	3.50	3.00	4.00	5.00	5.00	5.00
	D=20	4.00	5.00	4.00	5.00	5.00	4.00	5.00

5.3.1. Effect of clothing level

The Friedman test was used to examine responses to each clothing level for each distortion level in frosted glass and each combination of actor and observation duration. The results shown in Table 5.11 suggest statistically significant differences (p <0.001) for the four lower degrees of distortion (D=4,8,12 and 16) for each combination of actor and observation duration. For the highest level of distortion (D=20), differences in clothing identification were significant with 3.0 s observations but were not suggested to be significant at 0.3 s observations.

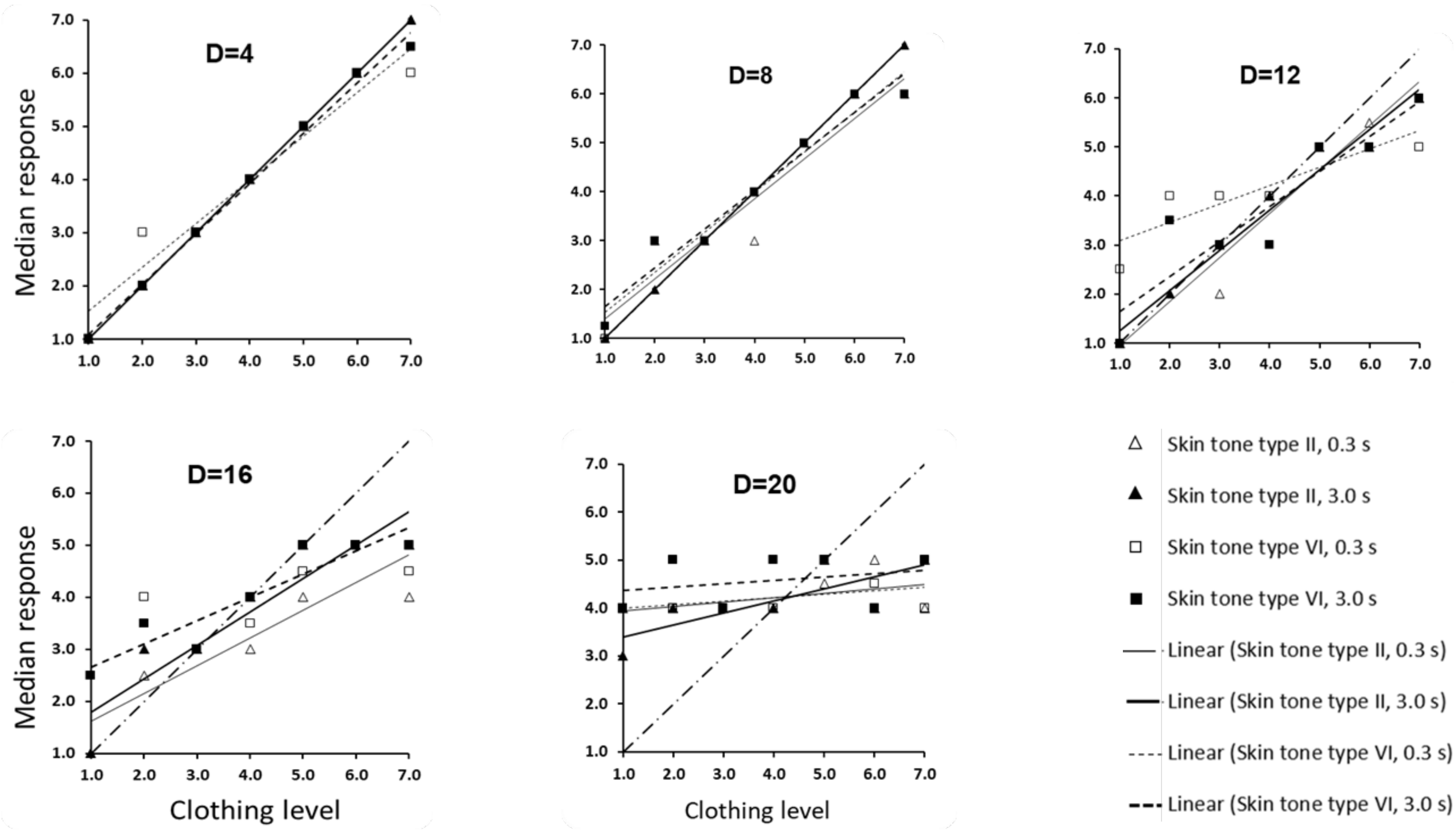


Figure 5-2: Median clothing level responses plotted against actual clothing levels for five distortion levels of frosted glass, ranging from (4 to 20) in steps of four distortion units (shown in each graph). These results are for the two actors: a white skin tone (type II) and a dark brown to black skin tone (type VI) and the 0.3 s, 3.0 s observation durations. The centre dashed line represents the ideal response for correct identification

Table 5-11: Significance of differences between reported clothing levels as tested using the Friedman test for different levels of distortion for the frosted glass, for the two actors and the two observation durations

Actor	Duration	Frosted glass distortion level				
	(s)	D=4	D=8	D=12	D=16	D=20
II	0.3	p< 0.001	p< 0.001	p< 0.001	p< 0.001	p= 0.26
	3.0	p< 0.001	p< 0.001	p<0 .001	p< 0.001	p< 0.001
VI	0.3	p< 0.001	p< 0.001	p< 0.001	p< 0.001	p< 0.293
	3.0	p< 0.001	p< 0.001	p< 0.001	p< 0.001	p< 0.006

A chance level of clothing identification would result in a regression line of slope zero (a horizontal line) in the graphs included in Figure 5.12. To verify conclusions drawn using the Friedman test, t-test for the slope coefficient based on the line of best fit using simple linear regression was used to determine whether the slopes departed from zero. For the highest level of distortion (D=20), differences in clothing identification were significant with 3.0 s observations but were not suggested to be significant at 0.3 s observations. The slopes of the regression lines were tested for significant departure from zero (Table 5.12). For distortion levels 4 to 16, the slopes departed significantly from zero (p<0.001), suggesting insufficient privacy. For the highest level of distortion (D=20) the slopes were observed not to depart from unity for either actor or either duration.

Table 5-12: Significance of differences of the slope of the regression line from zero, for different levels of distortion for the frosted glass, for the two actors and the two observation durations.

Actor	Duration	Frosted glass distortion level				
	(s)	D=4	D=8	D=12	D=16	D=20
II	0.3	p< 0.001	p< 0.001	p< 0.001	p< 0.001	p= 0.26
	3.0	p< 0.001	p< 0.001	p<0 .001	p< 0.001	p< 0.187
VI	0.3	p< 0.001	p< 0.001	p< 0.001	p=0.010	p< 0.36
	3.0	p< 0.001	p< 0.001	p< 0.001	p< 0.001	p< 0.51

For additional analysis, the Wilcoxon test was applied shown in Table 5.13 and 5.14 for each distortion level and for pairwise comparisons across the clothing levels for each actor's skin tone type (II and VI), and for each observation duration (0.3 s and 3.0 s).

The pairwise clothing levels comparisons for actor type II and observation duration 0.3 show significant differences between most of the clothing levels at distortion levels 4,8,12 and 16 for actor II. Some pair-wise comparisons suggest that clothing levels 2 and 3 were not recognised significantly in the case of either actors at most degrees of distortion.

The Wilcoxon results shown in Table 5.13 demonstrate that performance on discrimination between most of the clothing levels was poor at distortion level 16 for the type VI actor compared with the type II actor, where the visual discrimination was significant between most of the clothing levels. However, the Friedman test suggests that at distortion degree 16, clothing levels were not identified significantly. Thus, this distortion is considered not sufficient for visual privacy.

5.3.2. Effect of observation duration

For the frosted glass the effect of observation duration is shown in Table 5.15. The degree of distortion in the frosted glass results indicate that identification performance for both actors was poorer when associated with observation duration. In particular, for actor with skin tone (type VI), the data seem not to support the hypothesis. The significant effect of observation duration at 8 distortion degrees of frosted glass was high in clothing levels 2,4,5 and 7 for actor type II type, while the data indicate that observation duration had a lower effect on the type VI actor at lowest distortion level when the actor was wearing level 2 or level 7 clothing.

Table 5-13: Calculated p_ values from pairwise comparisons of responses on clothing level at each distortion degree, actor skin tone type (II) and observation duration 0.3 sec using Wilcoxon-Asymp. Sig. (2-tailed) Significant at *p*< 0.05.

Distortion degree	Clothing level	1	2	3	4	5	6
D=4	**2**	*p*<0.001					
	3	*p*<0.001	*p*<0.001				
	4	*p*<0.001	*p*<0.001	*p*<0.001			
	5	*p*<0.001	*p*<0.001	*p*<0.001	*p*<0.001		
	6	*p*<0.001	*p*<0.001	*p*<0.001	*p*<0.001	*p*<0.001	
	7	*p*<0.001	*p*<0.001	*p*<0.001	*p*<0.001	*p*<0.001	*p*<0.001
D=8	**2**	*p*<0.001					
	3	*p*<0.001	*p*=0.374				
	4	*p*<0.001	*p*=.019	*p*=.007			
	5	*p*<0.001	*p*<0.001	*p*<0.001	*p*<0.001		
	6	*p*<0.001	*p*<0.001	*p*<0.001	*p*<0.001	*p*<0.001	
	7	*p*<0.001	*p*<0.001	*p*<0.001	*p*<0.001	*p*<0.001	*p*=0.617
D=12	**2**	*p*=0.009					
	3	*p*=0.001	*p*=0.315				
	4	*p*<0.001	*p*<0.001	*p*<0.001			
	5	*p*<0.001	*p*<0.001	*p*<0.001	*p*=0.187		
	6	*p*<0.001	*p*<0.001	*p*<0.001	*p*<0.001	.004	
	7	*p*<0.001	*p*<0.001	*p*<0.001	*p*<0.001	.001	*p*=0.563
D=16	**2**	*p*=0.024					
	3	*p*=0.016	*p*=0.815				
	4	*p*=0.001	*p*=0.031	*p*=0.084			
	5	*p*<0.001	*p*=0.006	*p*=0.006	*p*=0.168		
	6	*p*<0.001	*p*<0.001	*p*<0.001	*p*<0.001	*p*=0.029	
	7	*p*<0.001	*p*<0.001	*p*<0.001	*p*=0.002	*p*=0.122	*p*=0.730
D=20	**2**	*p*=0.170					
	3	*p*=0.828	*p*=0.829				
	4	*p*=0.791	*p*=0.007	*p*=0.840			
	5	*p*=0.652	*p*=0.021	*p*=0.755	*p*=0.988		
	6	*p*=0.660	*p*=0.009	*p*=0.477	*p*=0.838	*p*=0.572	
	7	*p*=0.477	*p*=0.085	*p*=0.539	*p*=0.623	*p*=0.672	*p*=0.848

Table 5-14: Pairwise clothing level comparisons for each distortion degree, actor skin tone type (VI) and observation duration 0.3 sec using Wilcoxon- Asymp. Sig. (2-tailed) Significant at *P*< 0.05.

Distortion degree	Clothing level	1	2	3	4	5	6
D=4	**2**	*p*<0.001					
	3	*p*<0.001	*p*=0.829				
	4	*p*<0.001	*p*<0.001	*p*<0.001			
	5	*p*<0.001	*p*<0.001	*p*<0.001	*p*<0.001		
	6	*p*<0.001	*p*<0.001	*p*<0.001	*p*<0.001	*p*<0.001	
	7	*p*<0.001	*p*<0.001	*p*<0.001	*p*<0.001	*p*<0.001	*p*=0.499
D=8	**2**	*p*<0.001					
	3	*p*<0.001	*p*=0.701				
	4	*p*<0.001	*p*=0.065	*P*=0.014			
	5	*p*<0.001	*P*=0.003	*P*=0.001	*P*=0.019		
	6	*p*<0.001	*p*<0.001	*p*<0.001	*p*<0.001	*p*<0.001	
	7	*p*<0.001	*p*<0.001	*p*<0.001	*p*<0.001	*p*<0.001	*P*=0.016
D=12	**2**	*p*=0.079					
	3	*p*=0.255	*p*=0.340				
	4	*p*=0.049	*p*=0.786	*p*=0.413			
	5	*p*=0.001	*p*=0.080	*p*=0.008	*p*=0.006		
	6	*p*=0.001	*p*=0.015	*p*=0.004	*p*=0.002	*p*=0.265	
	7	*p*<0.001	*p*=0.012	*p*=0.001	*p*=0.001	*p*=0.255	*p*=0.877
D=16	**2**	*p*=0.091					
	3	*p*=0.371	*p*=0.092				
	4	*p*=0.175	*p*=0.371	*p*=0.433			
	5	*p*=0.002	*p*=0.175	*p*=0.013	*p*=0.035		
	6	*p*<0.001	*p*=0.095	*p*=0.002	*p*=0.006	*p*=0.612	
	7	*p*=0.005	*p*=0.282	*p*=0.013	*p*=0.470	*p*=0.393	*p*=0.120
D=20	**2**	*p*=0.374					
	3	*p*=0.113	*p*=0.054				
	4	*p*=0.257	*p*=0.684	*p*=0.106			
	5	*p*=0.110	*p*=0.055	*p*=0.007	*p*=0.094		
	6	*p*=0.051	*p*=0.491	*p*=0.008	*p*=0.806	*p*=0.231	
	7	*p*=0.838	*p*=0.467	*p*=0.255	*p*=0.227	*p*=0.007	*p*=0.120

Table 5-15: Significant differences in the effect of observation duration (0.3 sec and 3.0 sec) on visual discrimination between clothing levels through the frosted glass (distortion levels) for actor skin tone types II and Vl. Wilcoxon- Asymp. Sig. (2-tailed)

Actor/skin tone	Distortion degree	Clothing level						
		1	2	3	4	5	6	7
II	D=4	*p*=0.102	*p*=0.020	*p*=0.439	*p*=0.218	*p*=0.150	*p*=1.000	*p*=0.405
	D=8	*p*=0.257	*p*=0.006	*p*=0.381	*p*=0.011	*p*=0.039	*p*=0.499	*p*=0.022
	D=12	*p*=0.016	*p*=0.571	*p*=0.406	*p*=0.564	*p*=0.155	*p*=0.823	*p*=0.343
	D=16	*p*=0.699	*p*=0.728	*p*=0.758	*p*=0.106	*p*=0.046	*p*=0.334	*p*=0.246
	D=20	*p*=0.047	*p*=0.961	*p*=0.142	*p*=0.581	*p*=0.622	*p*=0.912	*p*=0.817
VI	D=4	*p*=0.157	*p*=0.001	*p*=0.674	*p*=0.109	*p*=0.803	*p*=0.609	*p*=0.025
	D=8	*p*=0.015	*p*=0.146	*p*=0.619	*p*=0.357	*p*=0.063	*p*=0.427	*p*=0.593
	D=12	*p*=0.040	*p*=0.122	*p*=0.216	*p*=0.351	*p*=0.982	*p*=0.755	*p*=0.317
	D=16	*p*=0.909	*p*=0.735	*p*=0.288	*p*=0.162	*p*=0.572	*p*=0.356	*p*=0.061
	D=20	*p*=0.970	*p*=0.597	*p*=0.380	*p*=0.384	*p*=0.461	*p*=0.963	*p*=0.488

5.3.3. Effect of skin tone

For the frosted glass Table 5.16 shows that the effect of skin tone was considerably more significant when the type II actor was wearing the lowest levels of clothing, 1,2 and 3, at distortion degrees of 8,12 during observation time 0.3s and at distortion degrees 12 ,16, during longer observation. This result appears to reflect the effect of the degree of skin exposure shown by the Wilcoxon test, where the results of pairs comparisons between the highest clothing levels were significant except for the pairs comparisons involving 1 ,2 and 3.

One other significant difference emerged in the case of clothing level 7 and this was also shown by the Wilcoxon test where the categorisation of clothing 7 for the type VI actor was significantly different from that of the other clothing levels.

Table 5-16: Significant differences in the effect of actors' skin tone type (II and VI) on visual discrimination between clothing levels through different levels of frosted glass (distortion level) for 0.3 sec and 3.0 sec observation durations, Wilcoxon- Asymp. Sig. (2-tailed).

Duration (s)	**Distortion level**	Clothing level						
		1	2	3	4	5	6	7
0.3	4	p=0.414	p=0.068	p=0.670	p=0.869	p=0.082	p=0.564	p<0.001
	8	p=0.033	p=0.365	p=0.092	p=0.135	p=0.469	p=0.249	p=0.311
	12	p=0.001	p<0.001	p=0.006	p=0.877	p=0.261	p=0.391	p=0.116
	16	p=0.013	p=0.012	p=0.205	p=0.704	p=0.092	p=0.793	p=0.587
	20	p=0.701	p=0.041	p=0.031	p=0.563	p=0.047	p=0.537	p=0.205
3.0	4	p=1.00	p=0.705	p=0.739	p=0.527	p=0.589	p=0.102	p=0.012
	8	p=0.129	p=0.053	p=0.819	p=0.033	p=0.597	p=0.096	p=0.063
	12	p=0.003	p=0.005	p=0.413	p=0.165	p=0.819	p=0.229	p=0.053
	16	p=0.004	p=0.030	p=0.002	p=0.512	p=0.715	p=0.945	p=0.938
	20	p=0.163	p=0.014	p=0.583	p=0.633	p=0.636	p=0.549	p=0.849

5.4. Experimental validation

For clothing scale, it has several intervals, rather than just two or three, giving respondents a finer choice, each step can be characterised by one (or two) steps in each of the five change categories. In addition, the results from the Saudi women matched those of the Libyan women, as predicted from similar cultural backgrounds. While the results from the European women did not match those of the Libyan women, as predicted from their different cultural backgrounds. i.e., The scale allowed the women to be differentiated.

A scale validity exercise was conducted to check the assumed order of privacy, with ten participants asked to place the ten clothing levels into an ascending order of privacy. These responses confirmed the experimenter's assumed order in all cases except one, where one participant placed clothing levels 8 and 9 in the reverse order.

For window treatments experiments, the actors were located at one of three horizontal positions as shown in (section 4.3.3), relative to the background (left, middle and right) as a precaution against changes in clothing being highlighted by a change in image if the actor was located always at the same location. This brings the risk that in some positions the exposed arms are easier to see than in others. To consider this, we conducted a further analysis of trials using one actor (type II) at four levels of free area (3%,11%,19% and 60%) and one observation duration (0.3 s). These data did not suggest any variation in ability to identify clothing level with horizontal position (Figure 5.3).

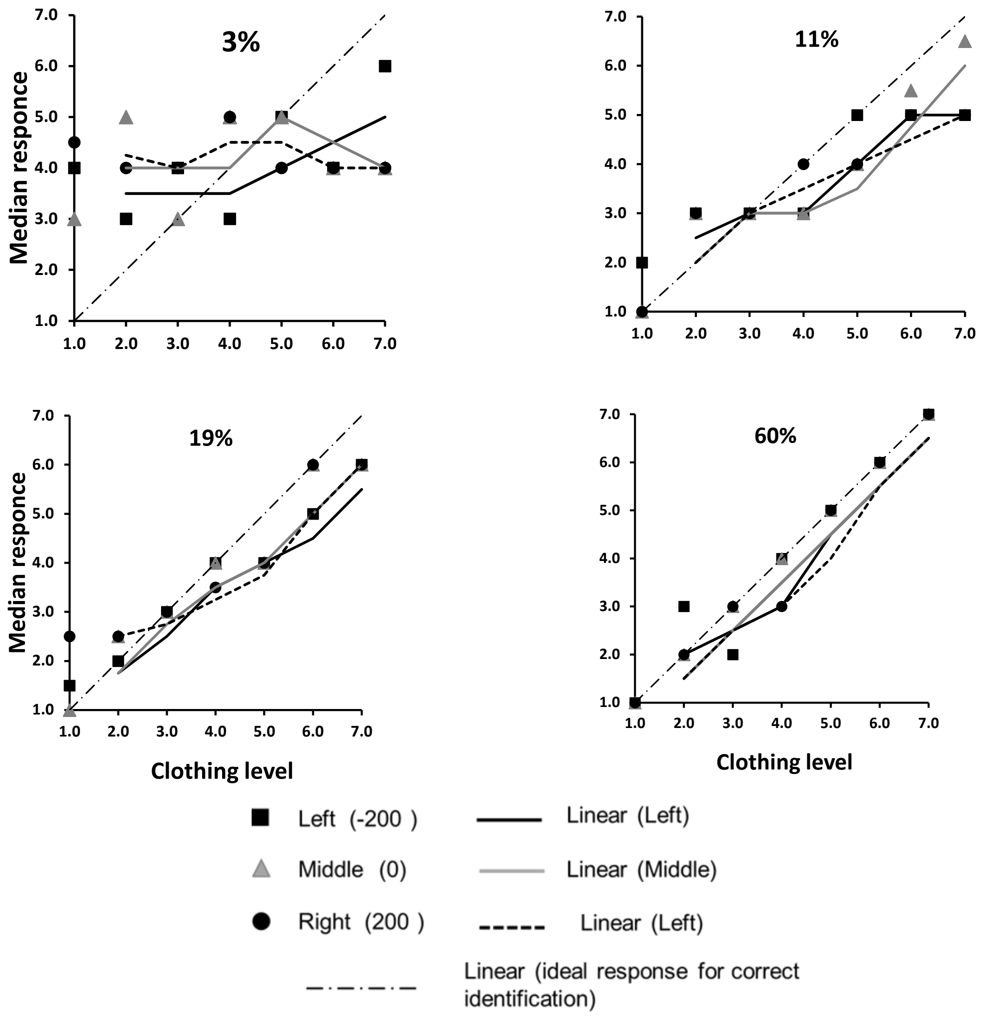


Figure 5-3: The effect of changing actor's location (left, middle and right) on rating identification of clothing level. Example of four levels of free area for the horizontal blind (3%,11%,19% and 60%) for a white skin tone (type II) actor, during 0.3 s observation duration

5.5. Summary

The data were not suggested to be drawn from a normally distributed population for the horizontal blinds and the frosted glass) as assessed using measures of dispersion, graphical plots and the Shapiro-Wilks and Kolmogorov-Smirnov tests.

For each level of blind opening (% free area), and each distortion level in frosted glass for each combination of actor and observation duration, the Friedman test was used to compare responses to each clothing level. The desired level of privacy, chance level of clothing level identification, would mean each of the seven clothing levels received the same average clothing level reported by participants, as indicated by the Friedman test failing to reveal a significant difference. The results show that statistically significant results (p<0.001) were obtained for free areas of 6% and greater, for both observation durations and for both actors. Only when free area was reduced to 3% were the differences not suggested to approach non-significance, although the difference remained highly significant for the actor of skin type II with the longer duration.

For frosted glass, the highest level of distortion (D=20), differences in clothing identification were significant with 3.0 s observations but were not suggested to be significant at 0.3 s observations. For the four lower degrees of distortion (D=4,8,12 and 16) Friedman test to compare clothing identification across the seven levels of clothing, suggests statistically significant differences (p <0.001). T -test for the slope coefficient based on the line of best fit using simple linear regression was also used to determine whether the slopes departed from zero. For 3% free area and for the highest level of distortion (D=20) the slopes were not suggested to depart from unity for both actors at observation duration 0.3s.

Chapter 6. Discussion

6.1. Introduction

The research reported in this thesis has investigated the degree of visual privacy offered by two type of window treatments, horizontal blinds and frosted glass.

An examination of the literature revealed that the overall attitude towards visual privacy in Libya and other Muslim countries is linked to female clothing level when visible to non-family members. Therefore, the first experiment in this thesis examined the association between privacy, situation and different clothing levels. The discussion starts with one of the hypotheses raised in the literature review (Chapter 2), which was that females' clothing levels are in some cultures associated with visual privacy, and also describes why the validation steps integral to the experimental design suggest the data are robust.

Sufficient privacy' was defined as being achieved by a window treatment, which reduces to chance the ability to identify the clothing worn by a person behind the window. In the second section, the accepted level of visual privacy offered by the horizontal blind and the frosted glass are compared. Next, the current study approach is compared with those from previous studies that adopted a quantitative method to evaluate visual privacy.

6.2. Privacy offered by clothing

A novel scale was developed (Chapter 3) to investigate the privacy offered by clothing. The scale presented step changes in the tightness and/or skin exposure of clothing, both of which are linked to evaluations of female modesty (Shafee, 2000).

The clothing scales was administered in a survey to investigate the degree of clothing associated with expected privacy in different social settings with test participants recruited from different cultural backgrounds of identifying the level of clothing associated with sufficient privacy in different levels of proximity to other people.

The clothing scale (section 3.2.1) varied two attributes of clothing: the degree of skin exposure and the looseness of clothing, these changes being presented visually (as photographs of an actor) rather than as text descriptions. The scale included 10 categories, ranging from the actor wearing shorts and a vest (high degree of skin exposure, tight-fitting clothing) to the actor wearing a Khimar (low degree of skin exposure, loose clothing). This scale extended the image-based scale of Albrecht et al. (2014). Each step of the scale represents a gradual change in skin exposure and/or the tightness of clothing to create a step change in privacy.

Responses were gained from 90 females, drawn equally from three home locations (Libya, Saudi Arabia and Europe) to test expectations of privacy. The focus of this work is the responses of Libyan females: participants from Saudi and Europe were recruited to test whether expected differences in privacy were revealed as a means of validating the rating scale.

For Libyan women, while clothing level 6 (a head scarf, arms and legs fully covered by a jacket and trousers) was the median expectation when inside the home, but potentially rendered them visible to a stranger, this could be relaxed to level 2 (tighter-fitting clothing, greater degree of skin exposure) if visible only to members of the family. For women from Saudi Arabia, a nation with stricter controls on female modesty, the clothing level when visible to a stranger increased to 7. For European women, the median responses were clothing level 2 when visible to strangers and clothing level 1 for visibility only to the family (Table 3.1). Thus , the results as expected for the desired level of privacy in (Table 3.4 ,comparison 5), the difference between clothing level inside the house close to the window and when the females were visible just to family members was statistically significant ($p>0.001$).

Experiment 1 therefore confirmed that different levels of clothing are associated with different degrees of privacy. Figure 6.1 shows the desired level of clothing for Libyan women in two contexts. While they choose to wear clothing level 2 in the family home, they would instead wear clothing level 6 if they expect to reside in a room of the family house where they are at risk of being observed by non-family members, such as members of the general public outside the home who look through the window.

Figure 6-1: Examples of clothing representing differently levels of acceptable provacy for Libyan women. *Left*: clothing level 2, acceptable in the family home, not visible to strangers. *Right*: Clothing level 6, worn in the home when they are at risk of being viewed by non-family members.

The clothing scale created in this research might be used broadly to investigate modesty in clothing, since the scale includes most of the variables that affect modesty in clothing in Muslim society. In addition, the scale could be extended to a lower degree or higher degree of clothing related to skin exposure.

There are other clothing levels that were not included, which was because these levels represent specific types of societies, such as the loose long gown without head scarf in the text clothing scale created by Bachleda et al. (2012) for Morocco, also the short dress without head scarf in the scale of images created by Albrecht et al. (2014 to represent a group of female Muslim students in South Africa. In addition, there are other variables that were also not considered, such as clothing transparency, as we assumed this variable is similar to degree of skin exposure and consequently to clothing modesty.

Although people may need privacy for many other reasons (Rahim, 2015), for people who desire privacy in clothing , the chosen clothing levels from 1 to 7 in the experiments that investigated visual privacy could be extended to a lower or higher degree of clothing depending on the degree of modesty in clothing needed in public space and inside the house, which would consequently raise or reduce the degree of window treatment.

Instead of needing to change their level of clothing, this thesis explored instead the ability of window treatments to provide sufficient privacy, and thus allow women the freedom to wear more relaxed clothing while at home.

Window treatments involve materials that are attached to the window frame or applied directly to the glass, with the goal of providing solar shading, insulation to reduce heat transmission, or blocking the view for privacy (Braun, 1981).Experiments 2 and 3 were conducted to explore the privacy offered by two window treatments, horizontal blinds and frosted glass, with aim being to establish the level of that treatment required for clothing, where recognition was reduced to a certain %, or where any two adjacent clothing levels would be reduced to chance.

Blinds and frosting offer two different approaches to privacy and privacy control. Blinds work by blocking the flow of light, and hence blocking vision, which reduces daylight transmission to the interior space, but are controllable – the blind angle and blind extent (whether the whole or part of a window is covered) can both be adjusted by the occupants. Frosting diffuses light rather than blocking it, so there is a less reduction in daylight transmission than with blinds, but the degree of frosting is not variable once the windows are installed.

6.3. Visual privacy offered by window treatments

Experiments 2 and 3 investigated the degree to which clothing could be identified with changes in the level of window treatment. For horizontal blinds, levels of treatment were operationalised as the percentage of window area not obscured by blinds. Blinds rotated to a horizontal angle would have minimal impact on vision to the inside (assuming an observation point perpendicular to the glass) and hence a free area approaching 100%. Blinds rotated towards a vertical position would give a smaller percentage of free area. For frosted glass, the impact of frosting was simulated using the image distortion function in Photoshop Microsoft, with a distortion of D=2 (was that the lowest level of distortion) giving an image similar to the undistorted image and D=20 being the maximum distortion available.

Two further variables were tested: skin tone and the duration of observation. Skin tone describes the colour of a person's skin, and when defined using the Fitzpatrick scale (ARPANSA, 2020) ranges from Ivory White (level II) to dark brown and black (level VI). Skin tone was included because variation offers different degrees of contrast between the skin and clothing and hence the ability to discriminate the degree of skin exposure with different levels of clothing. Two actors were used for the test images used in experiments 2 and 3, one of white skin tone (skin type II) and one of very dark brown to black skin tone (skin type VI). Both wore the same black clothing and thus presented different levels of skin-to-clothing contrast.

A person walking outside of a house may glance quickly through a window or may stare for a longer time. The impact of this was investigated by presenting test images for two durations, either 0.3 s or 3.0 s. 0.3 s was represented a typical gaze fixation or a quick glance (Jovancevic-Misic and Hayhoe, 2009), and a longer duration of 3.0 s was represented a more focused gaze.

The degree of privacy provided was measured by asking participant observers to determine the level of clothing worn by a target behind the window treatment, this being chosen from a pictorial scale with seven categories (Figure 4.2), with the goal of establishing when identification was reduced to a chance level.

The results of the window treatments experiments (3 and 4) demonstrate that the ability to recognise clothing levels is affected by the degree of free area when using horizontal blinds and the distortion level (simulated degree of frosting) when using in frosted glass.

For each level of window treatment, the Friedman test was used to compare clothing levels (scale categories) reported for each level of clothing presented. If the window treatment did not provide sufficient privacy, the test participants would have been able to correctly identify the level of clothing, and the Friedman test would reveal a significant difference between the seven clothing levels. If the window treatment provided sufficient privacy that clothing identification was reduced to chance, then the

Friedman test would not suggest a significant difference see earlier Table 5.3, the Friedman test for the horizontal blinds experiment. For the shorter duration (0.3 s), the differences in identification of clothing levels approached non-significance only when the free area was reduced to 3%, for both actors, skin tones II and VI, at (p=0.054 and p=0.066) respectively. However, with a longer observation duration at this level of free area the level of clothing identification tended to increase, and the chance level decreased.

Similar results were also suggested by the frosted glass experiment see Table 5.11. The results demonstrate that the ability to recognise clothing levels is affected by distortion levels and observation duration: lower distortion level and longer observation duration tend to increase the frequency of correct identification of clothing levels. Only the highest distortion level, 20 for the frosted glass, at 0.3 duration, led to the chance level of clothing identification, for both actors. The results indicate that the differences in identification of clothing levels did not approach non-significance for either actor, skin tone II or VI, at (p= 0.26 and p< 0.293) respectively.

The differences in identification of clothing levels at 3% in a horizontal blind, by the Friedman test, approach significance (p=0.054 and p=0.066) but do not surpass the standard threshold (p=0.05). To verify conclusions drawn using the Friedman test the gradient of the best fit line was examined. If the participant identified clothing levels correctly, the slope would depart significantly from horizontal, consequently indicating insufficient privacy. A chance level of clothing identification would result in a horizontal regression line of slope zero. This was tested using the t-test for the slope coefficient based on the line of best fit using simple linear regression (Tables 5.4 for Horizontal blinds and 5.12 for frosted glass).

For free areas of 6% or more, the slopes departed significantly from horizontal (p<0.001) in all cases. For 3% free area, the slope was significantly different to zero for both actors with the 3.0 s observation but did not depart significantly for the 0.3 s observation.

The distortion level of 20 in frosted glass provided a higher privacy performance than the free area of 3% in the horizontal blinds at an observation duration of 0.3s for the actor with skin tone (type II). Figure 6.2 also shows an identical slope line at distortion level 20 for both actors at an observation 0.3s. Meanwhile, the t-test result (Table 5.12), in the slope line of distortion level 20, suggests high performance in terms of visual privacy of (p= 0.26). In comparison, the slope line for 3% for the horizontal blinds (Table 5.4) for the actor of skin (type II; p= 0.098).

As mentioned above visual privacy provided by frosted glass, according to the Friedman test and t-test results, was slightly higher than with the horizontal blind. Table 6.1 shows the findings of the Wilcoxon test used in this research to compare results between 3% visual privacy offered by the horizontal blind and the degree of distortion D=20 in frosted glass for each combination of clothing levels, actors and observation duration. No significant differences were found except in the cases of two clothing levels. As a result, it was concluded that under similar test conditions the horizontal blind and frosted glass would tend to produce similar results in terms of visual privacy.

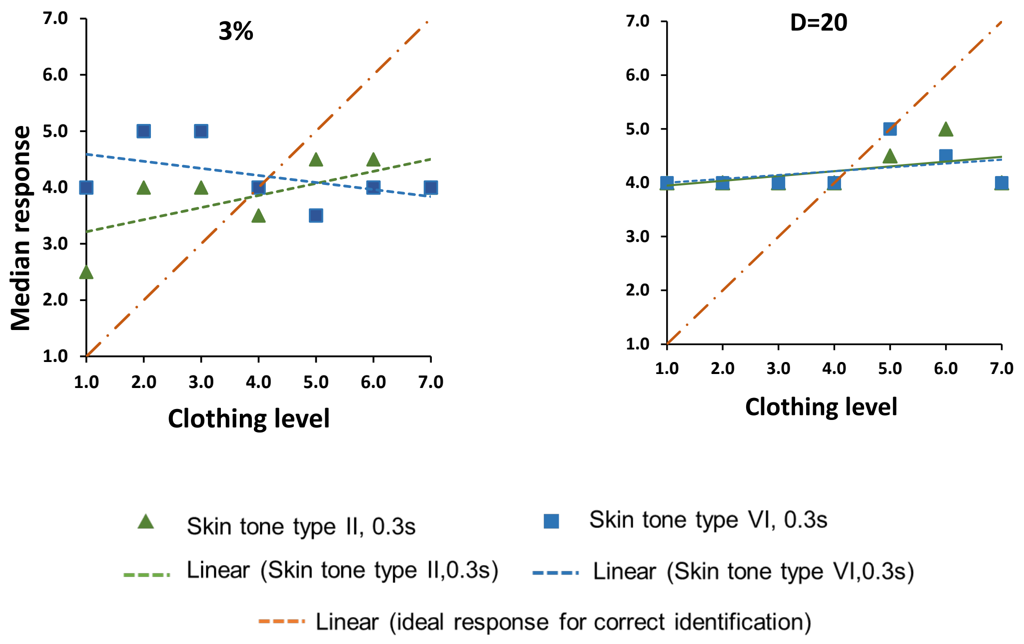


Figure 6-2: The Comparison of the results of privacy offered by two window treatments. Free area of 3% (left) for the horizontal blind and distortion level D=20 (right) for frosted glass. Each graph shows the slope line of the median response for clothing levels plotted against the actual clothing level for each actor's skin tone II and VI at an observation duration of 0.3s

Table 6-1: Results of Wilcoxon signed-rank test used to compare visual privacy offered by the degree of free area (3%) of horizontal blind and the distortion level of frosted glass (D=20).

Duration (S)	Actors/ Skin type	Clothing level 1	2	3	4	5	6	7
0.3	II	*p*<0.035	*p*<0.124	*p*<0.885	*p*<0.928	*p*<0.316	*p*<0.586	*p*<0.532
	VI	*p*<0.887	*p*<0.924	*p*<0.094	*p*<0.005	*p*<0.042	*p*<0.690	*p*<0.376
3.0	II	*p*<0.967	*P*<.108	*p*<0.899	*p*<0.590	*p*<0.334	*p*<0.146	*p*<0.545
	VI	*p*<0.212	*p*<0.196	*p*<0.745	*p*<0.047	*p*<0.802	*p*<0.647	*p*<0.654

6.3.1 Effect of clothing

The discussion of the effect of clothing level is strongly associated with the effect of the contrast between the skin tone and clothing colour. This is shown in (Tables 5.1 and 5.9) which indicates that the median responses for clothing level 1(high skin exposure) for the actor skin tone II, tended to be correctly identified, at most of the free areas of the horizontal blind and the distortion levels in frosted glass. Wilcoxon test (Tables 5.5 and 5.6) results also, indicate that clothing level 1 significantly differs from all other clothing levels at 6%, 11%, 19%, 34% and 60%. The median responses for clothing levels 1 and 2, were higher at free areas 6%,11% than the medians for clothing levels 4, 5,6 and 7, in particular where there was lower contrast between the skin tone and clothing colour. One possible explanation for this is that in the case of actor type VI, at the 6%, 11% and with greater free area of 19 %, the clothing levels 1 and 2 were not sufficiently visible. For visual privacy, this means that there was a tendency to see actor VI as wearing higher clothing levels. Similar results for frosted glass where clothing level 1 identified significantly more than other clothing levels at distortion degrees D=4, D=8, D=12 and D=16 for the actor with skin tone (type II). While for the actor with skin tone (type VI) there was insufficient visual identification of clothing level at lower distortion level D=16.

6.3.2 Effect of skin tone

The analysis by Wilcoxon test in Table 6.2 demonstrates the effects of skin tone for both window treatments were significant at the lowest clothing levels (1,2). One of the expected results is that when the two actors were compared clothing level 7 and blind openings 6%,19%,34% and 60%, significant differences were observed between the actors, this is because there is a difference originally in clothing level 7 between actors (see clothing scale Figure 3.1).

Table 6-2: Pairwise comparisons for the effect of actors' skin tone on visual identification of clothing level across the degrees of free areas of the horizontal blind and the distortion levels of frosted glass.

	Duration(s)	horizontal blinds	frosted glass
Actors Skin tone II vs VI	0.3	Yes, for clothing levels (1,2)	Yes, for clothing levels (1,2)
	3.0	Yes, for clothing level (7)	Yes, for clothing level (7)

Furthermore, for the frosted glass this the difference between actors for clothing level 7 emerged at lowest distortion level D=4.

Figure 6.3 illustrates the effect of actor skin tone for frosted glass and horizontal blind, which begins at the middle degree of window treatments, from distortion level 8 to 16 for frosted glass ,and from 6% to 34% for the free areas of the horizontal blind . However, no effect of the skin tone was observed at the highest level of free area, 60%, and the lowest free area, 3%, with the horizontal blind except of clothing level 7. The explanation could be that identification of clothing levels tends to be at chance level at the lowest free area (3%) and it tends to be 100% correct for every actor at 60%.

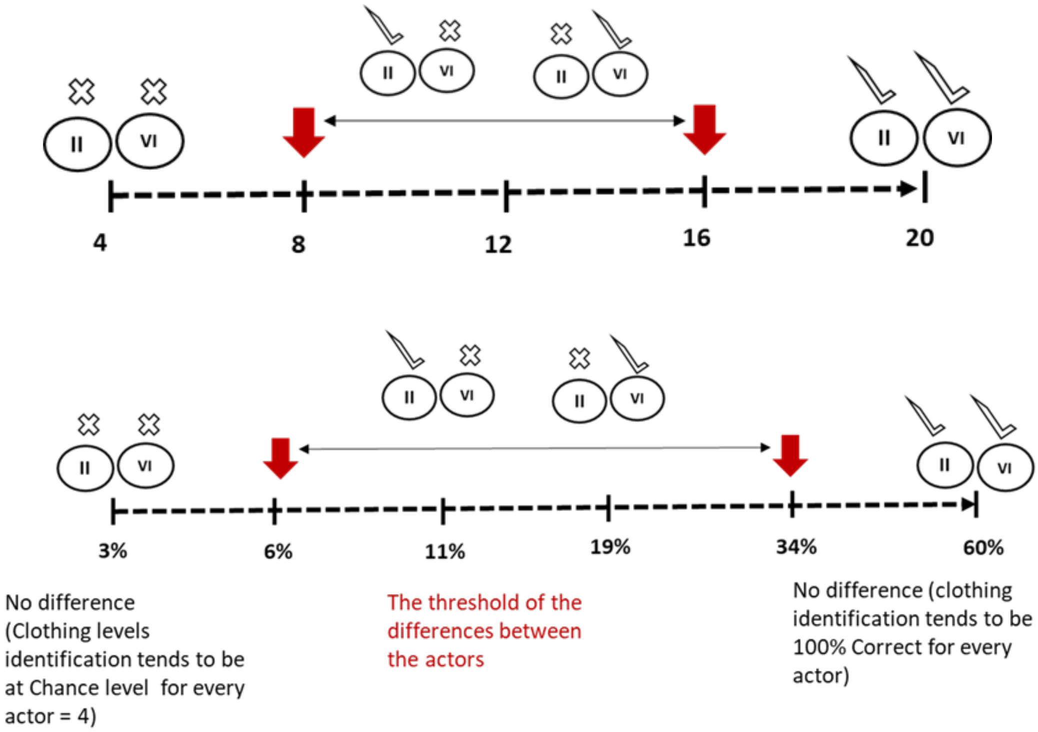


Figure 6-3: The threshold of the significant effect of the actors' skin tone (II and VI) on visual identification of clothing levels for the levels of free areas of horizontal blinds and the distortion levels in frosted glass.

6.3.3 Effect of observation duration

Variation in observation duration was included in this experiment as such variation is expected in the natural setting and might affect the degree of visibility from outside to inside the home. Previous studies have not indicated a limited observation time during the experiment. In Kotbi's (2019) study, participants were able to make as many guesses as they liked until the image was recognised, at which point the examiner recorded the position of the window, which was considered the worst scenario for visual privacy this might be considered a long duration, closer to 3.0 than 0.3 s. Same, probably a long duration, in the study by Hariyadi and Fukuda (2017), no time limit was set for observation in either the physical or digital images experiments, with the data collected being the average of illuminance at which respondents began to see objects.

The current work extends by considering a short duration, 0.3s, chosen to represent a single glance (Jovancevic-Misic and Hayhoe, 2009). The results from the current study using the Wilcoxon test shown in Table 6.3, suggested significant differences between the observation durations 0.3s and 3.0s for the horizontal blind for most of the clothing levels for both actors. In contrast, for the frosted glass the result suggested no differences for most of the clothing levels for either actor.

Table 6-3: Pairwise comparisons for the effect of observation duration on visual identification of clothing level, across the degrees of free areas of the horizontal blind and the distortion levels of frosted glass.

Test variables			**Horizontal blind**	**Frosted glass**
Duration (s) **0.3 vs 3.0**	**Actors** **Skin tone type**	**II**	Yes	No
		VI	Yes	No

Figure 6.4 shows the differences also between 0.3s and 3.0s observation duration for the slope lines of 6%, 11%, 19%, 34% and 60% free area of horizontal blind, and distortion levels 4,8,12 and 16 in the frosted glass. The dotted lines represent the clothing identification during observation 0.3s, which in the case of the horizontal blind approaches the slope of the line of actual clothing level, while the straight line approaches the horizontal line of slope zero. Whereas, for the frosted glass the dotted slope lines for 0.3s and the straight lines for 3.0 s observation duration approach the slope of the actual clothing level line.

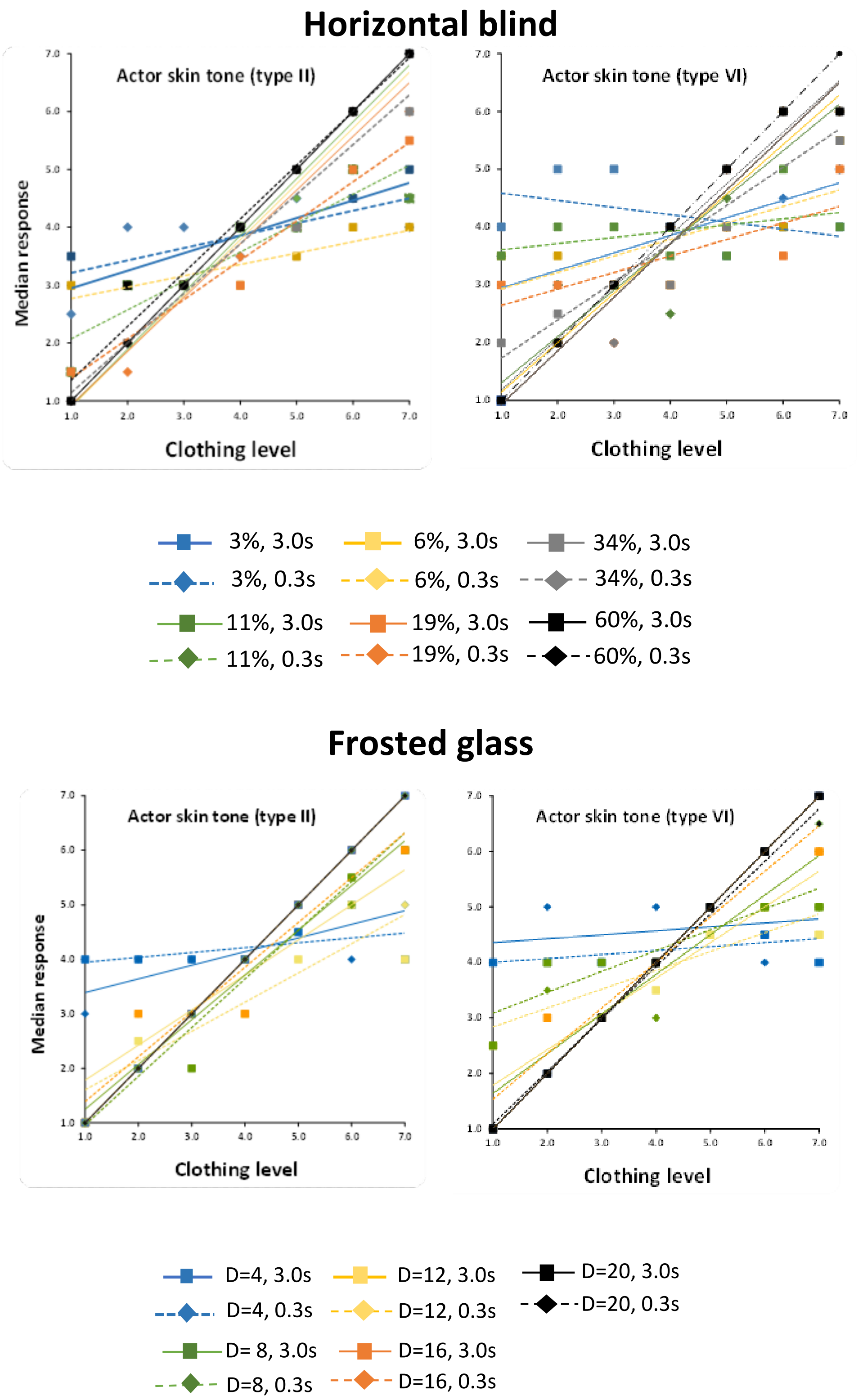


Figure 6-4: The differences between the effects of observation durations of 0.3s and 3.0s on visual identification of clothing level for the free areas of the horizontal blind and distortion levels in frosted glass. Left side graphs show the actor with skin tone type II, and right side graphs the actor with skin tone type VI. The straight lines represent a 0.3s observation duration, and the dotted lines represent a 3.0s observation duration.

6.4. Comparison with Previous Studies

Quantitative analyses of visual privacy were previously reported by Hariyadi, Fukuda and Ma (2017) and Kotabi (2019). Comparison of the current work with those studies allows a discussion about methods and scale, as well as the variables examined in these researches.

In the current study, visual privacy was investigated in the laboratory, where ranges of variables were controlled. The properties of window treatments, the distance between observer and window, the light condition between outside and inside, and duration of observation are among the most important of these variables.

Hariyadi, Fukuda and Ma (2017) tested 5 types of Sudare (traditional treatment for privacy in Japan), under 11 levels of light conditions, with each screen having its own characteristics in terms of colour and degree of openness. Hariyadi, Fukuda and Ma (2017) used a scale from 0 (could not see the object) to 6 (could identify the detail and colour). The responses depended on the objective assessment of the observer. One of the main features of this study was the use of two experimental methods, one of which was physical in terms of the windows and the people being observed.) and the second was digital images experiment and the result suggests this gives similar results to experiments using real windows and window treatments. The least free area for Sudare screen, tested is 24%. The results indicated that Sudare with 24% (bigger diameter and wider spacer between the slats) with the illuminance ratio of more than 4.30 has a higher value of visibility to outside, but it is considered low for visual privacy, the observer could see the target clearly (identify the detail and colour) .

Kotbi (2019) conducted physical experiment in terms of the screen used (mashrabiyya), however the object been observed were six symbols(pictures) placed behind screens. The number of the variables tested by Kotbi (2019) are three perforated screens and three angles. The accepted visual privacy was measured when the participant could not identify the image of the symbols behind the screen.

In the current research, clothing and the degree of window treatments are other variables that were assumed to be culturally related to visual privacy and in turn to affect daylight. The scale used for visual privacy in the current study is related to the culture of certain societies. Although the different clothing levels on the scale allow users flexibility in selecting the appropriate level of clothing, and hence the degree of obscuring the window treatment, there are other societies that desire privacy for reasons other than acceptability of clothing.

There are five degrees of frosted glass in the glassing materials companies and there is limited information on parameters for testing the frosted glass in subjects related to visual privacy. A copy of the permission to use the frosted glass images advertised by the company (see Figure C.9 in appendix C).

In addition, frosted glass, are advertised in the market by using symbols or pictures of equipment, and some others use real actors' images, Figure 6.5. Actors were used to improve context validity. In the current work, visual privacy accuracy would be higher using real actors' images, “Photographic Figure Rating Scale “had good validity (Shafran and Fairburn, 2001).

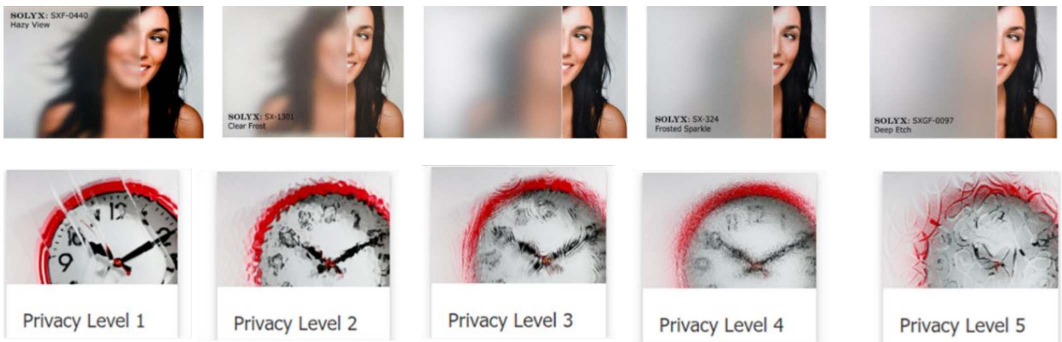


Figure 6-5: Differences between using pictures and real actors to investigate visual privacy. The advertisement images for frosted glass used by a glass film company (https://www.pilkington.com/en-gb/uk/householders/decorative-glazing). A copy of the permission is attached in Appendix F.

The two actors used in the target images had different skin tones (white and dark brown to black; types II and Vi of the Fitzpatrick scale), presenting different skin to clothing contrasts. Despite this difference, the same conclusions regarding window treatment for sufficient privacy were drawn for both actors. In previous work investigating privacy and window treatments (Hariyadi and Fukuda, 2017a) or view to outside (Oe et al 2021) only one actor/mannequin was used so the influence of skin tone, if any, was not addressed.

Sufficient privacy in this research was defined as the ability to discriminate the clothing worn by the actor being reduced to chance level. For the seven images of clothing level used in this experiment that was a reduction to 14% (i.e., 1/7). In figures 6.1 and 6.2 this chance level is visualised by a horizontal line. That is a somewhat arbitrary choice based on the number of levels of clothing included in the test images; repeating the experiment with a different number of clothing levels would therefore change the chance level. In further work, this choice of threshold should be examined, for example, whether 50% identification would be acceptable privacy.

In previous work (Hariyadi, Fukuda and Ma ,2017) visual privacy was measured using a 0-6 scale, where 0 was defined as "cannot see the object" and 6 as "can see the object clearly (identify the detail, colour)" .They assumed that sufficient visual privacy was gained when the evaluations were either 0, 1 or 2 on that scale. This is a different approach: it is a subjective measure of sufficient privacy, whereas the current work used an objective measure.

The results by Kotabi (2019) might be more or less than the accepted visual privacy needed, especially since Kotabi's (2019) research aimed to design an effective shading device, to improve interior daylighting and maintain privacy in girls' schools in Saudi Arabia. Consequently, the main findings might affect the amount of daylight needed. Nevertheless, the differences arising from use of the scale of the current study and the Kotbi scale (2019) need further investigation.

The visual size of the symbols in the scale used by Kotbi (2019) was linked to three distances between the observer and the window. These three distances within the school surroundings were analysed by Kotbi (2019) during the field work as the worst-case scenarios to investigate visual privacy. Although the distance was controlled in the physical experiment by Hariyadi, Fukuda and Ma (2017), with the observer and Sudare screen separated by the same distance as the object and Sudare screen, there is no indication of the simulated distance.

In the current work the target was scaled to present a distance of 4 m from the observer, with both at approximately the same horizontal level. This would represent a pedestrian walking along the pavement and looking through a ground floor window. Increasing the distance between the observer and the target would reduce the size of details subtended at the observer's eye: this could increase the difficulty of discerning detail and it would then be possible to increase the percentage free area of blind opening (or a lower level of distortion with frosted glass) to reach the same level of clothing recognition. At different positions within a room the target may be differently illuminated due to their relative location to sources of daylight and electric lighting: in further work it would be useful to establish the worst-case position.

A main finding in Hariyadi, Fukuda and Ma (2017) study, in addition to identifying the Sudare that offered optimal visual privacy, was that changing the light condition between the observer and the people being observed affected the value of visibility, and this variable could be investigated in further work on the horizontal blind and frosted glass. The light in the current work was controlled to reduce the contrast between the image and the wall. The light was turned on to simulate the laboratory and the curtains were drawn to exclude daylight for the trials conducted in the daytime. To control the illuminance contrast between inside and outdoor and ensure consistency of light conditions, artificial Sky Dome was used by Kotbi (2019) at a setting of about 7000lux.

6.5. Summary

In this chapter, the outcomes of experiment No. 1 and experiment No. 2 were compared. Results of both experiments show that, for both window treatments, visual privacy was achieved only for the highest levels of window treatments considered here: horizontal blinds closed to a free area of 3% and frosted glass of distortion level D=20. The effects of skin tone for both window treatments were significant at the lowest clothing level. The effect of observation duration was significant for both actors with the horizontal blinds but were not for frosted glass for both actors.

Comparisons with previous studies suggest that light condition between the observer and the people being observed affected the value of visibility, and this variable could be investigated in further work on the horizontal blind and frosted glass. The ethnicities of test participants were not recorded. Previous work suggests similar results to experiments using real windows and window treatments, a physical experiment could be conducted in which the person being observed could wear the same levels of clothing that were used in the current study's clothing scale. Furthermore, the results of the images experiment could be compared with those from the physical experiment.

While the identification of clothing level is an objective evaluation and should not be affected by the observer's ethnicity, there is a possibility that it might. In further work it would be interesting to test that assumption.

Chapter 7. Conclusion

7.1. Conclusions

This study developed a strategy to investigate the visual privacy of female occupants through two window treatments, horizontal blinds and frosted glass. This was done to explore whether window treatments would permit females of some Muslim cultures to wear more relaxed clothing when at home. The literature review did not reveal sufficient evidence about the degree to which window treatments enabled visual privacy and hence further experimental work was conducted. One reason is that previous work has tended to focus on daylight performance and minimizing solar radiation rather than visual privacy.

Conclusions are presented below according to the two research hypotheses raised in section 2.10.

H1. Variation in clothing levels in some cultures is associated with the need for visual privacy inside the home.

One means of maintaining privacy is by the choice of clothing. In previous works, clothing scales have been used to investigate social and cultural aspects, where the degree of skin coverage (including the head) and the degree of looseness and tightness were the main variables used (by Bachleda, Hamelin and Benachour, 2012; Albrecht et al., 2014; Shafee, 2020). Nevertheless, the literature showed no evidence of that choice being based on female attitudes towards visual privacy. Thus, in the present study, the importance of visual privacy inside the home and its relation to Muslim female clothing has been quantitatively investigated by survey questionnaire in chapter 3, where a scale has been developed to measure the privacy offered by clothing, extending the clothing levels used in the scales in previous work (Albrecht et al., 2014; Erickson, 2017).

The results from 90 females, drawn equally from three home locations (Libya, Saudi Arabia and Europe), have shown that variations in the cover and tightness of clothing affect the perceived level of privacy in different situations.

H2. Variations in the degree of window treatment affect the visual identification of clothing levels.

The results were used to evaluate the degree of two window treatments which offers sufficient level of privacy for clothing level 2 (the relaxed and flexible clothing level for Libyan women inside the house).

This study reported an experiment conducted to investigate two types of window treatments – horizontal blinds and frosted glass. The horizontal blind characterised by free area rather than slat angle. The percentage free areas used here represent blind angles of 75.9˚,70.1˚,62.9˚,54.1˚,41.3˚ and 23.6˚ for percentage free areas of 3%, 6%, 11%, 19%, 34% and 60%. The degree of frosting was simulated using the distortion function in Microsoft Photoshop. Five distortion levels were used, ranging from 4 to 20 in steps of four distortion units. For the horizontal blinds, only the 3% level of free area and distortion level of 20 for the frosted glass reduced clothing identification to a chance level, for actors with both types of skin tone (II type and VI), clothing level 2 (short and t shirt) was seen as an acceptable level of modest clothing, at a short observation duration.

In addition, **three** other variables were observed and suggested to test:

1. **Contrast between females' skin tone and clothing affects visual identification of clothing levels**

In previous work investigating privacy and window treatments (Hariyadi and Fukuda, 2017a) or view to outside (Oe et al 2021) only one actor/mannequin was used, so the influence of skin tone, if any, was not addressed. The significant effect of skin tone type was found at lower clothing levels, and at shorter observation duration 0.3s for both window treatments. However, the difference between actors was significant at observation duration 3.0s for frosted glass for clothing 7 (Long sleeve jacket with trouser), in which case the effect was not related to the skin tone type. There were accidental differences between actors for clothing level 7 (see the clothing scale in Table

4.1), and this is considered one of the limitations of the clothing scale, where some mistakes have affected the results, as will be explained in the limitations (section 7.2). Despite the actor with skin tone type VI being seen as more clothed at longer observation duration, visual privacy was significantly insufficient at the 3% level of free area of the blind and at distortion level 20 of the frosted glass.

2. **Variations in observation duration affect visual identification of clothing levels**

Being under gaze is culturally forbidden, and arguably connected to women's desire for visual privacy and modesty (Al-Kodmany, 2017). Since there was no time limit to the observation period in previous work that investigated visual privacy, its duration might be considered as long. This study extends the previous work by considering a short duration of 0.3s, chosen to represent a single glance (Jovancevic-Misic and Hayhoe, 2009). Analysis of the effect of observation duration on visual identification of clothing level for the horizontal blind showed the differences between the two actors for these durations, indicating that long gaze leads to high visual identification for clothing level. However, the effect was not significant for most of the distortion levels of the frosted glass for either actor.

3. **Variations in the actors' location behind the window treatment affect visual identification of clothing levels**

Analysis was conducted for the effect of the three locations for one actor (actor II) at four levels of free area (3%,11%,19% and 60%) and one observation duration (0.3 s). These data did not suggest any variation in the ability to identify clothing level with horizontal position.

7.2. Limitations and Recommended Further Works

While visual privacy was investigated in this research by matching images and using a clothing scale, different methods could be used in further studies, such as a descriptive method with the same application. Participants could be asked to describe clothing levels in the images, whether the actor is wearing long sleeves or short, and they could describe the degree of looseness or tightness of the clothing. In addition, participants could be asked to identify the degree of visual privacy they prefer in order to evaluate clothing levels behind different types and degrees of window treatments and pick what they desire in terms of visual privacy.

The results for 3% of the horizontal blinds and 20 degrees of the frosted glass showed that these treatments obscure the view inside the house, thus allowing females to wear flexible clothes. A second important issue, which should be considered in further work, is the possibility of maintaining this degree of privacy while providing adequate natural light. In terms of the daylight, the illuminance level of 3% degree opening of the blind does not achieve the useful daylight index (UDI) threshold. However, this finding may be the result of methodological limitations, and further investigation is needed.

In this study, other variables, such as the glass type, were not considered when investigating visual privacy. The diffusion of light as it passes through the glass material can cause haze that results in poor visibility and/or glare (Novotny et al., 2019), which is a factor that could have affected the result of this study and would consequently increase the degree of opening of the blind which would be needed to provide acceptable visual privacy. Furthermore, tinted glass is another popular approach for maintaining visual privacy inside the home and it is a common glass type used in Libya. Unlike frosted glass, tinted glass does not obscure the view to the outside of the building. The VT of tinted glass is between 0.23 and 0.51 (Duarte et al., 2009; Li and Tsang, 2008), which is approximately half of the typical visible transmittance of clear glass (VT), at 0.88 (Cuce and Riffat, 2015).

There are two other variables that need further consideration in future work, namely how increasing the opening degree of the blinds might increase the flow of the daylight.

The difference in illuminance between outside and inside the house affects the degree of visibility through the window (Hariyadi and Fukuda 2017). The images in Figure 7.1 show in the first condition the window with curtain and in the second just the window, with both of the windows having similar degrees of visual privacy.

Figure 7-1 The effect of the reflection on the glass and the difference in luminance between outside and inside the house on visual privacy. The left image: the window without window treatments.The right image: the window covered by a curtain.

This work has reported a new method to investigate four variables' effects on visual privacy, in the laboratory, where the ranges of the variables were controlled. The two experiments were conducted under artificial light conditions; for the horizontal blind the average horizontal illuminance (projector table) was 606 lux, and the vertical illuminance (participant view) was 472 lux. Meanwhile, for the frosted glass experiment, the horizontal illuminance was 544 lux, and the average vertical illuminance was 380 lux. Compared to the illuminance of daylight, the experimental light conditions may have influenced the degree of visibility to the observer during the experiment, and therefore increased the accuracy of answers to identify the clothes. Hence, the contrast between outside and inside the house could be made higher by using a simulated artificial sky in the experimental place.

In addition, the literature has shown strategies for use with the slots of horizontal blinds, by directing daylighting to the depth of the room by changing the materials and angles of rotation of the slats (Chan and Tzempelikos, 2013). These strategies could be applied to the tested free areas of the blinds that offered sufficient visual privacy and testing its effectiveness in terms of daylight.

In the real environment, visibility through the window to pedestrians in the street is affected by the reflection caused by the buildings, trees, etc. Estimation of these obstacles could be added to the images by inserting a layer in front of the images using Photoshop software.

Despite the lack of availability of parameters for testing the frosted glass, it is possible to request a sample from the glass factory, which could provide different degrees of frosted glass with properties such as light transition and reflection for using the methods of the current work to test the effectiveness of those degrees on visual privacy.

The clothing scale needs to be adjusted to make the step-changes in looseness and coverage more precise regarding the differences between clothing levels. This was a limitation that affected the results, since clothing level 7 differed between actors, and the differences in the degree of looseness between clothing levels 7 and 8 were not precise. Furthermore, the actors should be similar in terms of their bodily characteristics, including body shape, size, and head, so that the difference in results is caused by the skin tone type, not by other factors. The black colour of the clothing, additionally, created a contrast with the actor with white skin (type II), whereas the contrast was less defined with skin type VI. To confirm the findings on the performance of the effect of skin tone on visual identification of clothing level, the colour of the clothing scale should be close to the actor's skin tone in order for the results to be confirmed.

More consideration could be given to the cultural background of participants, although the difference was not shown any effect on the participants' responses in Kotbi's (2019) study. However, the scale used in this study includes traditional clothes, which some participants may find easier to identify than others.

APPENDIX A: Experiment 1 (clothing scale)

Table A-1: The changes steps in the clothing scale (the degree of skin exposure)

	1	2	3	4	5	6	7	8	9	10
										
Parts of body covered by clothing										
Trunk (chest, hips and thighs)	X	X	X	X	X	X	X	X	X	X
Shoulders		X	X	X	X	X	X	X	X	X
Lower legs			X	X	X	X	X	X	X	X
Sternal region				X	X	X	X	X	X	X
Arms					X	X	X	X	X	X
Neck						X	X	X	X	X
Hair						X	X	X	X	X
Face										X
Hands										X
Percentage of skin exposure	**61%**	**47.7%**	**31.7%**	**26.8%**	**16.6%**	**11.7%**	**11.7%**	**11.7%**	**11.7%**	**1.2%**

Table A-2: The changes steps in the clothing scale (the degree of arms coverage)

										
	1	2	3	4	5	6	7	8	9	10
Arms coverage										
Long						x	x	x	x	x
Mid					x					
Short	x	x	x	x						

Table A-3: The changes steps in the clothing scale (the degree of legs coverage

	1	2	3	4	5	6	7	8	9	10
Legs coverage										
Long			X	X	X	X	X	X	X	X
Mid		X								
Short	X									

Table A-4: The changes steps in the clothing scale (the length of the Top clothing)

	1	2	3	4	5	6	7	8	9	10
The length of Top clothing										
Long								*	*	*
Mid					*	*	*			
Short	*	*	*	*						

Consent to be photographed

Name of the project: The conflict between privacy and daylight

I understand that the Intisar Husain is a PhD student at Sheffield University studying the conflict between day light and privacy. The research requires to take photos of an actor in different clothing levels. The photos will only be used for the research purposes such as illustration, analysis, thesis, and journals publication.

Please check the correct box and complete the information below to whether you do wish or do not wish to grant Intisar Husain to use your taken photos.

- [x] I DO grant permission for my taken photo.
- [ ] I DO NOT grant permission for the use of my taken photo in research purposes.

Photographer's address : University of Sheffield, Lighting research Group, School of Architecture, Floor 9,The Arts Tower, Western Bank ,Sheffield,S10 2TN.

Name of the participant photographed: [redacted]

Participant's address: University of Sheffield, Acoustics Group, School of Architecture, Floor 9, The Arts Tower, Western Bank ,Sheffield,S10 2TN.

Name: [redacted]

Signatu[redacted] Date: 15/05/2018

Photographer Name: Intisar Husain

Signature: [redacted] Date: 15/05/2018

Figure A-1: Example of consent form used to confirm that the two actors were happy for their photographs to be used in the current research and arising publications.

The questions about female clothing levels in different contexts indicated in the Tables A-5 to A-7 are:

Q1. Outside their home
Q2. Inside their home, visible only to family members
Q3. Inside their home, but potentially visible to pedestrians/neighbours outside
Q4. Inside their home, in this case the female is assured that she is visible to pedestrians/neighbours outside.

Table A-5: Raw results of clothing levels responses by Libyan women in Four contexts

Participant ID	Questions about females clothing level according to four contexts			
	Q1 Outside	Q2 Inside: visible to anyone	Q3 Inside: possibly visible to any one	Q4 Inside visible to family members
1	6	2	2	2
2	8	7	4	1
3	6	6	6	2
4	7	9	2	2
5	6	6	2	2
6	8	7	7	2
7	7	6	6	3
8	6	6	2	2
9	6	6	5	2
10	6	5	5	1
11	6	5	5	1
12	9	6	6	3
13	7	5	5	2
14	6	5	4	2
15	7	6	1	1
16	7	6	3	2
17	7	4	2	1
18	7	6	4	1
19	6	5	5	2
20	8	6	6	4
21	7	6	6	2
22	4	3	3	2
23	7	7	7	4
24	7	5	4	2
25	7	5	4	3
26	3	3	2	1
27	6	5	1	1
28	7	6	4	3
29	7	6	6	2
30	6	4	3	2

Table A-6: Raw results of clothing levels responses by Saudi women in Four contexts

Participant ID	Questions about females clothing level according to four contexts			
	Q1 Outside	Q2 Inside: visible to anyone	Q3 Inside: possibly visible to any one	Q4 Inside visible to family members
1	6	5	4	5
2	8	6	4	1
3	6	5	1	1
4	8	8	8	3
5	9	6	5	1
6	7	8	4	5
7	10	7	3	2
8	7	6	1	1
9	7	6	2	2
10	7	4	4	4
11	7	3	3	4
12	10	10	4	1
13	7	7	1	1
14	7	6	2	1
15	7	6	5	3
16	8	6	5	3
17	5	4	3	2
18	9	9	2	1
19	6	5	1	2
20	8	8	8	5
21	7	7	7	2
22	10	9	5	1
23	6	5	3	2
24	7	6	5	4
25	6	6	3	2
26	7	6	4	1
27	3	4	4	4
28	9	7	6	3
29	6	4	4	3
30	5	3	2	2

Table A-7: Raw results of clothing levels responses by European women in four contexts

Participant ID	Questions about females clothing level according to four contexts			
	Q1 Outside	Q2 Inside: visible to anyone	Q3 Inside: possibly visible to any one	Q4 Inside visible to family members
1	1	1	1	1
2	1	1	1	1
3	1	1	1	1
4	1	1	1	1
5	2	1	1	1
6	3	1	1	1
7	1	1	1	1
8	3	1	1	1
9	3	3	2	2
10	5	2	1	2
11	3	2	1	2
12	1	1	1	1
13	1	1	1	1
14	2	2	1	1
15	2	2	2	2
16	4	3	3	3
17	2	1	1	1
18	1	1	1	2
19	3	2	1	1
20	1	1	1	1
21	2	1	1	1
22	2	2	1	1
23	3	2	1	1
24	3	3	3	3
25	1	1	1	1
26	5	4	4	3
27	3	2	1	1
28	1	1	1	1
29	2	1	1	1
30	3	2	1	1

Table A-8: Normality test for Q1 (clothing responses by Libyan, Saudi and European women outside the house)

NORMALITY PROFILE FOR Q1		LIBYAN	SAUDI	EUROPEAN
Central Tendency	Mean	6.57	7.13	2.17
	Median	7.0	7.0	2.0
NORMALITY?	Within 0.5?	yes	yes	yes
Graphical	Histogram	near	Near	No
	Box Plot	No	Near	No
	Q-Q plot	No	Near	near
NORMALITY?		no	near	no
Measures of dispersion	Skewness	-1.01	-0.55	0.83
	(within ±0.5)			
	Kurtosis	3.2	2.0	0.44
	(within ±1.0)			
NORMALITY?		no	no	no
Statistical tests				
Shapiro-Wilks	statistic			
	level of significance	0.00	0.018	0.00
Kolmogorov-Smirnov	statistic			
	level of significance	0.00	0.004	0.001
NORMALITY (not normal if p<0.05)		no	no	no
OVERALL ASSESSMENT OF NORMALITY		No	No	No

Table A-9: Normality test for Q2(Inside their home, visible only to family members)

NORMALITY PROFILE FOR Q2		LIBYAN	SAUDI	EUROPEAN
Central Tendency	Mean	5.43	5.93	1.60
	Median	6.0	6.0	1.0
NORMALITY?	Within 0.5?	no	yes	no
Graphical	Histogram	near	yes	No
	Box Plot	near	near	near
	Q-Q plot	No	No	No
NORMALITY?		no	near	no
Measures of dispersion	Skewness	-0.372	-0.436	1.30
	(within ±0.5)			
	Kurtosis	1.323	0.481	1.224
	(within ±1.0)			
NORMALITY?		no	no	no
Statistical tests				
Shapiro-Wilks	statistic			
	level of significance	0.005	0.157	0.00
Kolmogorov-Smirnov	statistic			
	level of significance	0.001	0.014	0.000
NORMALITY (not normal if p<0.05)		no	no	no
OVERALL ASSESSMENT OF NORMALITY		No	No	No

Table A-10: Normality test for Q3(Inside their home, but potentially visible to pedestrans/neighbours outside)

NORMALITY PROFILE FOR Q4		LIBYAN	SAUDI	EUROPEAN
Central Tendency	Mean	1.93	2.11	1.27
	Median	2.00	2.00	1.00
NORMALITY?	Within 0.5?	yes	yes	yes
Graphical	Histogram	no	no	no
	Box Plot	near	near	near
	Q-Q plot	no	no	no
NORMALITY?		no	no	no
Measures of dispersion	Skewness	0.81	0.81	0.86
	(within ±0.5)			
	Kurtosis	0.33	-0.15	3.74
	(within ±1.0)			
NORMALITY?		no	no	no
Statistical tests				
Shapiro-Wilks	statistic			
	level of significance	0.00	0.00	0.00
Kolmogorov-Smirnov	statistic			
	level of significance	0.00	0.00	0.00
NORMALITY (not normal if p<0.05)		no	no	no
OVERALL ASSESSMENT OF NORMALITY		No	No	No

Table: A-11: Normality test for Q4(Inside their home, in this case the female is assured that she is visible to pedestrians/neighbours outside

NORMALITY PROFILE FOR Q3		LIBYAN	SAUDI	EUROPEAN
Central Tendency	Mean	3.87	3.67	1.23
	Median	4.00	4.00	1.00
NORMALITY?	Within 0.5?	yes	yes	yes
Graphical	Histogram	no	no	no
	Box Plot	near	near	no
	Q-Q plot	near	near	no
NORMALITY?		near	near	no
Measures of dispersion	Skewness	-0.001	0.530	3.219
	(within ±0.5)			
	Kurtosis	-1.198	-0.80	10.460
	(within ±1.0)			
NORMALITY?		no	no	no
Statistical tests				
Shapiro-Wilks	statistic			
	level of significance	0.038	0.49	0.00
Kolmogorov-Smirnov	statistic			
	level of significance	0.018	0.187	0.00
NORMALITY (not normal if p<0.05)		no	yes	no
OVERALL ASSESSMENT OF NORMALITY		No	No	Yes

APPENDIX B: Experiment 2 (Horizontal blinds)

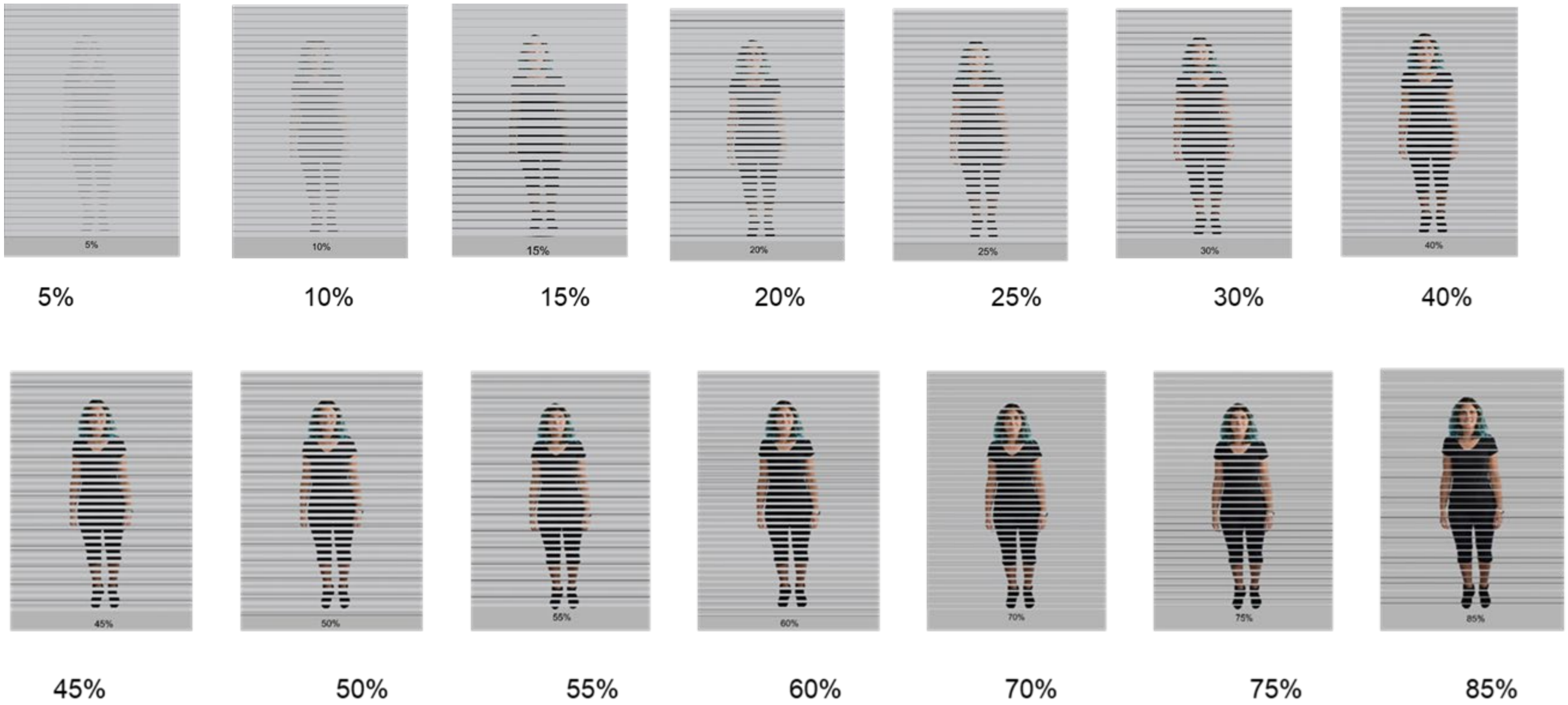


Figure B-1: pre-tested images for different degrees of free areas of the horizontal blinds with grey background to identify the images used in the main experiment.

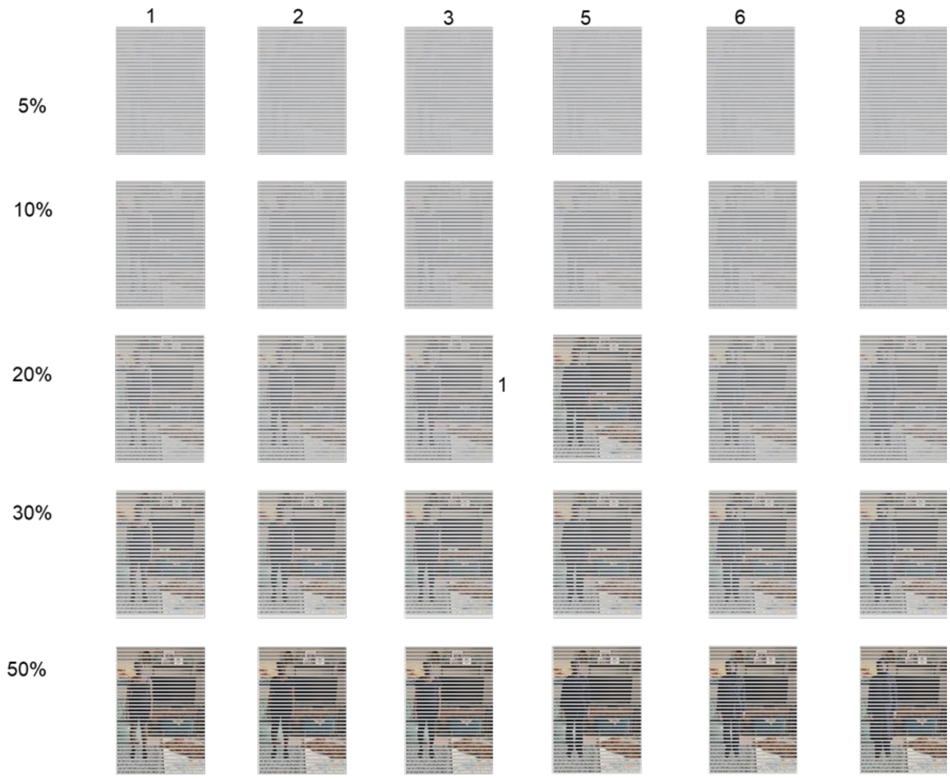


Figure B-2: pre-tested images for different degrees of free areas of the horizontal blinds with living room background, to identify the images used in the main experiment. Examples of the Free areas from 5% to 50%, for the actor's skin tone (type: VI and II), Clothing levels: 1,2,3,5,6,8

Table B-1: The illuminance level of the test images in the laboratory for the actor with skin tone type II. Blind opening (3% and 6%)

Blind opening (free area)		**3%**							**6%**						
Clothing level		1	2	3	4	5	6	7	1	2	3	4	5	6	7
Light condition in the lab(lux)	Horizontal (Close to the projector screen)	603	603	603	604	601	601	602	600	600	599	598	598	604	601
	Vertical (Participant view)	470	470	470	470	468	468	469	467	468	468	467	467	470	468

Table B-2: The illuminance level of the test images in the laboratory for the actor with skin tone type II. Blind opening (11% and 19%)

Blind opening (free area)		**11%**							**19%**						
Clothing level		1	2	3	4	5	6	7	1	2	3	4	5	6	7
Light condition in the lab(lux)	Horizontal (Close to the projector screen)	599	599	597	600	600	596	598	596	595	594	593	594	595	596
	Vertical (Participant view)	468	467	466	467	467	466	467	465	465	464	464	463	465	465

TableB-3: The illuminance level of the test images in the laboratory for the actor with skin tone type II. Blind opening (34% and 60%)

Blind opening (free area)		**34%**							**60%**						
Clothing level		1	2	3	4	5	6	7	1	2	3	4	5	6	7
Light condition in the lab(lux)	Horizontal (Close to the projector screen)	589	588	587	588	586	586	587	575	575	575	576	574	574	574
	Vertical (Participant view)	460	460	459	460	459	459	459	452	452	452	452	451	451	451

Table B-4: The illuminance level of the test images in the laboratory for the actor with skin tone type VI. Blind opening (3% and 6%)

Blind opening (free area)		3%							6%						
Clothing level		1	2	3	4	5	6	7	1	2	3	4	5	6	7
Light condition in the lab(lux)	Horizontal (Close to the projector screen)	602	604	604	604	603	605	601	600	597	598	599	599	600	597
	Vertical (Participant view)	470	470	470	470	470	471	469	468	465	467	468	468	468	466

Table B-5: The illuminance level of the test images in the laboratory for the actor with skin tone type VI. Blind opening (11% and 19%)

Blind opening (free area)		11%							19%						
Clothing level		1	2	3	4	5	6	7	1	2	3	4	5	6	7
Light condition in the lab(lux)	Horizontal (Close to the projector screen)	597	590	597	600	597	597	599	595	596	593	595	596	593	595
	Vertical (Participant view)	466	467	466	468	466	466	467	465	465	464	465	465	564	466

Table B-6: The illuminance level of the test images in the laboratory for the actor with skin tone type VI. Blind opening (34% and 60%)

Blind opening (free area)		34%							60%						
Clothing level		1	2	3	4	5	6	7	1	2	3	4	5	6	7
Light condition in the lab(lux)	Horizontal (Close to the projector screen)	587	589	587	589	586	589	587	574	577	574	575	575	576	576
	Vertical (Participant view)	460	460	460	461	459	461	459	451	452	451	452	452	452	452

Horizontal blinds (pilot study)

A pilot study with ten participants was conducted to confirm the experimental design. The target images were of both actors, with seven levels of clothing and five levels of blind closure: 6%, 34%, 11%, 19% and 60%. The result from the pilot study demonstrated that there was greater confusion regarding the smallest opening area, 6 %, which did not reach the threshold of acceptable privacy. A further (smaller) blind opening ratio (3.4%) was added to the test images. This was a 0.25 log step smaller than 6%, and hence follows the same progression as the other sizes. A new experiment was designed and built.

Changes have been applied to the main experiment of the horizontal blinds:

1. A further (smaller) blind opening ratio (3.4%) was added to the test images. This was a 0.25 log step smaller than 6%, and hence follows the same progression as the other sizes. A new experiment was designed and built.
2. In the pilot study, the laboratory room lights were switched off. In the main experiment, the light was turned on to reduce the contrast between the image and the wall. In this condition, from the picture on the wall it seems like the room is lit at night in real life (Figure B-3).

Figure B-3: The effect of the light condition in the laboratory (light off and on). Pilot study presentation on the left vs the main experiment on the right.

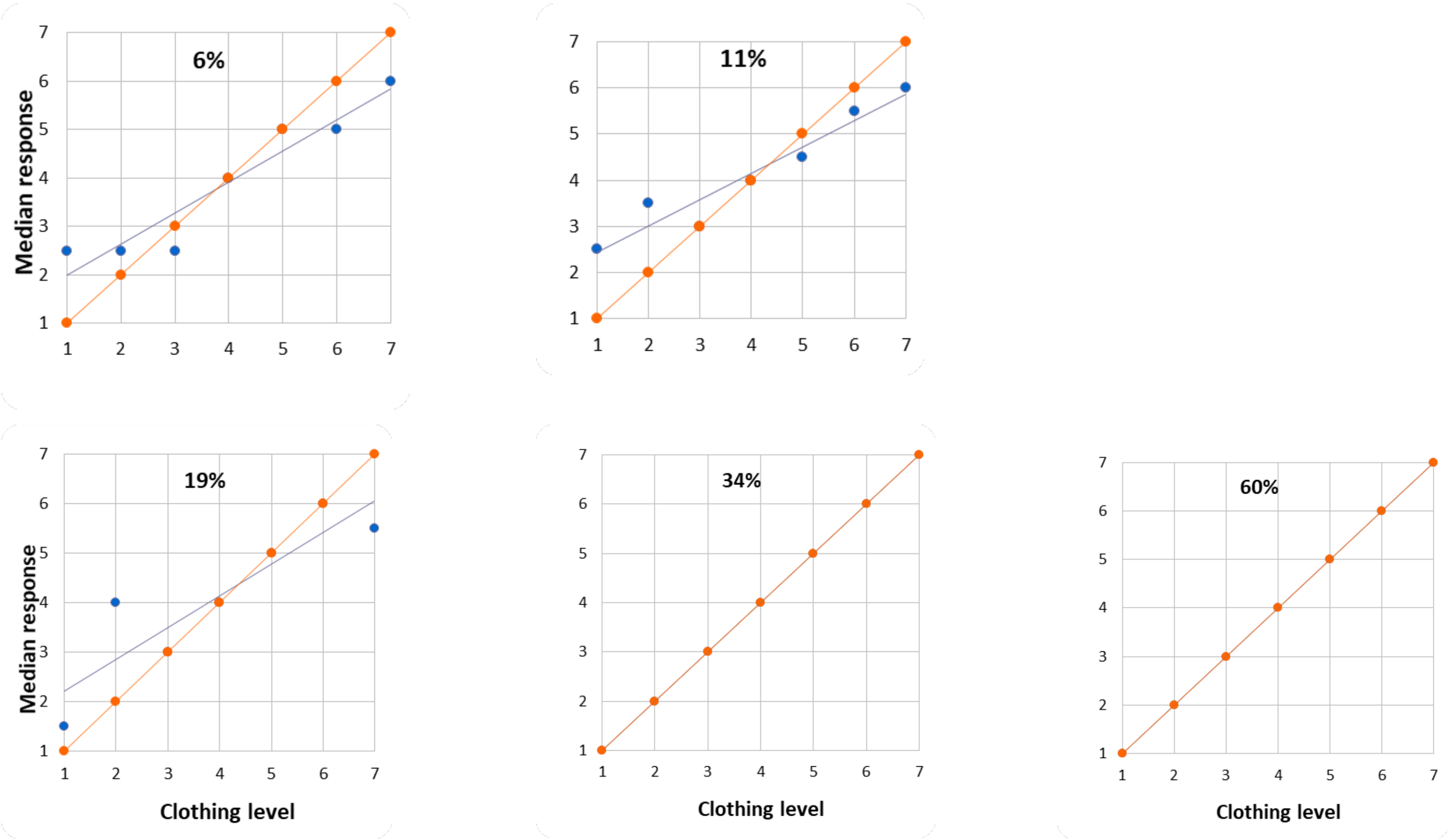


Figure B-4: Pilot study results. Median clothing level response plotted against actual clothing level for the five levels of open area (% shown in each graph). These results are for the dark skin tone (type II) and the 0.3 s observation duration.

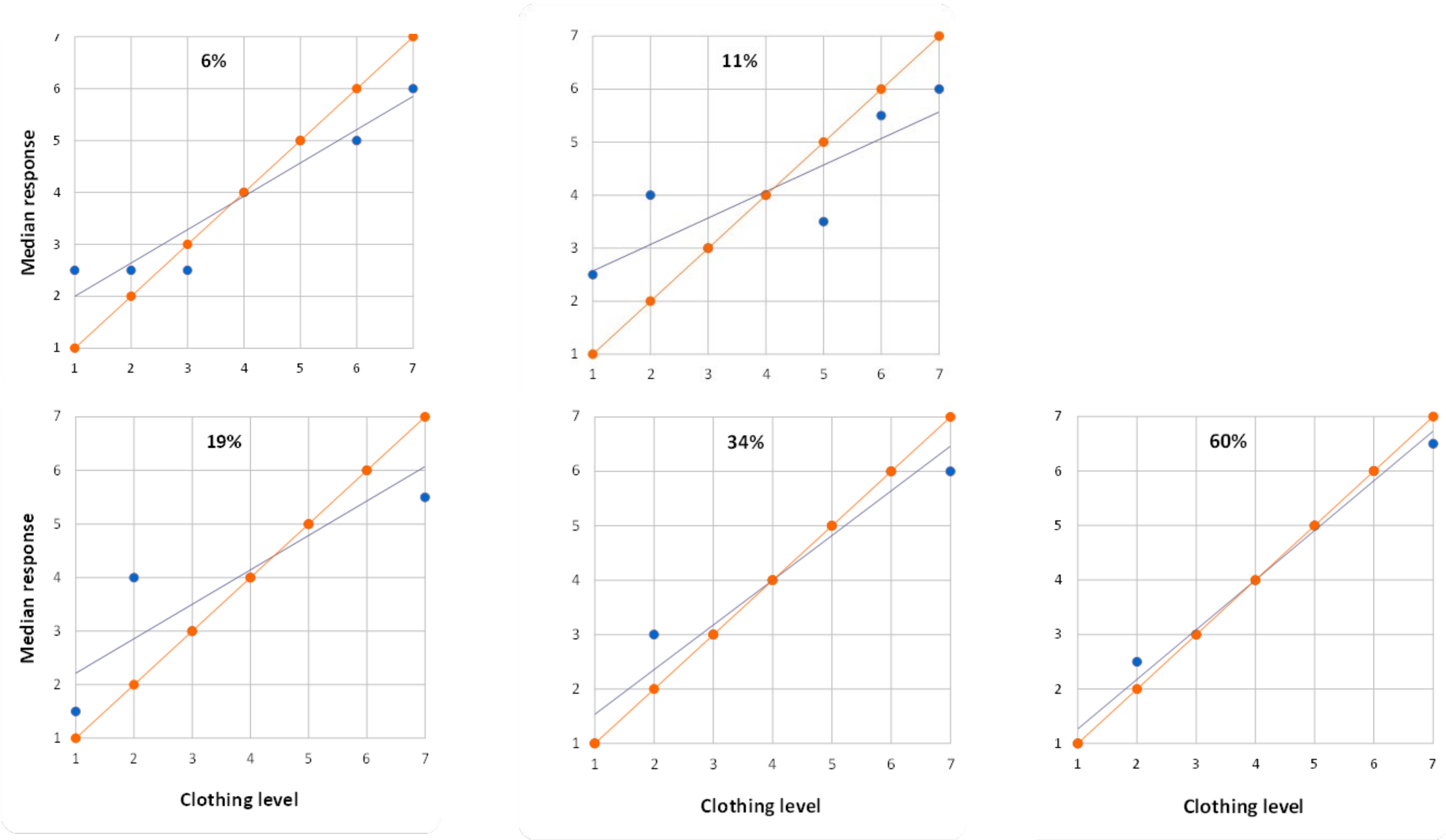


Figure B-5: Pilot study results. Median clothing level response plotted against actual clothing level for the five levels of open area (% shown in each graph). These results are for the dark skin tone (type VI) and the 0.3 s observation duration.

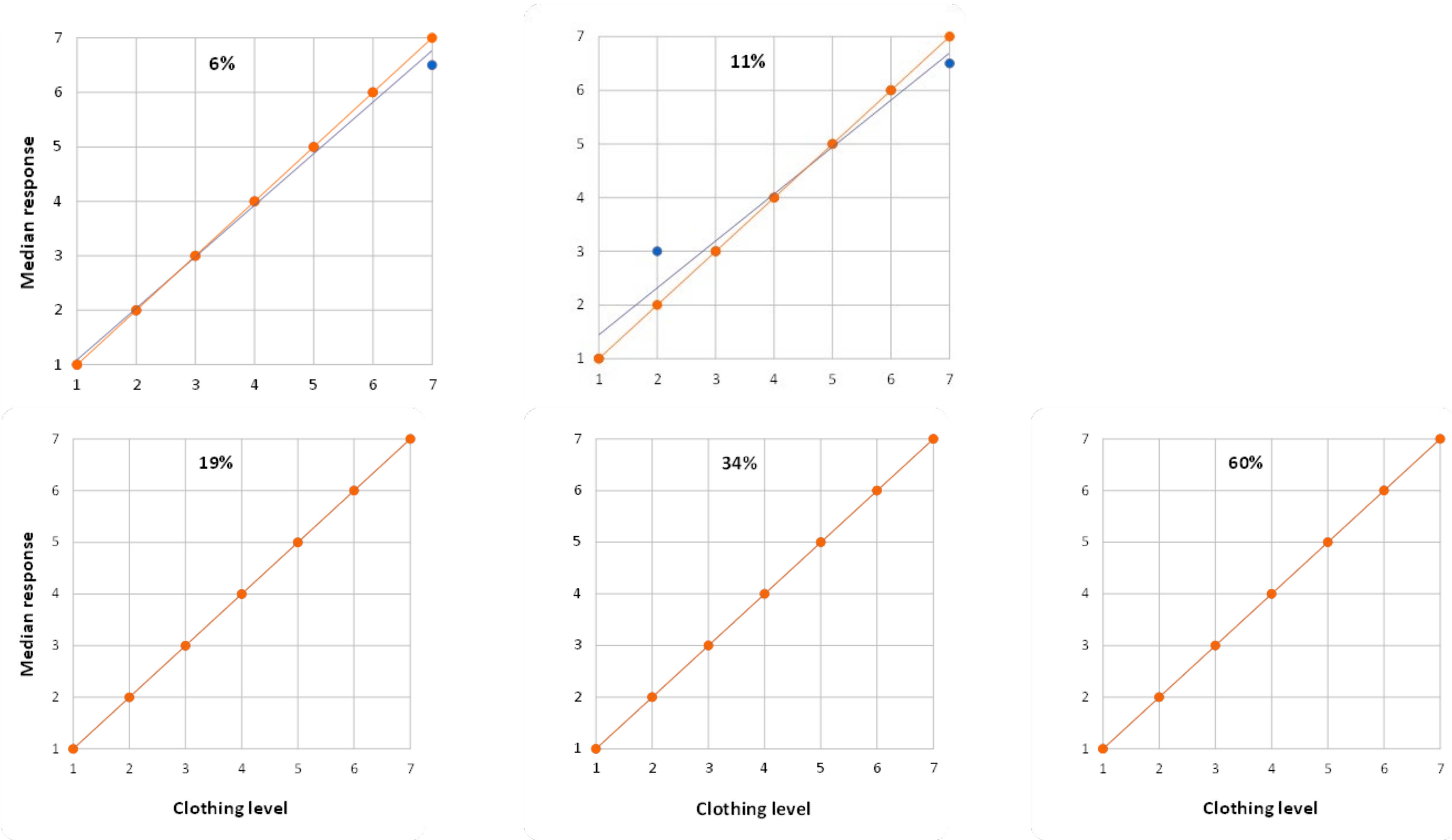


Figure B-6: Pilot study results. Median clothing level response plotted against actual clothing level for the five levels of open area (% shown in each graph). These results are for the white skin tone (type II)) and the 1.0 s observation duration.

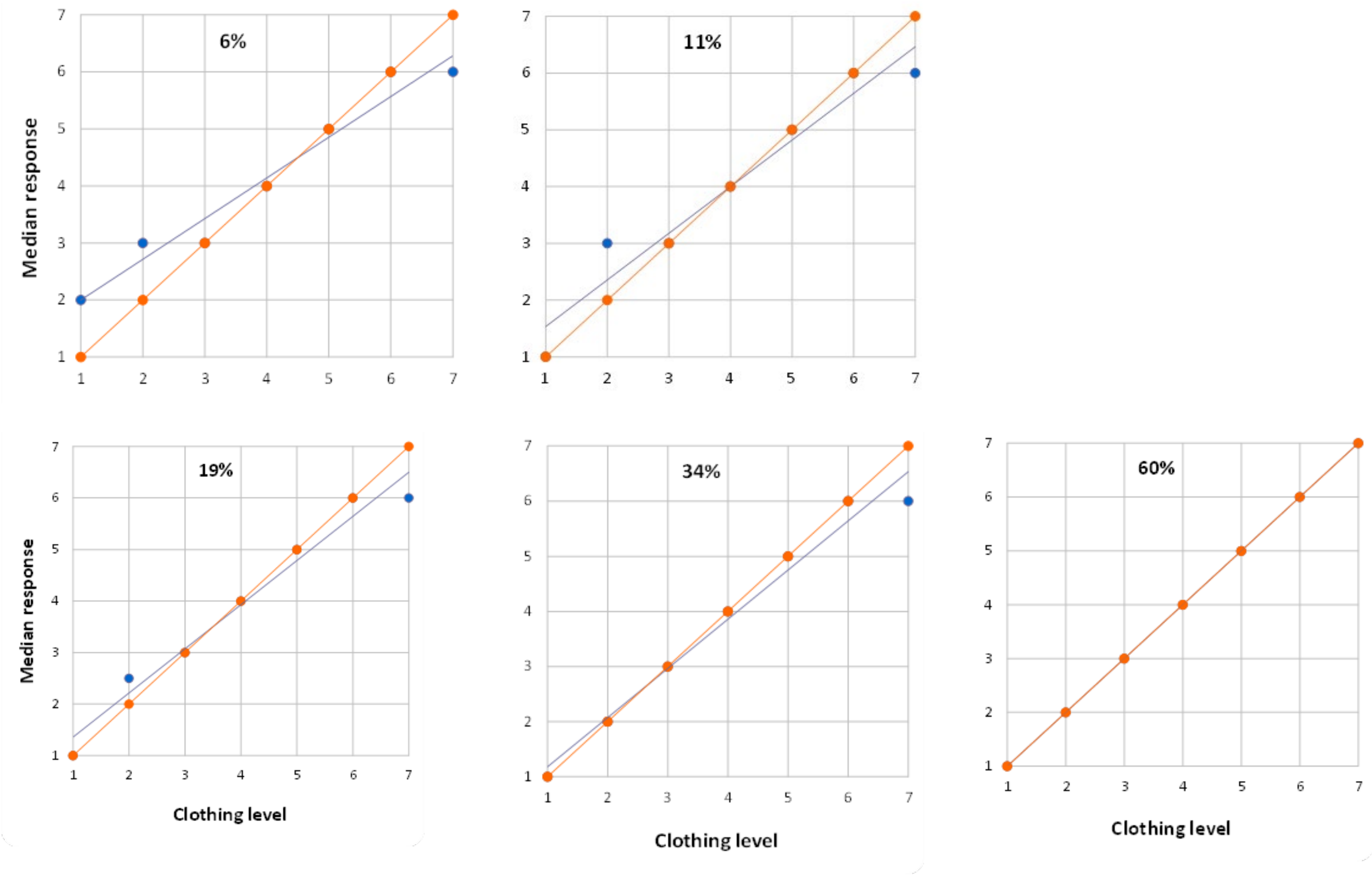


Figure B-7: Pilot study results. Median clothing level response plotted against actual clothing level for the five levels of open area (% shown in each graph). These results are for the white skin tone (type VI) and the 1.0 s observation duration

1. For each participant, at the beginning of each test session, a 20 min learning session was provided to confirm understanding of the difference in clothing levels.
2. The presentation has been paused until a response is entered, the stop screen will not change unless the researcher records the response, then participant take two second delay to start the next presentation.
3. In the rating trials,1.0 sec duration has been omitted which is one of the three durations used in the pilot study, the reason is that, for observation duration 0.3 sec trial, the greater clothing confusion of visibility and there was a similar result which is near perfect responses for the 1.0 sec and 3.0sec trials.
4. Clothing level 7 image for actor number (1) in the first experiment was with white spot colour. The spots used by participants as a key, then most of the mean responses were correct in clothing level 7 with the first actor more than the second actor see figure 5, 6. See figure B_8.

Figure B-8: The versions of clothing used in experiment (2). Change in clothing level 7: the colour of the outer garment on the left was changed (by Photoshop)

Table B-7: Responses of horizontal blinds experiment for each clothing level and blind opening (free area 3%,6% and 11%)/Actor skin actor tone (type II)/observation duration 0.3s

Participant ID	Blind opening (free area)																				
	3%							6%							11%						
	Clothing level							Clothing level							Clothing level						
	1	2	3	4	5	6	7	1	2	3	4	5	6	7	1	2	3	4	5	6	7
1	7	7	7	7	7	7	7	1	3	3	7	5	4	7	3	4	3	7	6	7	7
2	2	5	5	7	7	2	2	6	2	6	1	7	1	1	4	1	3	6	4	7	2
3	1	3	2	2	4	6	4	3	3	3	1	5	2	6	1	3	4	4	4	5	7
4	5	6	4	4	5	5	4	4	3	4	5	4	3	7	6	5	4	5	5	5	7
5	3	3	6	2	3	5	6	2	3	3	3	3	4	2	1	5	3	3	3	6	4
6	2	3	4	5	5	4	6	2	3	3	3	3	5	3	1	3	3	4	4	4	2
7	5	6	6	6	2	5	5	3	3	3	6	3	4	5	2	2	3	2	3	5	6
8	1	2	1	3	5	4	3	4	2	5	3	4	4	2	1	1	3	6	4	4	1
9	3	6	3	1	1	3	3	1	3	1	4	3	6	3	3	1	2	4	3	6	4
10	1	1	1	1	1	1	1	4	4	2	3	3	6	6	1	4	3	4	4	4	5
11	5	4	2	5	6	4	4	5	3	3	6	5	6	7	3	3	3	7	5	6	7
12	5	3	4	3	1	2	6	1	2	3	1	6	6	7	1	2	2	3	3	6	3
13	1	7	5	5	6	5	6	3	3	4	5	5	6	6	2	3	3	6	2	7	7
14	3	4	3	2	6	6	7	3	3	1	2	3	5	6	1	3	3	3	5	6	6
15	5	4	5	4	5	4	1	1	3	4	4	2	5	2	3	2	2	3	3	5	3
16	4	5	3	6	4	4	2	1	4	3	4	5	7	7	1	3	2	2	4	4	3
17	6	4	7	1	7	3	2	1	6	2	3	5	6	2	3	2	1	6	7	6	4
18	5	5	1	7	5	3	6	3	6	4	4	1	1	7	2	6	3	4	3	6	7
19	4	6	4	5	4	5	5	2	3	4	4	3	6	7	1	3	4	4	4	5	5
20	3	4	7	6	5	5	3	2	4	5	5	4	6	5	5	4	2	2	5	4	5
21	3	3	2	5	3	1	5	5	4	1	5	3	5	4	2	2	3	3	5	3	4
22	5	5	2	5	4	4	5	2	5	3	3	7	6	7	2	4	3	5	5	7	7
23	4	6	5	4	7	6	5	1	5	2	2	3	3	3	1	3	3	2	5	4	5
24	5	5	6	6	6	5	6	4	6	6	3	6	7	7	1	6	3	7	5	6	6
25	4	4	6	3	4	5	5	5	3	3	3	4	5	5	4	2	3	3	3	5	4
26	5	4	6	3	5	4	6	1	2	3	2	5	3	6	3	3	3	3	5	4	5
27	3	3	1	5	5	4	3	6	3	4	4	1	6	3	2	1	3	2	5	1	6
28	4	1	7	5	5	2	2	1	3	3	2	6	2	4	1	3	3	3	3	7	7
29	5	4	6	6	6	4	5	2	1	5	3	2	2	7	1	1	3	3	4	5	5
30	5	6	4	3	4	7	7	2	4	4	5	4	4	4	3	2	2	6	3	7	3
31	3	2	3	3	6	4	4	1	2	3	4	4	5	3	3	3	3	4	7	7	3
32	6	6	3	5	4	3	5	1	3	2	5	2	6	4	1	2	3	4	6	6	7
33	3	4	3	1	2	2	4	4	3	3	3	5	5	7	1	3	4	5	4	6	3
34	4	4	4	4	4	4	3	1	4	3	3	2	3	6	2	4	4	3	3	4	3
35	5	7	2	7	6	2	5	3	4	3	3	3	7	4	1	3	3	2	3	7	5
36	1	3	3	2	4	6	6	1	3	2	2	5	7	4	4	3	4	4	6	5	7
37	3	5	4	3	3	2	4	1	4	3	3	5	6	7	1	4	2	3	5	4	6
38	3	6	3	5	7	6	6	2	2	2	6	5	4	6	1	5	3	3	4	5	6
39	5	5	5	1	4	4	7	1	3	4	5	4	6	7	1	2	5	3	6	5	7
40	1	3	2	3	3	3	4	1	4	4	2	3	4	7	1	3	3	2	3	5	5

Table B-8: Responses of blind experiment for each clothing level and blind opening (free area 19%,34% and 60%)/Actor skin tone (type II)/observation duration 0.3s

Participant ID	Blind opening (free area)																				
	19%							34%							60%						
	Clothing level							Clothing level							Clothing level						
	1	2	3	4	5	6	7	1	2	3	4	5	6	7	1	2	3	4	5	6	7
1	1	2	7	4	2	4	6	1	3	4	2	5	6	6	1	3	2	4	5	4	7
2	5	2	5	4	5	5	4	1	3	2	2	6	6	7	1	2	2	4	5	6	7
3	1	2	2	2	5	5	7	1	2	3	3	4	6	6	1	3	3	4	4	5	7
4	5	2	3	2	4	7	7	1	2	3	4	4	6	6	1	2	4	4	5	6	7
5	1	4	2	3	4	6	6	1	3	3	2	4	6	6	1	3	4	4	3	6	7
6	3	3	3	2	5	1	4	1	3	2	4	3	6	6	1	3	3	2	5	6	7
7	2	2	3	4	5	6	7	1	2	3	5	4	6	7	1	2	3	4	5	6	7
8	1	5	1	1	2	2	2	2	2	2	4	5	6	6	1	3	2	4	5	6	7
9	3	2	3	3	3	1	5	1	2	2	4	4	6	2	1	3	3	3	5	6	7
10	1	3	2	4	4	6	5	1	2	3	4	3	1	6	1	3	3	4	5	6	6
11	1	2	1	2	5	3	5	1	3	2	3	3	6	7	1	2	2	4	5	6	7
12	1	1	2	2	6	7	7	1	2	1	4	5	6	7	1	2	2	4	5	6	7
13	2	1	3	2	4	5	6	1	3	2	4	5	6	6	1	2	3	4	5	6	7
14	1	3	2	3	4	6	4	1	3	2	2	5	7	7	1	2	3	2	5	6	7
15	2	3	3	3	4	6	6	1	3	2	2	5	6	7	1	2	2	4	5	6	6
16	1	3	2	6	3	3	5	1	3	2	2	1	7	7	1	2	3	4	5	7	7
17	1	1	7	6	4	7	6	1	2	2	2	4	7	6	1	2	2	4	5	7	7
18	3	2	3	4	6	6	6	1	3	3	3	4	6	7	1	2	2	4	5	6	7
19	1	2	3	4	3	6	6	1	3	3	2	5	5	7	1	3	3	4	5	6	6
20	1	3	2	4	3	6	6	1	2	2	3	5	7	6	1	3	3	3	5	6	6
21	2	1	2	2	3	4	5	1	3	2	3	5	7	6	1	2	3	4	4	6	7
22	2	1	2	4	5	5	7	1	2	2	4	4	6	7	1	2	2	2	5	6	7
23	1	1	5	4	4	3	2	1	4	3	4	4	6	6	1	3	3	4	5	7	6
24	1	3	3	4	4	6	7	1	4	3	3	4	3	7	1	2	3	4	5	6	7
25	1	3	2	4	4	4	3	1	2	2	4	5	2	7	1	2	3	4	5	7	6
26	1	5	3	6	2	6	7	1	2	3	3	4	7	6	1	2	3	4	5	6	7
27	1	2	2	3	4	6	2	1	2	2	3	5	4	1	1	3	3	4	5	6	7
28	4	1	3	4	5	7	7	1	2	3	4	6	7	7	1	3	3	4	4	6	7
29	1	3	2	3	4	1	5	1	3	3	1	5	6	6	1	2	3	4	5	7	7
30	1	3	6	3	6	5	6	1	1	2	3	3	6	7	1	2	2	3	5	6	6
31	1	4	2	3	4	6	2	1	2	2	4	5	7	6	1	3	3	4	5	7	7
32	4	2	3	4	5	5	7	1	2	2	4	3	6	7	1	2	3	4	4	7	7
33	1	2	4	4	4	4	4	1	4	3	4	5	4	5	1	2	4	3	4	6	7
34	3	3	4	4	6	4	6	1	3	3	3	1	5	6	1	3	3	3	5	6	6
35	1	4	3	2	4	7	5	1	2	3	2	7	6	3	2	2	2	3	3	7	7
36	1	3	3	4	5	6	6	1	2	3	4	5	6	7	1	3	3	4	5	6	7
37	1	3	3	4	5	6	7	1	3	3	3	4	6	6	1	3	3	4	5	6	7
38	2	2	3	3	4	6	5	5	3	2	2	3	6	5	1	3	3	3	5	7	7
39	1	3	3	3	2	6	7	1	3	3	4	4	6	7	1	3	3	4	5	7	7
40	1	4	2	3	4	5	5	1	2	3	3	5	6	7	1	3	3	3	4	6	7

Table B-9: Responses of blind experiment for each clothing level and blind opening (free area 3%,6% and 11%)/Actor skin tone (type VI)/observation duration 0.3s

Participant ID	Blind opening (free area)																				
	3%							6%							11%						
	Clothing level							Clothing level							Clothing level						
	1	2	3	4	5	6	7	1	2	3	4	5	6	7	1	2	3	4	5	6	7
1	7	7	7	3	7	7	6	7	2	5	5	4	7	7	7	7	3	7	7	7	6
2	7	7	4	2	1	1	7	1	7	2	2	6	4	5	2	7	1	3	3	4	5
3	2	6	3	4	2	3	4	5	4	3	4	4	6	6	1	2	3	3	4	3	3
4	4	5	5	4	5	6	6	7	4	3	4	3	3	6	4	5	6	4	5	7	4
5	4	2	4	4	2	4	3	1	3	1	2	3	4	6	3	2	4	3	3	4	4
6	6	5	6	4	7	5	1	4	3	3	3	3	6	4	4	4	4	6	3	6	4
7	6	4	5	5	6	7	5	2	4	3	3	2	6	4	4	2	4	7	4	6	4
8	4	2	5	1	2	4	3	3	4	4	4	6	1	6	3	4	3	3	3	3	5
9	2	4	5	4	6	1	4	3	2	1	2	4	3	3	6	2	5	1	6	6	6
10	1	1	1	5	1	1	1	6	1	3	3	4	1	5	3	4	4	5	3	2	1
11	4	5	5	5	3	4	5	3	3	3	4	3	3	4	2	4	3	5	4	4	4
12	3	1	3	2	4	6	6	3	6	3	2	3	5	6	1	2	2	3	4	6	6
13	4	4	2	2	3	5	6	3	1	3	4	5	6	5	4	4	3	5	6	7	5
14	4	7	2	3	3	4	5	3	5	4	3	5	3	6	4	2	3	3	5	5	5
15	4	4	2	2	4	4	5	2	2	2	2	5	3	5	2	2	2	3	4	2	4
16	1	5	4	3	2	4	1	1	6	3	2	5	7	4	1	1	5	6	4	2	5
17	5	4	5	1	7	2	5	1	5	5	2	2	3	5	3	4	6	7	6	6	6
18	6	3	7	2	3	4	4	1	1	6	3	5	3	6	1	6	4	7	6	6	7
19	3	3	4	3	5	5	4	2	2	3	3	6	5	6	3	4	3	4	5	5	1
20	5	5	2	2	3	5	6	3	2	4	4	5	4	4	3	5	2	2	3	6	6
21	6	5	5	2	2	4	2	3	4	2	3	3	2	1	1	2	1	3	3	3	4
22	3	3	7	3	5	7	5	2	4	2	3	5	6	6	3	4	6	4	4	6	7
23	5	6	7	4	4	7	6	1	2	4	2	3	4	6	3	3	5	3	3	2	3
24	5	5	4	4	6	6	6	5	6	4	7	6	6	3	5	6	7	6	4	6	6
25	4	5	6	6	6	3	1	2	3	4	2	4	5	3	3	3	3	2	3	3	4
26	4	5	4	5	6	4	6	1	2	3	3	4	6	5	3	4	5	5	4	4	6
27	2	4	5	5	2	5	5	1	6	2	3	4	3	5	5	2	2	1	2	5	3
28	3	5	4	4	7	5	5	2	2	6	3	6	3	3	1	3	4	4	6	2	5
29	6	5	3	6	2	3	5	1	1	5	1	2	6	2	1	2	3	2	3	6	5
30	5	5	5	3	3	4	5	4	3	7	2	6	7	6	6	4	5	6	3	4	6
31	3	5	5	2	4	6	3	3	6	4	4	1	5	6	4	6	2	3	5	6	3
32	4	2	4	6	3	5	5	2	2	5	3	2	7	5	1	5	6	3	4	5	5
33	3	2	2	3	4	2	1	3	3	4	4	3	4	6	2	4	3	4	4	7	3
34	4	4	4	4	4	4	3	1	4	3	3	2	3	6	2	4	4	3	3	4	3
35	1	2	4	4	4	5	7	1	1	5	2	2	5	4	3	6	3	6	3	3	2
36	3	5	6	6	4	5	5	2	7	5	3	4	6	7	5	6	5	4	5	6	4
37	5	5	4	5	3	5	5	5	5	3	4	6	5	7	3	4	5	3	6	3	6
38	6	5	4	3	5	5	5	3	4	3	6	5	5	4	2	6	2	3	4	6	4
39	4	6	4	5	6	6	2	2	2	4	6	3	6	6	6	2	4	2	4	4	4
40	5	4	4	3	3	5	6	3	5	2	3	3	4	5	4	2	4	2	3	4	4

Table B-10: Responses of blind experiment for each clothing level and blind opening (free area 19%,34% and 60%)/Actor skin tone (type VI)/observation duration 0.3s

Participant ID	Blind opening (free area)																				
	19%							34%							60%						
	Clothing level							Clothing level							Clothing level						
	1	2	3	4	5	6	7	1	2	3	4	5	6	7	1	2	3	4	5	6	7
1	2	4	3	3	7	5	6	1	2	1	2	4	7	6	1	2	3	4	5	7	7
2	7	1	2	2	4	2	4	4	5	5	3	2	6	4	2	3	3	3	2	7	6
3	1	4	2	4	4	6	5	1	3	4	4	4	7	5	1	2	3	4	4	6	5
4	3	3	3	3	3	4	5	5	3	3	4	5	6	6	1	2	2	4	6	6	6
5	5	1	4	5	3	5	6	4	2	3	3	3	6	6	1	2	3	4	4	6	5
6	2	3	3	4	5	4	3	3	2	1	3	5	1	4	1	3	3	4	6	6	6
7	3	2	3	3	6	3	6	1	3	3	3	3	6	6	1	2	3	4	5	6	6
8	5	2	5	4	6	2	4	1	4	5	1	5	4	4	1	6	3	2	1	3	4
9	1	3	3	2	3	1	3	1	1	1	3	1	5	1	1	3	1	3	5	6	6
10	4	3	3	3	1	3	5	3	1	3	3	6	6	6	1	2	4	4	5	6	6
11	1	5	4	4	4	6	6	5	3	4	3	3	7	6	1	4	3	3	5	6	6
12	3	4	2	6	4	6	6	1	2	2	3	5	4	7	1	2	2	2	5	6	7
13	1	6	3	3	3	6	6	1	2	3	4	4	6	7	1	2	3	4	5	6	7
14	2	2	4	3	5	6	4	1	3	1	2	4	7	6	1	3	3	3	5	7	6
15	4	3	4	5	5	3	2	1	4	6	3	5	6	6	1	2	3	4	2	6	6
16	2	1	3	3	4	6	4	1	3	2	3	5	6	6	1	4	2	4	5	6	6
17	6	5	6	2	4	7	6	1	3	2	3	5	6	3	1	3	2	4	5	6	7
18	2	6	2	2	6	5	6	1	5	1	4	5	7	7	1	3	2	4	4	6	6
19	3	3	4	4	4	4	5	1	3	3	5	5	6	5	1	3	2	4	5	6	7
20	3	4	2	3	6	5	7	1	2	2	2	2	6	6	1	3	3	2	4	6	6
21	3	3	2	5	5	2	4	1	4	1	2	5	7	3	1	5	4	2	5	6	7
22	1	2	3	4	4	6	6	1	3	3	4	5	4	6	1	3	2	4	5	6	6
23	2	6	4	5	5	5	4	2	2	2	4	7	6	6	1	3	2	2	5	6	7
24	1	6	1	3	5	6	7	1	4	3	4	3	6	6	1	2	3	2	5	6	6
25	2	3	2	4	5	3	6	1	4	3	5	5	4	6	1	2	3	4	5	6	6
26	2	2	5	3	5	6	6	1	3	2	2	1	6	6	1	3	2	3	5	6	7
27	1	3	1	3	5	6	3	1	1	3	3	5	3	6	1	4	3	4	5	7	6
28	1	2	2	3	5	6	1	1	3	2	3	5	1	6	1	4	3	4	5	6	6
29	3	6	2	4	4	3	6	1	4	3	4	1	6	6	1	3	2	4	5	4	6
30	1	4	3	4	2	6	6	1	5	2	3	2	6	6	1	2	2	2	4	6	6
31	4	2	3	1	4	6	6	1	4	2	4	4	7	7	1	1	3	4	5	6	7
32	1	1	2	2	3	6	7	1	2	4	3	6	6	7	1	1	3	4	4	7	5
33	4	4	3	3	4	5	7	2	4	2	4	4	6	6	2	2	4	3	4	6	6
34	3	3	4	4	6	4	6	1	3	2	4	3	3	5	1	6	3	4	5	7	7
35	7	2	3	2	4	5	5	1	2	2	3	4	5	5	1	2	3	3	4	7	6
36	1	5	3	4	2	6	7	2	3	3	2	4	6	7	1	3	3	4	5	6	7
37	3	4	2	4	6	5	7	1	3	4	4	5	7	7	1	4	3	4	5	6	7
38	1	6	2	3	4	4	5	2	5	2	3	5	5	5	1	2	1	3	5	6	7
39	1	3	3	3	5	6	7	1	3	3	4	4	6	5	1	4	3	4	5	7	6
40	1	2	3	3	3	4	6	2	3	3	2	5	6	6	1	2	2	3	5	6	6

Table B-11: Responses of blind experiment for each clothing level and blind opening (free area 3%,6% and 11%)/Actor skin actor tone (type II)/observation duration 3.0s

Participant ID	Blind opening (free area)																				
	3%							6%							11%						
	Clothing level							Clothing level							Clothing level						
	1	2	3	4	5	6	7	1	2	3	4	5	6	7	1	2	3	4	5	6	7
1	3	4	3	7	7	7	7	2	2	1	3	5	6	7	1	2	3	3	5	6	7
2	3	3	2	3	4	6	7	1	2	2	2	3	6	7	1	1	3	3	2	6	7
3	1	2	2	3	4	1	6	1	2	2	4	5	6	7	1	2	3	4	4	6	6
4	4	6	3	4	4	6	7	1	3	3	4	4	6	7	1	3	2	4	5	6	6
5	4	3	4	3	6	4	4	1	2	3	2	5	6	6	1	3	2	3	2	6	7
6	5	5	4	4	5	5	4	1	2	3	4	4	6	7	2	3	3	4	5	4	4
7	6	3	7	5	2	4	7	1	3	4	5	5	6	3	1	2	2	3	5	4	7
8	5	1	2	5	2	3	1	3	1	2	2	4	5	1	1	2	3	2	1	3	6
9	1	2	4	5	2	6	2	1	2	3	4	4	5	7	1	2	3	4	5	6	7
10	1	1	1	1	1	3	4	1	2	3	3	3	6	6	1	3	3	4	4	6	7
11	1	4	4	4	4	6	5	1	2	3	3	4	6	7	1	4	3	4	4	6	7
12	3	1	2	4	4	3	3	1	2	3	4	3	6	7	1	2	3	3	5	6	7
13	1	3	3	6	6	6	6	1	2	3	4	6	6	7	1	2	3	4	6	6	7
14	4	2	2	6	6	4	4	2	2	3	3	6	7	7	1	2	4	3	5	6	7
15	4	3	4	6	6	6	3	3	6	3	4	5	7	6	1	3	3	3	6	6	7
16	4	3	3	2	2	6	4	1	2	3	4	5	6	7	1	3	3	3	3	2	7
17	5	2	5	4	3	4	7	1	2	3	2	4	6	7	1	2	4	4	7	4	7
18	3	5	5	3	6	3	7	1	3	2	4	5	7	6	1	2	3	3	5	4	6
19	2	6	3	3	5	6	6	1	3	3	4	5	7	7	1	2	3	4	5	6	7
20	1	4	6	6	4	5	2	1	2	3	2	5	6	7	1	2	3	3	4	6	6
21	1	2	3	5	6	7	7	1	3	3	3	6	6	7	1	3	3	5	5	6	7
22	3	4	3	4	3	6	6	1	2	3	4	4	6	7	1	2	4	5	6	7	7
23	7	1	7	1	1	2	4	1	4	3	3	4	6	6	1	2	3	3	4	6	7
24	3	3	6	3	2	6	6	1	2	3	4	2	6	6	1	2	2	4	4	6	7
25	5	3	5	6	5	5	2	1	2	2	3	6	6	6	2	3	3	5	3	6	5
26	4	2	3	6	4	6	6	1	2	1	4	4	6	7	1	3	3	2	5	6	6
27	1	3	4	5	6	7	7	1	3	3	3	5	6	6	1	3	2	3	5	7	6
28	4	4	2	4	2	5	1	2	3	3	4	5	7	6	1	2	3	4	5	7	6
29	1	4	3	6	4	7	7	1	2	2	4	5	6	7	1	2	3	4	4	6	7
30	5	6	5	3	6	6	6	1	3	3	3	4	7	7	2	2	2	5	5	6	6
31	3	6	2	5	4	3	6	1	2	2	3	5	7	7	1	2	3	3	5	6	7
32	5	2	5	4	4	6	5	1	2	3	3	5	5	5	1	2	3	4	5	6	6
33	4	6	3	6	6	5	6	1	3	3	3	3	7	7	1	2	3	3	3	7	7
34	1	2	4	3	4	4	4	1	1	6	4	3	7	4	1	2	2	3	4	4	5
35	5	2	4	2	3	4	2	1	2	2	4	4	7	7	1	3	3	4	4	7	7
36	2	3	2	2	4	7	5	1	1	3	4	5	7	6	1	2	3	3	5	6	7
37	2	3	3	6	4	2	7	1	2	2	4	5	6	7	1	2	4	3	4	6	7
38	4	6	3	6	3	4	6	1	3	1	3	5	6	5	1	2	2	3	3	7	7
39	1	3	6	5	4	7	6	1	2	3	4	5	6	7	1	2	3	4	5	6	7
40	4	4	2	3	3	3	4	1	3	2	3	3	5	7	1	2	3	3	5	6	7

Table B-12: Responses of blind experiment for each clothing level and blind opening (free area 19%,34% and 60%)/Actor skin tone (type II)/observation duration 3.0s

Participant ID	Blind opening (free area)																				
	19%							34%							60%						
	Clothing level							Clothing level							Clothing level						
	1	2	3	4	5	6	7	1	2	3	4	5	6	7	1	2	3	4	5	6	7
1	2	2	2	2	4	3	7	1	2	2	4	4	6	7	1	2	3	4	5	6	7
2	1	2	3	4	5	6	7	1	2	3	4	4	6	7	1	2	3	3	4	6	7
3	1	2	3	4	5	6	7	1	2	3	4	5	6	6	1	2	3	4	5	6	7
4	1	2	2	3	4	7	7	1	2	3	3	5	6	7	1	2	3	4	5	6	6
5	1	1	3	3	5	6	7	1	2	3	3	5	6	7	1	2	3	4	5	6	7
6	1	2	3	4	4	7	6	1	2	3	4	5	5	7	1	3	3	4	5	6	7
7	1	2	3	5	5	6	7	1	2	3	4	5	6	7	1	2	3	4	5	6	7
8	1	2	1	2	5	5	3	1	2	2	3	4	6	7	1	1	3	3	5	6	7
9	1	2	2	4	5	6	7	1	2	3	4	4	6	7	1	2	3	4	5	6	7
10	1	2	3	3	5	6	7	1	2	3	3	5	6	7	1	2	3	4	5	6	7
11	1	2	3	3	2	6	7	1	2	3	4	5	6	7	1	2	3	4	5	6	7
12	1	3	3	4	5	6	7	1	2	3	3	5	6	7	1	2	3	4	5	6	7
13	1	2	3	4	6	6	7	1	2	3	4	5	7	7	1	2	3	4	5	6	7
14	1	2	2	4	5	6	7	1	2	3	4	5	6	7	1	2	3	4	5	6	7
15	1	3	3	3	4	6	7	1	2	3	4	5	6	7	1	3	3	4	5	6	7
16	1	2	2	4	4	6	7	1	2	3	3	5	6	7	1	2	3	4	5	6	7
17	1	2	3	4	5	7	6	1	2	4	4	5	6	7	1	2	3	4	5	6	7
18	1	2	3	4	5	6	7	1	2	3	4	5	6	7	1	2	3	4	5	6	7
19	1	4	3	4	5	6	7	1	2	3	4	5	6	7	1	2	3	4	5	6	7
20	1	2	3	3	4	6	6	1	2	3	3	5	6	6	1	2	3	4	5	6	7
21	1	2	2	4	4	6	7	1	2	3	3	4	6	7	1	2	3	4	5	6	7
22	1	2	3	4	5	6	7	1	2	3	4	5	6	7	1	2	3	4	5	6	7
23	1	2	3	4	4	6	5	1	2	3	4	5	6	7	1	2	3	4	5	6	7
24	1	2	3	4	5	6	7	1	2	3	4	5	6	7	1	2	3	4	5	6	7
25	1	2	2	4	3	7	6	1	2	3	3	5	6	6	1	2	3	4	5	6	7
26	1	3	2	2	5	6	7	1	3	3	4	5	6	7	1	2	3	4	5	6	7
27	1	2	3	4	5	6	6	1	3	3	4	5	7	7	1	2	2	4	5	6	7
28	1	2	3	4	4	5	5	1	2	3	4	5	6	5	1	2	3	4	5	6	7
29	1	2	2	3	5	6	7	1	2	3	4	5	6	7	1	2	3	4	5	6	7
30	1	2	2	3	3	6	7	1	2	3	3	5	6	7	1	2	3	4	5	6	7
31	1	2	3	4	5	6	7	1	3	3	3	4	6	6	1	2	3	4	5	6	7
32	1	2	3	4	5	6	7	1	2	3	4	5	7	7	1	2	3	4	5	6	7
33	1	2	2	4	5	6	7	1	2	3	4	5	6	7	1	2	3	4	4	6	7
34	1	2	2	4	6	6	6	1	2	3	4	5	6	7	1	2	3	4	5	6	6
35	1	3	3	3	4	6	6	1	2	3	3	5	6	7	1	2	3	4	5	6	7
36	1	2	3	3	5	6	7	1	2	3	4	5	6	7	1	2	3	4	4	6	7
37	1	2	3	3	5	6	7	1	2	3	4	5	6	7	1	2	3	4	5	6	7
38	1	2	3	4	5	5	7	1	4	3	4	6	6	6	1	2	3	4	5	6	7
39	1	2	2	4	5	6	7	1	2	3	4	5	6	7	1	2	3	4	5	6	7
40	1	2	3	3	4	6	7	1	2	3	3	4	6	7	1	2	3	4	4	7	7

Table B-13: Responses of blind experiment for each clothing level and blind opening (free area 3%,6% and 11%)/Actor skin tone(type VI)/observation duration 3.0s

Participant ID	Blind opening (free area)																				
	3%							6%							11%						
	Clothing level							Clothing level							Clothing level						
	1	2	3	4	5	6	7	1	2	3	4	5	6	7	1	2	3	4	5	6	7
1	4	7	7	2	7	7	6	1	2	3	4	4	6	7	4	3	4	3	5	6	6
2	5	2	5	3	7	3	1	1	3	4	4	6	6	6	1	6	3	1	4	6	6
3	2	1	2	1	1	3	5	2	2	4	4	3	6	6	1	3	2	4	4	6	7
4	3	6	4	4	6	4	5	1	4	3	4	4	6	6	1	3	3	1	5	5	7
5	3	5	3	4	4	6	6	1	1	4	3	5	6	7	2	2	1	3	2	6	7
6	5	3	3	4	4	5	3	1	4	3	4	4	6	2	3	2	3	3	5	5	4
7	2	2	6	7	4	4	3	6	1	3	4	6	4	6	2	5	6	3	7	6	5
8	2	1	5	1	4	3	1	1	1	1	1	2	6	1	1	3	3	1	4	5	6
9	3	4	5	6	3	2	1	1	2	2	1	4	3	5	1	1	2	2	6	5	6
10	2	1	2	1	1	1	1	1	1	3	1	3	6	7	1	2	3	1	4	6	6
11	4	3	3	4	4	4	3	1	2	4	1	4	6	5	1	4	1	1	3	6	6
12	5	7	5	2	5	7	4	1	2	3	3	4	7	6	1	2	2	3	5	6	7
13	2	1	5	5	6	3	5	1	2	4	4	5	6	6	1	3	3	4	5	6	7
14	5	3	5	6	6	2	3	2	2	3	4	5	6	7	1	2	3	4	5	5	7
15	4	4	6	3	4	5	4	1	3	3	4	3	6	6	1	3	3	4	3	6	6
16	3	4	3	3	4	2	3	1	3	2	3	6	7	6	1	5	3	1	4	4	7
17	3	4	4	7	4	1	5	1	2	2	3	4	6	7	3	2	5	4	4	7	6
18	2	6	5	7	5	6	6	1	7	3	3	6	6	6	1	3	3	4	5	6	6
19	2	4	4	5	6	6	2	1	3	2	4	6	7	7	1	3	4	4	5	6	6
20	5	5	5	2	6	6	6	1	2	2	3	5	6	6	1	2	3	3	5	7	6
21	2	6	2	3	4	6	3	1	2	2	3	5	6	6	1	1	3	2	4	6	6
22	1	2	3	4	5	6	7	1	2	2	4	5	6	7	1	2	2	4	5	6	6
23	3	4	1	1	5	4	7	1	3	3	3	5	7	6	1	4	3	3	5	6	6
24	6	4	6	4	6	6	6	1	1	3	3	4	6	6	1	2	4	3	5	6	4
25	5	4	6	5	5	3	4	4	4	5	6	5	4	6	1	3	3	3	4	7	6
26	2	4	2	5	4	6	4	1	7	1	5	5	6	7	1	2	4	4	4	7	7
27	3	4	2	4	6	4	5	1	1	5	2	5	6	6	1	6	3	2	5	6	6
28	2	4	2	1	5	6	1	1	3	2	5	4	7	7	1	2	3	1	4	4	6
29	4	5	6	6	6	4	6	1	2	3	3	5	7	6	1	3	3	2	5	6	6
30	6	5	5	2	5	5	5	1	2	2	5	5	6	6	4	4	4	4	5	6	6
31	1	4	5	2	3	4	6	2	3	3	4	5	6	7	1	4	3	2	4	7	7
32	3	4	4	6	6	6	6	1	2	2	3	4	6	4	1	2	3	2	5	7	7
33	3	3	6	3	5	5	6	1	2	2	2	4	6	6	2	3	3	3	4	7	7
34	4	4	4	5	4	4	4	1	5	2	4	7	6	7	1	2	2	4	7	6	7
35	5	3	4	5	3	5	6	3	1	3	3	1	5	6	1	3	2	4	5	6	6
36	4	4	4	4	4	3	6	1	2	2	4	5	6	6	1	3	1	5	4	6	6
37	2	4	5	3	5	7	6	1	4	2	4	4	6	6	1	2	3	3	3	7	7
38	6	5	2	5	5	3	4	1	1	3	3	4	6	4	1	5	3	3	5	6	7
39	6	4	5	5	4	4	6	1	2	3	4	5	6	7	1	2	3	4	5	6	6
40	4	5	2	6	6	4	5	1	4	4	1	5	6	6	1	3	2	2	4	6	6

Table B-14: Responses of blind experiment for each clothing level and blind opening (free area 19%,34% and 60%)/Actor skin tone (type VI)/observation duration 3.0s

Participant ID	Blind opening (free area)																				
	19%							34%							60%						
	Clothing level							Clothing level							Clothing level						
	1	2	3	4	5	6	7	1	2	3	4	5	6	7	1	2	3	4	5	6	7
1	1	1	3	2	2	6	6	1	2	1	4	5	6	6	1	2	3	4	5	6	7
2	1	2	3	4	3	6	6	1	2	2	4	4	6	4	1	2	3	3	4	6	6
3	1	1	2	4	5	6	7	1	2	2	4	5	6	5	1	2	3	4	5	7	7
4	1	2	3	4	6	6	6	1	1	2	4	5	6	6	1	2	3	4	5	6	7
5	1	1	3	3	6	7	6	1	2	2	4	5	6	7	1	2	3	4	4	7	6
6	2	4	3	4	4	6	5	1	2	3	4	5	7	6	1	2	3	4	5	6	7
7	1	2	2	3	5	4	5	1	2	3	4	5	5	7	1	2	3	4	5	7	5
8	1	6	2	4	5	3	3	1	2	1	3	6	6	6	1	3	3	3	5	6	6
9	1	1	2	1	5	6	7	1	2	3	4	5	6	6	1	2	3	5	5	6	7
10	1	1	4	3	2	6	6	1	2	3	3	5	7	6	1	2	3	3	5	6	7
11	1	3	3	3	3	6	7	1	2	2	4	4	7	6	1	2	3	4	4	6	7
12	1	1	1	4	5	6	7	1	2	3	4	5	6	6	1	2	2	4	5	6	7
13	1	1	3	4	5	6	6	1	2	2	4	5	6	6	1	2	3	4	5	6	7
14	1	3	3	4	2	6	7	1	2	3	4	5	6	7	1	2	3	4	5	6	7
15	1	3	3	4	4	6	6	1	3	3	4	5	6	7	1	2	3	4	5	6	7
16	1	1	3	4	5	3	6	1	1	3	4	5	6	6	1	3	3	4	5	6	6
17	1	1	2	1	5	6	5	1	2	2	4	5	7	6	1	2	3	4	5	6	7
18	2	5	2	3	5	7	6	1	2	3	4	5	7	7	1	2	3	3	5	6	7
19	1	2	2	4	5	6	6	1	3	3	4	5	6	6	1	2	3	4	5	6	7
20	1	4	3	3	5	7	6	1	2	3	4	5	6	7	1	2	3	3	5	7	7
21	1	3	2	4	5	6	7	1	2	3	3	5	6	6	1	2	3	4	5	6	7
22	1	2	2	4	5	6	7	1	2	3	4	5	6	7	1	2	2	4	5	6	6
23	3	2	3	3	5	6	7	1	2	3	4	5	7	7	1	2	3	4	5	6	7
24	1	3	3	4	5	6	7	1	3	3	3	5	6	7	1	2	3	4	5	6	7
25	1	5	3	5	4	6	5	1	2	2	4	5	6	6	1	2	3	4	4	6	6
26	1	1	3	3	5	6	6	1	2	3	4	5	7	6	1	3	3	4	5	6	7
27	1	2	1	3	5	7	6	1	2	3	4	5	7	6	1	2	3	4	5	6	7
28	1	2	3	3	5	6	6	1	2	3	4	5	6	7	1	2	3	4	5	6	6
29	1	1	2	4	5	4	6	1	2	3	4	4	6	6	1	2	2	4	5	6	7
30	1	1	3	4	4	6	6	1	1	3	4	5	6	6	1	2	3	3	6	6	7
31	1	2	2	4	5	6	7	1	3	2	2	4	6	6	1	2	3	4	5	6	7
32	1	2	3	2	4	7	6	1	2	3	4	5	6	7	1	2	3	4	5	6	7
33	1	2	3	4	5	7	6	1	2	3	4	5	7	7	1	2	3	4	5	7	7
34	1	2	2	4	6	5	7	1	2	3	4	5	6	6	1	2	3	4	5	6	6
35	1	1	3	3	4	6	6	1	2	3	4	5	6	6	1	2	3	4	5	6	6
36	1	1	2	4	5	6	6	1	1	3	4	5	6	6	1	2	3	4	5	6	7
37	1	3	1	4	5	6	7	1	2	3	4	5	6	6	1	2	3	4	5	6	6
38	1	4	2	4	4	6	6	1	1	3	4	5	6	7	1	2	3	4	5	7	6
39	1	3	2	4	2	6	6	1	2	2	4	5	6	7	1	2	3	4	5	6	7
40	1	2	2	3	4	6	6	1	2	2	3	5	6	5	1	2	3	3	5	6	6

Table B-15: Normality profile for: The effect of blind opening (free areas 3% and 6%) on visibility value. Actor skin tone type II, Observation time: 0.3 sec.

Blind opening (free area %)		**3%**							**6%**						
Clothing level Normality profile		1	2	3	4	5	6	7	1	2	3	4	5	6	7
(Yes if median is in 95% CI for mean)	Mean	3.70	4.35	3.93	4.03	4.53	4.03	4.50	2.42	3.35	3.23	3.55	3.95	4.72	5.08
	Confidence interval for mean	3.19_ 4.21	3.85_ 4.85	3.33_ 4.52	3.43_ 4.62	3.99- 5.06	3.53_ 4.52	3.96_ 5.04	1.93_ 2.92	2.99_ 3.71	2.85_ 3.60	3.08_ 4.02	3.48_ 4.42	4.19_ 5.26	4.47_ 5.68
	Median	4.0	4.0	4.0	4.0	5	4	5	2	3	3	3	4	5	6
Normality		**Yes**	**Yes**	**Yes**	**No**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**No**	**Yes**	**Yes**	**No**
Graphical	Histogram	No	No	No	No	No	Near	Near	No	Yes	Yes	Near	No	No	No
	Box Plot	Yes	No	Yes	Yes	Near	Near	Near	Near	Near	Near	Near	Yes	Near	Near
Normality		**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**Yes**	**No**	**No**
Measures of dispersion (Yes if both are yes)	Skewness (within ±0.5)	-0.28 Yes	-0.19 Yes	0.11 Yes	-0.11 Yes	-0.45 Yes	-0.08 Yes	-0.41 Yes	0.84 No	0.74 No	0.31 Yes	0.28 Yes	0.04 Yes	-0.66 No	-0.50 Yes
	Kurtosis (within ±1.0)	-0.66 Yes	-.48 Yes	-1.05 No	-0.84 Yes	-0.28 Yes	-0.54 Yes	-0.67 Yes	-.36 Yes	0.81 Yes	0.34 Yes	-0.37 Yes	-0.42 Yes	-0.39 Yes	-1.1 No
Normality		**Yes**	**Yes**	**No**	**Yes**	**Yes**	**Yes**	**Yes**	**No**	**No**	**Yes**	**Yes**	**Yes**	**No**	**No**
Statistical tests Shapiro-Wilks	statistic level of significance	0.005 No	0.06 Yes	0.028 No	0.019 No	0.020 No	0.082 Yes	0.025 No	<0.001 No	<.001 No	0.007 No	0.05 No	0.068 Yes	.003 No	<.001 No
Kolmogorov-Smirnov (not normal if $p<0.05$ (Yes if both are yes)	statistic level of significance	0.001 No	0.051 No	0.041 No	0.003 No	0.020 No	0.006 No	0.007 No	<.001 No	<.001 No	<.001 No	<.001 No	.008 No	<.001 No	<.001 No
Normality		**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**Yes**	**No**
OVERALL ASSESSMENT OF NORMALITY		**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**Yes**	**No**	**No**

Table B-16: Normality profile for: The effect of blind opening (free areas 11% and 19%) on visibility value. Actor skin tone type II, Observation time: 0.3 sec

Blind opening (free area %)		11%							19%						
Clothing level / Normality profile		1	2	3	4	5	6	7	1	2	3	4	5	6	7
(Yes, if median is in 95% CI for mean)	Mean	2.03	2.98	2.98	3.88	4.28	5.28	4.97	1.70	2.53	2.98	3.40	4.13	5	5.38
	Confidence interval for mean	1.61_ 2.44	2.56_ 3.39	2.74_ 3.21	3.39_ 4.36	3.89_ 4.66	4.85_ 5.70	4.42_ 5.53	1.33_ 2.07	2.19_ 2.86	2.54_ 3.41	3.04_ 3.76	3.78_ 4.47	4.46_ 5.54	4.88_ 5.87
	Median	1.50	3	3	3.50	4	5	5	1	2.50	3.00	3.50	4	6	6
Normality		**No**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**No**	**Yes**	**Yes**	**Yes**	**Yes**	**No**	**No**
Graphical	Histogram	No	Yes	Yes	No	No	No	No	No	No	No	No	Yes	No	No
	Box Plot	No	Near	Near	Near	Near	Near	Near	No	Near	Near	Near	Near	Near	Near
Normality		**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**
Measures of dispersion (Yes, if both are yes)	Skewness (within ±0.5)	1.23 No	0.5 Yes	0.39 No	0.68 No	0.42 Yes	-0.75 No	-0.39 Yes	1.66 **No**	0.40 Yes	1.56 **No**	0.37 Yes	-0.26 Yes	-1.09 **No**	-0.93 **No**
	Kurtosis (within ±1.0)	1.09 No	0.081 Yes	1.40 No	-0.53 Yes	-0.44 Yes	1.26 No	-0.88 Yes	1.90 **No**	-0.10 Yes	2.62 **No**	0.51 Yes	-0.18 Yes	0.50 Yes	0.11 Yes
Normality		**No**	**Yes**	**No**	**No**	**No**	**No**	**Yes**	**No**	Yes	**No**	Yes	Yes	**No**	**No**
Statistical tests Shapiro-Wilks	statistic level of significance	<.001 No	0.007 No	<.000 No	0.001 No	0.005 No	0.002 No	0.002 No	<.001 No	0.002 No	<.001 No	<.001 No	0.002 No	<.001 No	<.001 No
Kolmogorov-Smirnov (Not normal if p<0.05 (Yes, if both are yes)	statistic level of significance	<.001 No	<.001 No	<.001 No	<.001 No	0.003 No	0.013 No	0.018 No	<.001 No	0.001 No	<.001 No	<.001 No	<.001 No	<.001 No	<.001 No
Normality		**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**
OVERALL ASSESSMENT OF NORMALITY		**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**

Table B-17: Normality profile for: The effect of blind opening (free areas 34% and 60%) on visibility value. Actor skin tone type II, Observation time: 0.3 sec

Blind opening (free area %)		34%							60%						
Clothing level / Normality profile		1	2	3	4	5	6	7	1	2	3	4	5	6	7
(Yes, if median is in 95% CI for mean)	Mean	1.13	2.55	2.50	3.15	4.28	5.75	6.10	1.02	2.48	2.80	3.65	4.75	6.18	6.80
	Confidence interval for mean	0.92_ 1.33	2.33_ 2.77	2.31_ 2.69	2.86_ 3.44	3.90_ 4.65	5.34_ 6.16	5.67_ 6.53	0.97_ 1.08	2.31_ 2.64	2.62_ 2.98	3.45_ 3.85	4.58_ 4.92	5.98_ 6.37	6.67_ 6.67
	Median	1.00	2.50	2.50	3.00	4.00	6.00	6.00	1.00	2.00	3.00	4.00	5.00	6.00	7.00
Normality		**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**No**	**No**	**No**	**No**	**Yes**	**No**
Graphical	Histogram	No	No	No	No	Near	No	No	No	Yes	Yes	Near	No	No	No
	Box Plot	No	Near	Near	Near	Near	No	No	Near	Near	Near	Near	Yes	Near	Near
Normality		**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**Yes**	**No**	**No**
Measures of dispersion	Skewness (within ±0.5)	5.83 No	0.33 Yes	0.00 Yes	-0.31 Yes	-0.76 No	-2.18 No	-2.50 No	0.84 No	0.74 No	0.31 Yes	0.28 Yes	0.40 Yes	-0.66 Yes	-0.51 No
(Yes, if both are yes)	Kurtosis (within ±1.0)	35.10 No	-0.19 Yes	-0.34 Yes	-0.79 Yes	1.80 No	5.26 No	6.76 No	-0.36 Yes	0.81 Yes	0.34 Yes	-0.37 Yes	-0.42 Yes	-0.39 Yes	-1.10 No
Normality		**No**	**Yes**	**Yes**	**Yes**	**No**	**No**	**No**	**No**	**No**	**Yes**	**Yes**	**Yes**	**Yes**	**No**
Statistical tests Shapiro-Wilks	statistic level of significance	<.001	<.001 No	<.001 No	<.001 No	0.001 No	<.001 No	<.001 No	<.001 No	<.001 No	0.007 No	0.055 Yes	0.068 Yes	0.003 No	<.001 No
Kolmogorov-Smirnov (Not normal if p<0.05 (Yes, if both are yes)	statistic level of significance	<.001 No	<.001 No	<.001 No	<.001 No	<.001 No	<.001 No	<.001 No	<.001 No	<.001 No	<.001 No	<.001 No	0.008 No	<.000 No	<.001 No
Normality		**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**
OVERALL ASSESSMENT OF NORMALITY		**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**Yes**	**No**	**No**

Table B-18: Normality profile for: The effect of blind opening (free areas 3% and 6%) on visibility value. Actor skin tone type VI, Observation time: 0.3 s

Blind opening (free area %)		3%							6%						
Clothing level Normality profile		1	2	3	4	5	6	7	1	2	3	4	5	6	7
(Yes, if median is in 95% CI for mean)	Mean	4.08	4.30	4.30	3.60	3.98	4.45	4.38	2.59	3.46	3.54	3.18	3.95	4.56	4.95
	Confidence interval for mean	3.58_ 4.57	3.81_ 4.79	3.82_ 4.78	3.15_ 4.05	3.42_ 4.53	3.94_ 4.96	3.82_ 4.93	2.10_ 3.08	2.88_ 4.04	3.10_ 3.98	2.77_ 3.59	3.48_ 4.41	4.03_ 5.09	4.50_ 5.40
	Median	4.00	5.00	4.00	4.00	4.00	5.00	5.00	2.00	3.00	3.00	3.00	4.00	5.00	5.00
Normality		**Yes**	**No**	**Yes**	**Yes**	**Yes**	**No**	**No**	**No**	**Yes**	**No**	**Yes**	**Yes**	**Yes**	**Yes**
Graphical	Histogram	Yes	No	No	No	No	No	No	No	No	Yes	No	No	No	No
	Box Plot	Yes	No	No	Near	Near	No	Near	No	Near	No	No	Near	Near	No
Normality		**Yes**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**
Measures of dispersion (Yes, if both are yes)	Skewness (within ±0.5)	-0.17 Yes	-044 Yes	-056 Yes	0.05 Yes	0.25 Yes	-0.51 Yes	-0.76 No	1.05 No	0.38 Yes	0.38 Yes	1.16 No	-0.07 Yes	-0.34 Yes	-0.82 No
	Kurtosis (within ±1.0)	-0.37 Yes	-0.18 Yes	-0.15 Yes	-0.81 Yes	-095 Yes	0.12 Yes	-0.41 Yes	0.98 Yes	-0.92 Yes	.070 Yes	1.71 No	1.02 No	-0.648 Yes	0.43 Yes
Normality		**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**No**	**No**	**Yes**	**Yes**	**No**	**Yes**	**Yes**	**No**
Statistical tests Shapiro-Wilks	statistic level of significance	0.075 Yes	0.005 No	0.21 Yes	0.28 Yes	0.19 Yes	0.10 Yes	<0.001 No	<0.001 No	0.010 No	0.054 Yes	<0.001 No	.010 No	0.015 No	0.003 No
Kolmogorov-Smirnov (Not normal if p<0.05 (Yes, if both are yes)	statistic level of significance	0.016 No	<0.001 No	=0.001 No	0.042 No	0.010 No	=0.001 No	<.001 No	<0.001 No	0.003 No	0.001 No	<0.001 No	0.017 No	0.007 No	<.001 No
Normality		**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**
OVERALL ASSESSMENT OF NORMALITY		**Yes**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**

Table B-19: Normality profile for: The effect of blind opening (free areas 11% and 19%) on visibility value. Actor skin tone type VI, Observation time: 0.3 sec

Blind opening (free area %)		11%							19%						
Clothing level Normality profile		1	2	3	4	5	6	7	1	2	3	4	5	6	7
(Yes, if median is in 95% CI for mean)	Mean	3.10	3.78	3.73	3.90	4.10	4.65	4.45	2.58	3.35	2.95	3.38	4.33	4.72	5.28
	Confidence interval for mean	3.72_ 4.48	3.26_ 4.29	3.26_ 4.19	3.36_ 4.44	3.72_ 4.48	4.14_ 5.16	3.99_ 4.91	2.04_ 3.11	2.86_ 3.84	2.61_ 3.29	3.05_ 3.70	3.92_ 4.73	4.25_ 5.20	4.81_ 5.74
	Median	3.00	4.00	4.00	3.00	4.00	5.00	4.00	2.00	3.00	3.00	3.00	4.00	5.00	6.00
Normality		**No**	**Yes**	**Yes**	**No**	**Yes**	**Yes**	**Yes**	**No**	**Yes**	**Yes**	**No**	**Yes**	**Yes**	**No**
Graphical	Histogram	No	No	Near	No	No	No	No	No	No	Near	Near	Near	No	No
	Box Plot	No	Near	Yes	No	Near	Near	No	No	Near	Near	No	No	Near	No
Normality		**No**	**No**	**Yes**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**
Measures of dispersion	Skewness (within ±0.5)	0.50 Yes	0.30 Yes	0.19 Yes	0.43 Yes	0.65 No	-0.24 Yes	-0.42 Yes	1.13 No	0.38 Yes	0.64 No	0.20 Yes	-0.33 Yes	-0.78 No	-1.01 No
(Yes, if both are yes)	Kurtosis (within ±1.0)	-0.25 Yes	-0.88 Yes	-0.48 Yes	-0.73 Yes	-0.41 Yes	-1.20 No	0.03 Yes	0.82 Yes	-0.77 Yes	0.74 Yes	.023 Yes	.021 Yes	-0.33 Yes	0.70 Yes
Normality		**Yes**	**Yes**	**Yes**	**Yes**	**No**	**No**	**Yes**	**No**	**Yes**	**No**	**Yes**	**Yes**	**No**	**No**
Statistical tests Shapiro-Wilks	statistic level of significance	0.009 No	0.002 No	0.093 Yes	0.005 No	<0.001 No	0.002 No	0.024 No	<0.001 No	0.004 No	0.002 No	0.009 No	0.044 No	<0.001 No	<0.001 No
Kolmogorov-Smirnov (Not normal if p<0.05 (Yes, if both are yes)	statistic level of significance	0.003 No	0.001 No	0.007 No	<0.001 No	<0.001 No	<0.001 No	0.019 No	0.002 No	0.001 No	<0.001 No	<0.001 No	0.004 No	<0.001 No	<0.001 No
Normality		**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**
OVERALL ASSESSMENT OF NORMALITY		**No**	**No**	**Yes**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**

Table B-20: Normality profile for: The effect of blind opening (free areas 34% and 60%) on visibility value. Actor skin tone type VI, Observation time: 0.3 sec

Blind opening (free area %)		34%							60%						
Clothing level Normality profile		1	2	3	4	5	6	7	1	2	3	4	5	6	7
	Mean	1.58	3.03	2.65	3.20	4.10	5.53	5.60	1.05	2.85	2.68	3.43	4.60	6.08	6.20
(Yes, if median is in 95% CI for mean)	Confidence interval for mean	1.21_ 1.94	2.68_ 3.37	2.28_ 3.02	2.92_ 3.48	3.65_ 4.55	5.05_ 6.00	5.20_ 6.00	0.98_ 1.12	2.48_ 3.22	2.45_ 2.90	3.18_ 3.67	4.29_ 4.91	5.84_ 6.31	5.98_ 6.42
	Median	1.00	3.00	3.00	3.00	4.50	6.00	6.00	1.00	3.00	3.00	4.00	5.00	6.00	6.00
Normality		**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**No**	**No**	**No**	**Yes**	**Yes**
Graphical	Histogram	No	Yes	No	Near	No	No	No	No	No	No	No	No	No	No
	Box Plot	No	Yes	No	No	No	No	No	No	No	No	No	No	No	No
Normality		**No**	**Yes**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**
Measures of dispersion	Skewness (within ±0.5)	2.05 No	0.07 Yes	0.73 No	-0.17 Yes	-0.70 No	-1.684 No	-1.70 No	4.292 No	1.064 No	-0.430 Yes	-0.929 No	-2.176 No	-2.200 No	-.780 No
(Yes, if both are yes)	Kurtosis (within ±1.0)	3.29 No	-0.35 Yes	0.74 Yes	-0.08 Yes	0.15 Yes	2.79 No	3.79 No	17.285 No	1.294 No	0.334 Yes	-0.688 Yes	5.403 No	8.750 No	1.458 No
Normality		**No**	**Yes**	**No**	**Yes**	**No**	**No**	**No**	**No**	**No**	**Yes**	**No**	**No**	**No**	**No**
Statistical tests Shapiro-Wilks	statistic level of significance	<0.001 No	.005 No	.002 No	.001 No	.001 No	<0.001 No	<0.001 No	<0.001 No	<0.001 No	<0.001 No	<0.001 No	<0.001 No	<0.001 No	<0.001 No
Kolmogorov-Smirnov (Not normal if p<0.05 (Yes, if both are yes)	statistic level of significance	<0.001 No	<0.001 No	<0.001 No	<0.001 No	<0.001 No	<0.001 No	<0.001 No	<0.001 No	<0.001 No	<0.001 No	<0.001 No	<0.001 No	<0.001 No	<0.001 No
Normality		**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**
OVERALL ASSESSMENT OF NORMALITY		**No**	**Yes**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**

APPENDIX C: Experiment 3 (Frosted glass)

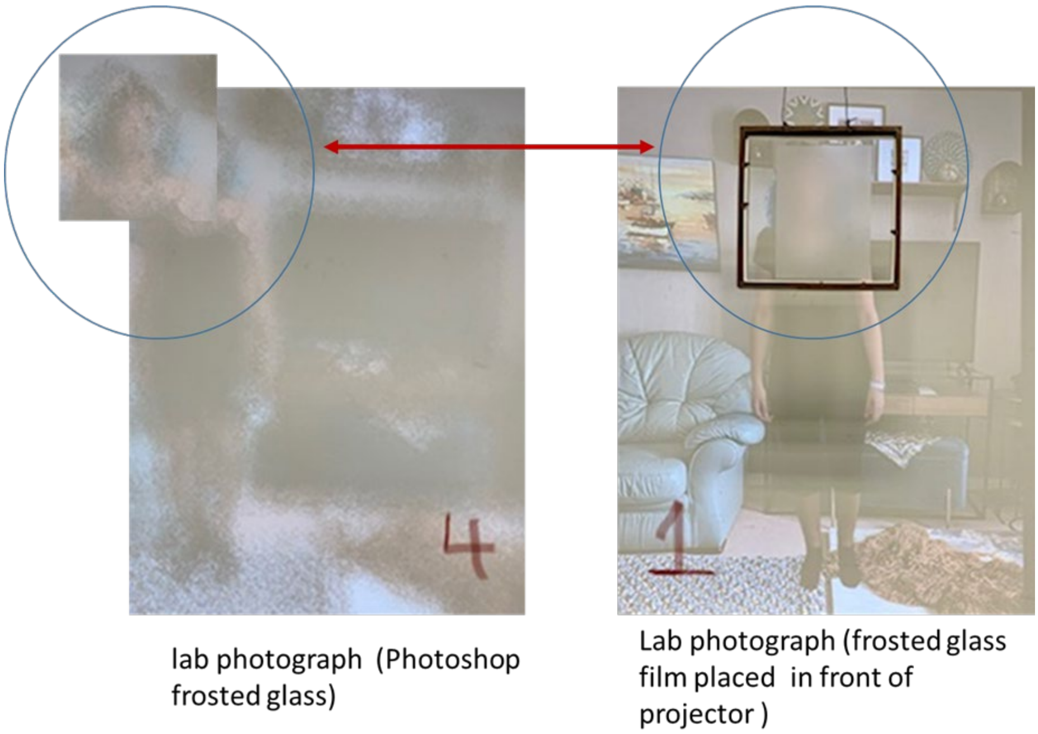


Figure C-1: Comparisons between the distortion levels of the frosted glass in Photoshop in the left and real sample of the frosted film obtained from the frosted glass factory on the right

Figure C-2: The effect of changing the smoothness levels: S=1 in the left and S=2 in the right which has been selected to simulate the real frosted glass. The rows show two examples of distortion levels, 4 and 8, used in the experiment. **Note: Distortion, Smoothness and Scaling are variables in frosted glass filter in Photoshop**

Figure C-3: The effect of changing the Scaling levels to 50,100 and 200. The Scaling levels in the images in the experiment were maintained at Sc =100; this is because there was no deformation affecting the images when testing the three scaling levels. The rows show two examples of distortion levels, 4 and 8, used in the experiment.

Table C-1: The illuminance level of the test images in the laboratory for the actor with skin tone type II. Distortion level (D=4 and D=8)

Frosted glass (distortion level)		D=4							D=8						
Clothing level		1	2	3	4	5	6	7	1	2	3	4	5	6	7
Light condition in the lab(lux)	Horizontal (Close to the projector screen)	545	545	545	547	545	543	533	539	547	544	543	544	546	543
	Vertical (Participant view)	381	381	381	383	380	379	368	381	383	380	379	380	382	380

Table C-2: The illuminance level of the test images in the laboratory for the actor with skin tone type II. Distortion level (D=12 and D=16)

Frosted glass (distortion level)		D=12							D=16						
Clothing level		1	2	3	4	5	6	7	1	2	3	4	5	6	7
Light condition in the lab(lux)	Horizontal (Close to the projector screen)	546	546	544	542	543	542	544	546	545	545	543	548	547	542
	Vertical (Participant view)	382	382	380	379	379	379	380	381	380	381	379	383	383	378

Table C-3: The illuminance level of the test images in the laboratory for the actor with skin tone type II. Distortion level (D=20)

Frosted glass (distortion level)		D=20						
Clothing level		1	2	3	4	5	6	7
Light condition in the lab(lux)	Horizontal (Close to the projector screen)	544	544	547	543	541	543	543
	Vertical (Participant view)	380	380	382	380	378	376	380

Table C-4: The illuminance level of the test images in the laboratory for the actor with skin tone type VI. Distortion level (D=4 and D=8)

Frosted glass (distortion level)		D=4							D=8						
Clothing level		1	2	3	4	5	6	7	1	2	3	4	5	6	7
Light condition in the lab(lux)	Horizontal (Close to the projector screen)	545	545	545	547	545	543	533	539	547	544	543	544	546	543
	Vertical (Participant view)	381	381	381	383	380	379	368	381	383	380	379	380	382	380

Table C-5: The illuminance level of the test images in the laboratory for the actor with skin tone type VI. Distortion level (D=12 and D=16)

Frosted glass (distortion level)		D=12							D=16						
Clothing level		1	2	3	4	5	6	7	1	2	3	4	5	6	7
Light condition in the lab(lux)	Horizontal (Close to the projector screen)	544	543	542	546	545	545	542	546	546	544	546	544	543	544
	Vertical (Participant view)	380	379	379	382	380	380	379	382	382	380	381	382	380	379

Table C-6: The illuminance level of the test images in the laboratory for the actor with skin tone type VI. Distortion level (D=20)

Frosted glass (distortion level)		D=20						
Clothing level		1	2	3	4	5	6	7
Light condition in the lab(lux)	Horizontal (Close to the projector screen)	542	542	546	541	541	541	541
	Vertical (Participant view)	378	379	382	378	378	378	378

Frosted glass experiment (pilot study)

Pilot study for the frosted glass was conducted to assess the distortion levels and how the distortion affects the visibility rating; in addition, how the actor's skin is influenced by the distortion and the probability of adding or decreasing the distortion level for each actor. Therefore, it was anticipated that the outcomes of this pilot study would reveal whether or not this distortion range is appropriate.

Eight distortion levels were used, ranging from 2 to 16 in steps of 2 distortion units. As with the degree of blind opening, the levels of distortion for the frosted glass were selected with the prediction that this range would yield correct responses ranging from chance level to near 100%. Two actors and five clothing levels were used.

The same general aperture used in the blind experiment was also used in the pilot study. The result from the pilot study (Figure C.4) demonstrated 100% correct responses regarding the lowest distortion level (2), which was remarkably near to the image without any distortion. The result was also nearly 100% for the frosted level (4). There was more significant confusion regarding the highest degree of distortion level (16), which did not reach a sufficient level of visual privacy. Some changes were conceived to address these flaws, including adding the highest distortion level, which was 20. Further, the lowest distortion level (2) was omitted because it was near to distortion level.

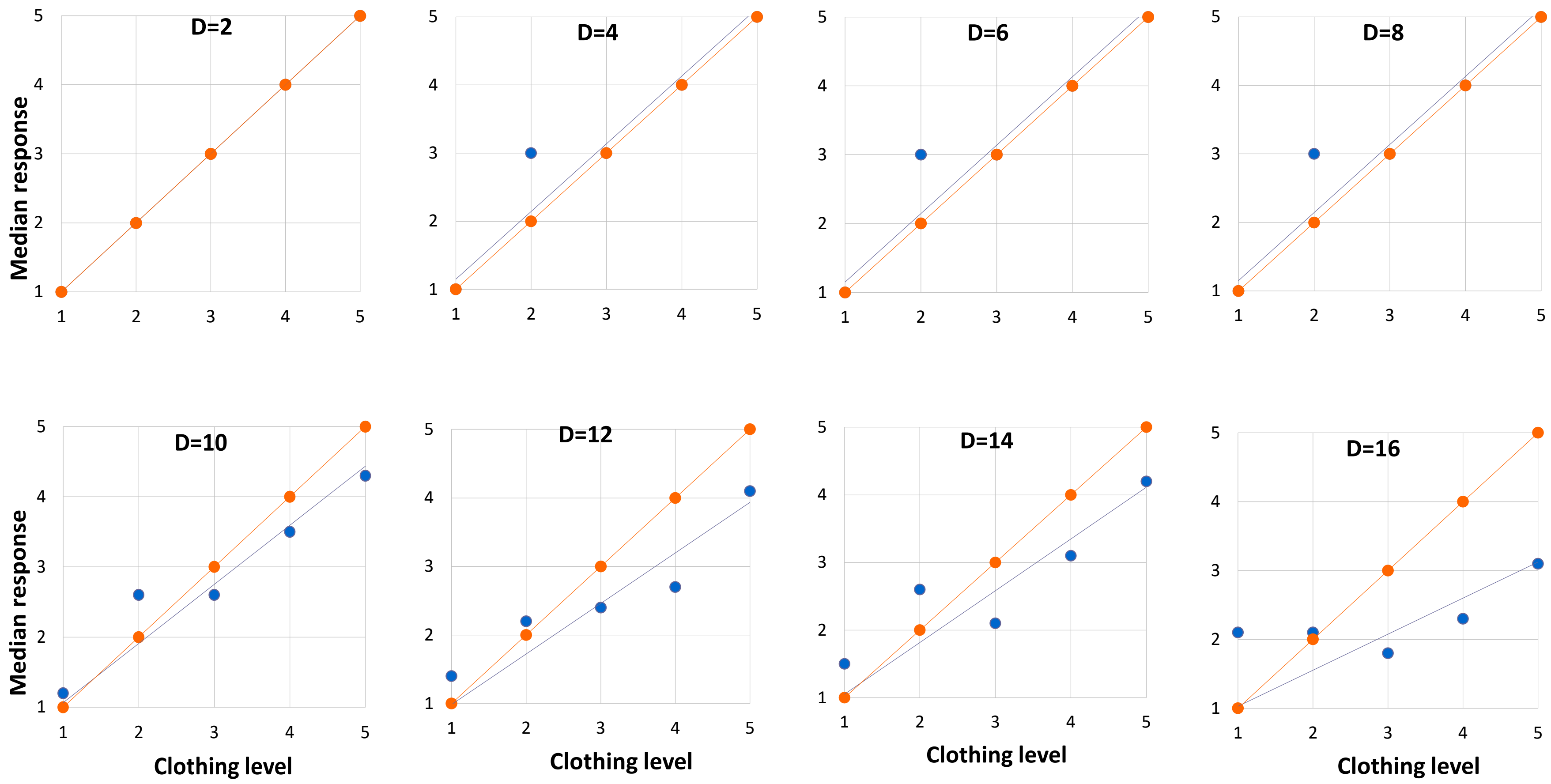


Figure C-4: Pilot study results. Median clothing level response plotted against actual clothing level for eight distortion levels of frosted glass, ranging from (2 to 16) in steps of two distortion units (shown in each graph). These results are for the white skin tone (type II) and the 0.3 observation duration. The orange line indicates the ideal response for correct identification of clothing level.

Table C-7: Normality profile for the effect of Frosted glass (distortion degree= 4 and D=8) on visual identification of clothing level. Actor/ skin tone type II, Observation time: 0.3 sec

Frosted glass (distortion level		**D=4**							**D=8**						
Clothing level Normality profile		1	2	3	4	5	6	7	1	2	3	4	5	6	7
(Yes, if median is in 95% CI for mean)	Mean	1.20	2.43	2.90	3.70	4.60	6.03	6.73	1.20	2.93	2.73	3.37	4.67	5.93	6.00
	Confidence interval for mean	.92_ 1.48	2.20_ 2.67	2.63_ 3.17	3.46_ 3.94	4.25_ 4.95	5.91_ 6.15	6.57_ 6.90	.97_ 1.43	2.64_ 3.23	2.41_ 3.06	3.08_ 3.65	4.30_ 5.04	5.69_ 6.17	5.67_ 6.33
	Median	1.00	2.00	3.00	4.00	5.00	6.00	7.00	1.00	3.00	3.00	3.00	5.00	6.00	6.00
Normality		**Yes**	**Yes**	**Yes**	**No**	**No**	**Yes**	**No**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**
Graphical	Histogram	No	No	Near	Near	No	No	No	No	No	Yes	No	Near	Near	Near
	Box Plot	No	No	No	Yes	No	No	No	No	No	Yes	Yes	No	No	No
Normality		**No**	**No**	**No**	**Yes**	**No**	**No**	**No**	**No**	**No**	**Yes**	**No**	**No**	**No**	**No**
Measures of dispersion	Skewness (within ±0.5)	4.665 No	1.172 No	.762 No	-1.220 No	-1.817 No	.793 No	-1.112 No	3.785 No	1.038 No	.229 Yes	-.259 Yes	-.835 No	-.793 No	-.671 No
(Yes, if both are yes)	Kurtosis (within ±1.0)	23.127 No	.431 No	1.465 No	1.655 No	2.803 No	8.363 No	-.824 No	15.851 No	1.708 No	.755 Yes	-.440 Yes	2.692 No	2.283 No	.053 Yes
Normality		**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**Yes**	**Yes**	**No**	**No**	**No**
Statistical tests Shapiro-Wilks	statistic level of significance	<.001 No	<.001 No	<.001 No	<.001 No	<.001 No	<.001 No	<.001 No	<.001 No	<.001 No	<.001 No	<.001 No	<.001 No	<.001 No	<.001 No
Kolmogorov-Smirnov (Not normal if p<0.05 (Yes, if both are yes)	statistic level of significance	<.001 No	<.001 No	<.001 No	<.001 No	<.001 No	<.001 No	<.001 No	<.001 No	<.001 No	=.003 No	<.001 No	<.001 No	<.001 No	<.001 No
Normality		No	No	No	No	No	No	No	No	No	No	No	No	No	No
OVERALL ASSESSMENT OF NORMALITY		**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**Yes**	**No**	**No**	**No**	**No**

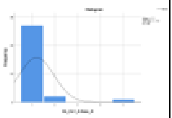
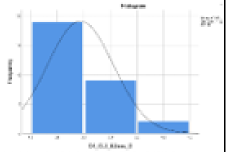
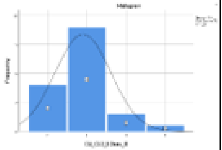
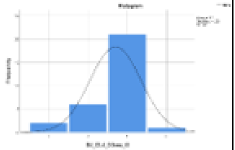
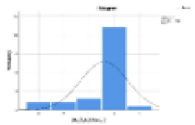
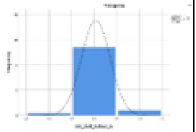
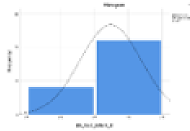
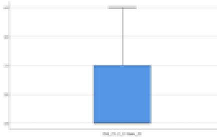
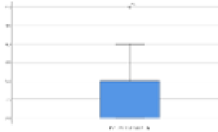
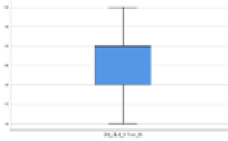
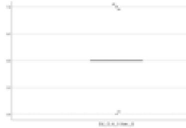
Normality	1	2	3	4	5	6	7
Histogram							
	No	No	No	No	No	No	No
Q_Q Plot							
	No	No	No	No	No	No	No

Figure C-5: Normality profile, examples of the Histogram and Q_Q Plot for clothing identification of seven clothing levels at distortion level D=4 for the Actor/ skin tone type II, Observation time: 0.3 sec

Table C-8 : Normality profile for the effect of Frosted glass (distortion degrees: D=12 and D= 16) on visual identification of clothing level. Actor/ skin tone type II, Observation time: 0.3 sec

Frosted glass (distortion level		**D=12**							**D=16**						
Clothing level Normality profile		1	2	3	4	5	6	7	1	2	3	4	5	6	7
(Yes, if median is in 95% CI for mean)	Mean	1.50	2.23	2.50	3.83	4.33	5.37	5.47	1.90	2.80	2.73	3.37	3.90	4.73	4.43
	Confidence interval for mean	1.15_ 1.85	1.83_ 2.63	2.09_ 2.91	3.33_ 4.33	3.74_ 4.92	4.97_ 5.76	4.96_ 5.97	1.30_ 2.50	2.26_ 3.34	2.17_ 3.30	2.83_ 3.91	3.30_ 4.50	4.22_ 5.25	3.84_ 5.03
	Median	1.00	2.00	2.00	4.00	5.00	5.50	6.00	1.00	2.50	3.00	3.00	4.00	5.00	4.00
Normality		**Yes**	**Yes**	**Yes**	**Yes**	**No**	**Yes**	**No**	**No**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**No**
Graphical	Histogram	No	No	Near	Yes	Near	No	No	No	No	No	No	No	Near	No
	Box Plot	No	No	No	Near	Yes	No	No	No	Near	No	Near	Yes	No	No
Normality		**No**	**No**	**No**	**Yes**	**Yes**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**
Measures of dispersion	Skewness (within ±0.5)	1.747 No	.577 No	.982 No	.325 Yes	-.315 Yes	-.266 Yes	-.855 No	1.729 No	.301 Yes	.748 No	.757 No	.335 Yes	-.729 No	-.558 No
(Yes, if both are yes)	Kurtosis (within ±1.0)	1.868 No	-.068 Yes	2.094 No	.260 Yes	-.660 Yes	-.623 Yes	.117 Yes	1.674 No	-.952 Yes	.557 Yes	.537 Yes	-.412 Yes	.661 Yes	.511 Yes
Normality		**No**	**No**	**No**	**Yes**	**Yes**	**Yes**	**No**	**No**	**Yes**	**No**	**No**	**Yes**	**No**	**No**
Statistical tests Shapiro-Wilks	statistic level of significance	<.001 No	.002 No	.002 No	.087 Yes	.103 Yes	.013 No	.003 No	<.001 No	.006 No	.008 No	.010 No	.071 Yes	.040 No	.009 No
Kolmogorov-Smirnov (Not normal if $p<0.05$ (Yes, if both are yes)	statistic level of significance	<.001 No	.877 Yes	.874 Yes	.939 Yes	.942 Yes	.907 Yes	.881 Yes	<.001 No	.002 No	.070 Yes	.004 No	.127 Yes	.002 No	<.001 No
Normality		**No**	**No**	**No**	**Yes**	**Yes**	**Yes**	**No**	**No**	**No**	**No**	**No**	**Yes**	**No**	**No**
OVERALL ASSESSMENT OF NORMALITY		**No**	**No**	**No**	**Yes**	**Yes**	**Yes**	**No**	**No**	**No**	**No**	**No**	**Yes**	**No**	**No**

Table C-9: Normality profile for the effect of Frosted glass (distortion degrees: D=20) on visual identification of clothing level. Actor/ skin tone type VI, Observation time: 0.3 sec

Normality profile		D=20						
Clothing level		1	2	3	4	5	6	7
(Yes, if median is in 95% CI for mean)	Mean	4.20	3.70	4.20	4.27	4.30	4.40	4.43
	Confidence interval for mean	3.58_ 4.82	3.14_ 4.26	3.51_ 4.89	3.59_ 4.94	3.85_ 4.75	3.87_ 4.93	3.79_ 5.08
	Median	4.00	4.00	4.00	4.00	4.50	5.00	4.00
Normality		**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**No**	**Yes**
Graphical	Histogram	No	No	No	No	No	Near	No
	Box Plot	Near	No	Near	Near	No	No	No
Normality		**No**	**No**	**No**	**No**	**No**	**No**	**No**
Measures of dispersion	Skewness (within ±0.5)	.090 Yes	.550 No	-.068 Yes	-.049 Yes	-.249 Yes	-.620 No	-.219 Yes
(Yes, if both are yes)	Kurtosis (within ±1.0)	-.881 Yes	-.036 Yes	-1.051 No	-.940 Yes	-.941 Yes	-.032 Yes	-.649 Yes
Normality		**Yes**	**No**	**No**	**Yes**	**Yes**	**No**	**Yes**
Statistical tests Shapiro-Wilks	statistic level of significance	.133 Yes	.053 Yes	.082 Yes	.102 Yes	.011 No	.032 No	.068 Yes
Kolmogorov-Smirnov (Not normal if p<0.05 (Yes, if both are yes)	statistic level of significance	.094 Yes	.008 No	.176 Yes	.190 Yes	.001 No	<.001 No	.036 No
Normality		**Yes**	**No**	**Yes**	**Yes**	**No**	**No**	**No**
OVERALL ASSESSMENT OF NORMALITY		**Yes**	**No**	**No**	**Yes**	**No**	**No**	**No**

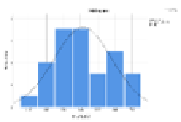
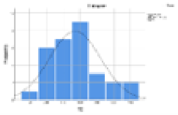
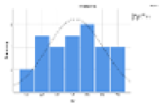
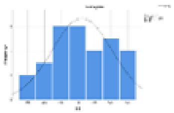
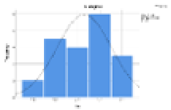
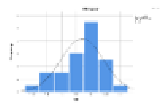
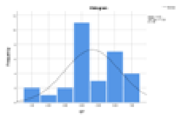
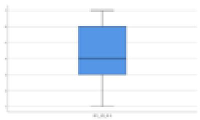
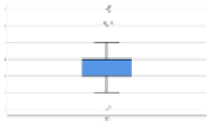
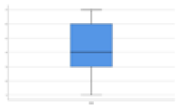
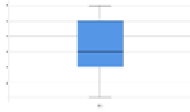
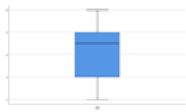
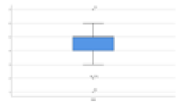
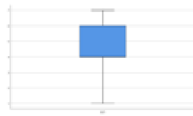
	Clothing level						
Normality	1	2	3	4	5	6	7
Histogram							
	No	No	No	No	No	Near	No
Q_Q Plot							
	Near	No	Near	Near	No	No	No

Figure C-6: Normality profile, examples of the Histogram and Q_Q Plot for clothing identification of seven clothing levels at distortion level D=20 for the Actor/ skin tone type II, Observation time: 0.3 sec

Table C-10: Normality profile for: The effect of Frosted glass (distortion degree D= 4 and D=8) on visual identification of clothing level. Actor/ skin tone type VI, Observation time: 0.3 sec

Frosted glass (distortion level		D=4							D=8						
Clothing level Normality profile		1	2	3	4	5	6	7	1	2	3	4	5	6	7
(Yes, if median is in 95% CI for mean)	Mean	1.07	2.80	2.83	3.67	4.87	6.07	6.17	1.77	3.23	3.10	3.67	4.47	5.70	6.17
	Confidence interval for mean	.97_ 1.16	2.50_ 3.10	2.57_ 3.09	3.42_ 3.91	4.70_ 5.03	5.85_ 6.28	5.95_ 6.39	1.35_ 2.18	2.77_ 3.70	2.73_ 2.73	3.34_ 4.00	3.98_ 4.95	5.32_ 6.08	5.99_ 6.34
	Median	1.00	3.00	3.00	4.00	5.00	6.00	6.00	1.00	3.00	3.00	4.00	5.00	6.00	6.00
Normality		**Yes**	**Yes**	**Yes**	**No**	**Yes**	**Yes**	**Yes**	**No**	**Yes**	**No**	**Yes**	**No**	**Yes**	**Yes**
Graphical	Histogram	No	No	No	No	No	No	No	No	Near	Yes	Near	Near	No	No
	Box Plot	No	Yes	No	Yes	No	No	No	No	Near	No	No	No	No	No
Normality		**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**Yes**	**No**	**No**	**No**	**No**	**No**
Measures of dispersion (Yes, if both are yes)	Skewness (within ±0.5)	3.660 No	-.034 Yes	.240 Yes	-1.052 No	-.786 No	-1.114 No	-.040 Yes	1.156 No	1.111 No	.689 No	.095 Yes	-.469 Yes	-2.453 No	.670 No
	Kurtosis (within ±1.0)	12.207 No	-.606 Yes	-.831 Yes	1.159 No	2.009 No	5.213 No	-.082 Yes	-.123 Yes	2.091 No	1.684 No	.891 Yes	.960 Yes	6.583 No	1.132 No
Normality		**No**	**Yes**	**Yes**	**No**	**No**	**No**	**Yes**	**No**	**No**	**No**	**Yes**	**Yes**	**No**	**No**
Statistical tests Shapiro-Wilks	statistic level of significance	<.001 No	.001 No	<.001 No	<.001 No	<.001 No	<.001 No	<.001 No	<.001 No	.003 No	.003 No	.001 No	.020 No	<.001 No	<.001 No
Kolmogorov-Smirnov (Not normal if p<0.05 (Yes, if both are yes)	statistic level of significance	<.001 No	<.001 No	<.001 No	<.001 No	<.001 No	<.001 No	<.001 No	<.001 No	<.001 No	<.001 No	<.001 No	<.001 No	<.001 No	<.001 No
Normality		**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**
OVERALL ASSESSMENT OF NORMALITY		**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**

Table C-11: Normality profile for: The effect of Frosted glass (distortion degree D=12 and D=16) on visual identification of clothing level . Actor/ skin tone type VI, Observation time: 0.3 sec

Frosted glass (distortion level		D=12							D=16						
Clothing level Normality profile		1	2	3	4	5	6	7	1	2	3	4	5	6	7
(Yes, if median is in 95% CI for mean)	Mean	3.03	3.97	3.47	3.80	4.73	5.03	5.03	3.00	3.87	3.20	3.47	4.47	4.63	4.23
	Confidence interval for mean	2.33_ 3.74	3.42_ 4.52	2.84_ 4.09	3.34_ 4.26	4.22_ 5.24	4.42_ 5.65	4.57_ 5.50	2.38_ 3.62	3.14_ 4.59	2.53_ 3.87	2.93_ 4.00	3.78_ 5.15	4.06_ 5.21	3.59_ 4.88
	Median	2.50	4.00	4.00	4.00	5.00	5.00	5.00	2.50	4.00	3.00	3.50	4.50	5.00	4.50
Normality		**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**
Graphical	Histogram	No	No	No	Near	No	No	No	No	No	No	Near	No	No	No
	Box Plot	No	Near	No	Yes	No	Near	Near	No	Yes	Near	No	Yes	No	Yes
Normality		**No**	**No**	**No**	**Yes**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**
Measures of dispersion	Skewness (within ±0.5)	.611 No	.130 Yes	.321 Yes	.406 Yes	-.881 No	-.402 Yes	-.182 Yes	1.064 No	.080 Yes	.452 Yes	.223 Yes	-.249_ Yes	-.238 Yes	-.343 Yes
(Yes, if both are yes)	Kurtosis (within ±1.0)	-.862 Yes	-.709 Yes	-.371 Yes	-.705 Yes	1.587 No	-1.135 No	.226 Yes	.587 Yes	-1.162 No	-.489 Yes	.192 Yes	-.886 Yes	-.321 Yes	-1.105 No
Normality		**No**	**Yes**	**Yes**	**Yes**	**No**	**No**	**Yes**	**No**	**No**	**Yes**	**Yes**	**Yes**	**Yes**	**No**
Statistical tests Shapiro-Wilks	statistic level of significance	.003 No	.085 Yes	.063 Yes	.009 No	<.001 No	.004 No	.009 No	.002 No	.046 No	.017 No	.144 Yes	.071 Yes	.148 Yes	.015 No
Kolmogorov-Smirnov (Not normal if $p<0.05$ (Yes, if both are yes)	statistic level of significance	.002 No	.002 No	.054 Yes	.002 No	<.001 No	.009 No	<.001 No	<.001 No	.195 Yes	.088 Yes	.065 Yes	.194 Yes	.200 Yes	.015 No
Normality		**No**	**No**	**Yes**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**Yes**	**Yes**	**Yes**	**No**
OVERALL ASSESSMENT OF NORMALITY		**No**	**No**	**Yes**	**Yes**	**No**	**No**	**No**	**No**	**No**	**No**	**Yes**	**Yes**	**Yes**	**No**

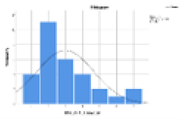
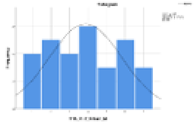
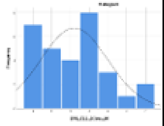
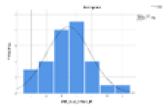
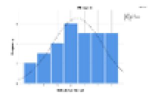
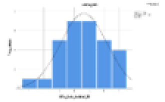
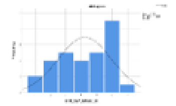
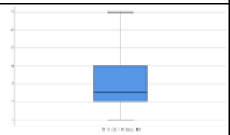
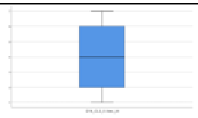
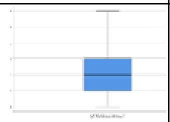
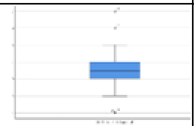
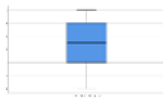
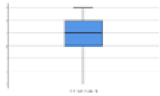
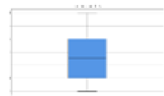
	Clothing level						
Normality	1	2	3	4	5	6	7
Histogram							
	No	No	No	Near	No	No	No
Q_Q Plot							
	No	Yes	Near	No	Near	No	Near

Figure C-7: Normality profile, examples of the Histogram and Q_Q Plot for clothing identification of seven clothing levels at distortion level D=16 for the Actor/ skin tone type VI, Observation time: 0.3 sec

Table C-12: Normality profile for the effect of Frosted glass (distortion degree D=20) on visual identification of clothing level. Actor/ skin tone type VI, Observation time; 0.3 sec

Normality profile		D=20						
Clothing level		1	2	3	4	5	6	7
(Yes, if median is in 95% CI for mean)	Mean	3.93	4.27	3.63	4.47	4.93	4.50	4.00
	Confidence interval for mean	3.31_ 4.56	3.73_ 4.80	3.00_ 4.26	3.92_ 5.01	4.42_ 5.44	3.97_ 5.03	3.48_ 4.52
	Median	4.00	4.00	4.00	4.00	5.00	4.50	4.00
Normality		**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**
Graphical	Histogram	No	Near	No	No	Near	No	Near
	Box Plot	Yes	Yes	Near	No	Near	No	Yes
Normality		**No**	**Yes**	**No**	**No**	**Yes**	**No**	**Yes**
Measures of dispersion	Skewness (within ±0.5)	-.262 Yes	-.355 Yes	-.155 Yes	.250 Yes	-.572 No	-.437 Yes	-.165 Yes
(Yes, if both are yes)	Kurtosis (within ±1.0)	-.916 Yes	-.285 Yes	-.840 Yes	-.436 Yes	-.164 Yes	-.156 Yes	-.243 Yes
Normality		**Yes**	**Yes**	**Yes**	**Yes**	**No**	**Yes**	**Yes**
Statistical tests Shapiro-Wilks	statistic level of significance	.056 Yes	.159 Yes	.048 No	.017 No	.023 No	.060 Yes	.151 Yes
Kolmogorov-Smirnov (Not normal if p<0.05 (Yes, if both are yes)	statistic level of significance	.003 No	.044 No	.057 Yes	<.001 No	.001 No	.058 Yes	.033 No
Normality		**No**	**No**	**No**	**No**	**No**	**Yes**	**No**
OVERALL ASSESSMENT OF NORMALITY		**No**	**Yes**	**No**	**No**	**No**	**Yes**	**Yes**

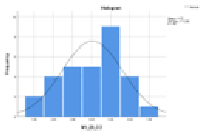
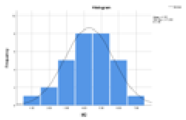
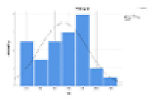
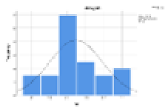
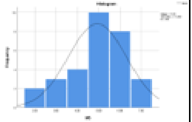
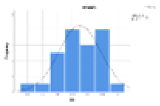
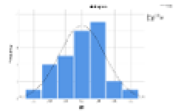
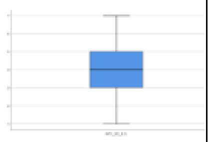
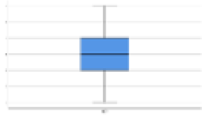
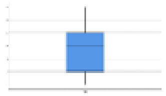
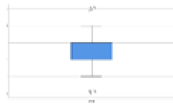
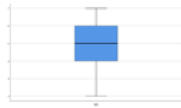
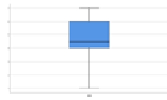
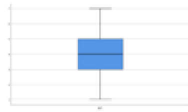
	Clothing level						
Normality	1	2	3	4	5	6	7
Histogram							
	No	Near	No	Near	Near	No	Near
Q_Q Plot							
	Near	Yes	Near	No	Near	No	Yes

Figure C-8 : Normality profile, examples of the Histogram and Q_Q Plot for clothing identification of seven clothing levels at distortion level D=20 for the Actor/ skin tone type VI, Observation duration 0.3s

Table C-13: Responses of frosted glass experiment for each clothing level and distortion degree (D=4, D=8 and D=12)/Actor skin actor tone (type II)/observation duration 0.3s

Participant ID	Frosted glass (distortion level)																				
	D=4							D=8							D=12						
	Clothing level							Clothing level							Clothing level						
	1	2	3	4	5	6	7	1	2	3	4	5	6	7	1	2	3	4	5	6	7
1	1	3	3	4	5	6	7	1	3	3	4	5	6	6	4	3	4	3	4	4	4
2	1	3	3	3	3	6	6	1	4	3	3	4	6	7	1	3	3	3	5	6	6
3	1	3	3	4	5	6	7	1	3	3	3	5	6	5	2	3	3	4	6	4	6
4	1	2	2	4	5	6	7	1	2	4	3	5	6	7	1	3	2	2	3	7	4
5	1	2	3	4	5	6	7	1	3	2	3	5	6	5	1	3	2	4	5	6	6
6	1	2	3	3	5	6	6	1	5	2	4	5	5	6	1	2	2	1	5	5	5
7	1	2	3	3	5	6	7	1	3	3	4	5	6	6	1	2	2	4	4	5	7
8	1	2	3	4	5	6	7	1	2	3	3	5	6	5	1	1	1	3	4	6	5
9	1	3	3	4	5	6	7	1	4	3	3	4	5	6	1	2	3	4	5	5	5
10	1	2	3	4	5	6	6	1	2	2	3	5	6	6	1	3	3	3	6	4	6
11	1	2	3	4	5	6	7	1	3	2	3	5	6	7	1	3	3	4	7	6	5
12	2	2	3	4	5	6	7	1	3	3	4	4	7	6	2	2	3	4	5	5	6
13	1	2	2	3	5	6	7	4	3	1	5	7	6	6	2	1	4	4	7	6	7
14	2	4	4	4	5	6	7	1	2	4	4	5	6	7	1	4	4	4	5	7	5
15	1	4	3	2	6	5	7	1	3	3	4	4	7	7	3	5	3	5	2	5	4
16	1	3	2	4	5	6	7	1	2	2	3	5	6	6	1	1	1	2	1	4	2
17	1	2	3	4	4	6	6	1	3	2	3	5	7	7	1	4	2	6	3	6	6
18	1	2	3	4	3	6	6	1	3	4	2	6	6	6	1	1	2	3	2	7	6
19	1	2	2	3	5	6	7	1	3	2	2	5	6	6	1	2	6	5	6	7	7
20	1	2	3	2	5	6	7	2	3	1	3	4	7	6	1	2	2	4	5	5	7
21	1	2	3	4	5	6	7	1	3	3	4	5	5	5	1	1	2	4	5	6	6
22	1	2	2	4	2	6	6	1	2	3	2	2	6	7	1	1	1	6	4	6	6
23	1	2	2	4	2	6	6	1	2	3	2	2	6	7	1	1	1	6	4	6	6
24	1	2	2	4	5	6	7	1	3	3	4	5	6	5	1	3	3	3	6	5	4
25	1	2	3	4	5	7	6	1	3	2	4	6	6	6	4	2	2	7	3	6	7
26	5	2	5	5	4	7	7	2	5	5	4	5	5	4	3	1	3	3	3	3	3
27	1	3	4	4	5	6	7	1	2	3	4	4	4	4	1	1	2	2	2	4	6
28	1	3	3	3	4	6	7	2	3	2	3	4	6	7	1	2	1	4	2	4	3
29	1	3	2	4	5	6	7	1	3	3	4	4	6	6	1	3	3	5	6	6	7
30	1	3	4	4	5	6	7	1	3	3	4	5	6	6	3	2	2	3	5	5	7

Table C-14: Responses of frosted glass experiment for each clothing level and distortion degree (D=16 and D=20)/Actor skin actor tone (type II)/observation duration 0.3s

Participant ID	Frosted glass (distortion level)													
	D=16							D=20						
	Clothing level							Clothing level						
	1	2	3	4	5	6	7	1	2	3	4	5	6	7
1	4	3	3	2	4	5	5	6	4	5	1	5	5	6
2	1	1	1	3	4	3	5	2	2	3	1	3	2	3
3	1	2	2	4	7	5	4	2	2	3	3	5	5	5
4	1	5	4	2	3	4	6	4	4	6	2	6	5	4
5	1	4	1	2	3	3	6	4	4	4	3	4	3	4
6	1	1	3	3	2	4	4	3	4	2	6	5	4	5
7	2	2	1	4	3	5	5	2	4	1	5	5	4	4
8	1	1	2	3	2	6	1	4	2	4	7	5	4	7
9	1	2	3	2	5	6	3	3	3	6	7	5	6	6
10	1	4	4	3	4	5	4	3	3	4	4	5	5	4
11	1	4	2	6	4	5	7	4	6	7	6	6	5	6
12	6	4	3	3	4	5	4	5	2	2	6	3	5	6
13	2	6	5	6	4	7	1	4	4	6	7	3	4	4
14	6	4	7	6	7	6	7	7	7	7	7	4	5	7
15	2	4	2	7	3	6	7	4	6	7	5	5	5	7
16	1	1	5	4	2	5	4	4	2	6	3	3	3	2
17	3	4	4	3	2	6	5	6	5	2	2	5	6	4
18	1	1	1	4	2	6	3	1	3	5	3	5	7	3
19	1	4	1	3	6	4	6	3	5	4	5	3	2	4
20	1	4	2	3	5	7	4	7	4	5	4	6	3	6
21	1	2	3	2	5	5	4	2	3	2	4	3	5	5
22	5	2	3	4	4	4	4	3	4	5	4	4	5	4
23	5	2	3	4	4	4	4	5	4	5	4	4	5	4
24	1	2	4	4	5	6	5	3	5	4	6	6	6	4
25	2	3	4	2	2	4	4	3	3	2	4	2	4	1
26	1	2	1	1	1	1	1	5	1	3	2	3	1	1
27	1	5	1	4	5	3	5	6	7	7	6	4	6	6
28	1	1	2	3	3	2	4	6	3	3	3	4	2	4
29	1	3	4	3	7	5	5	6	3	5	5	6	6	7
30	1	1	1	1	5	5	6	7	2	1	3	2	4	6

Table C-15: Responses of frosted glass experiment for each clothing level and distortion degree (D=4, D=8 and D=12)/Actor skin actor tone (type VI)/observation duration 0.3s

Participant ID	Frosted glass (distortion level)																				
	D=4							D=8							D=12						
	Clothing level							Clothing level							Clothing level						
	1	2	3	4	5	6	7	1	2	3	4	5	6	7	1	2	3	4	5	6	7
1	1	3	3	2	5	7	7	1	4	3	4	3	6	7	1	6	4	3	4	5	3
2	1	3	4	4	5	7	7	1	4	3	3	4	6	6	3	6	5	2	4	3	4
3	1	3	3	4	5	6	6	1	4	3	3	3	6	6	2	5	5	3	5	3	5
4	1	3	3	3	5	6	7	1	4	3	3	7	6	7	2	6	1	5	3	5	5
5	1	4	3	4	5	6	6	3	2	3	4	4	6	6	4	7	3	4	5	6	5
6	1	4	2	4	5	6	6	1	3	2	4	5	6	6	2	3	4	3	7	6	7
7	1	4	3	4	5	6	6	4	4	3	4	2	6	6	1	3	2	2	5	5	5
8	1	2	4	4	5	6	6	1	3	3	4	5	6	6	1	5	1	4	6	6	4
9	1	4	3	4	5	6	5	1	2	3	4	5	6	6	1	5	4	3	6	6	5
10	1	3	3	4	5	6	6	1	3	3	4	1	7	7	5	3	2	6	5	4	5
11	1	4	3	3	5	6	7	1	2	4	3	6	6	6	1	3	1	4	5	5	6
12	2	2	2	3	5	6	7	1	4	3	4	5	6	6	2	6	2	5	5	7	7
13	1	3	2	3	5	6	6	1	4	3	2	7	6	7	6	3	5	4	5	2	7
14	1	3	3	4	5	7	6	4	5	4	4	5	6	6	1	1	4	4	5	7	5
15	1	2	2	2	5	6	6	2	6	6	5	4	6	6	3	5	6	3	5	4	4
16	1	2	3	3	4	6	6	1	2	3	3	3	2	7	2	3	2	2	5	5	5
17	1	2	2	4	6	7	5	3	3	4	4	5	6	6	4	5	3	3	5	7	3
18	1	2	4	4	5	6	6	1	3	2	4	5	7	7	4	3	2	6	7	7	6
19	1	2	2	3	5	6	6	1	3	1	2	6	4	6	1	4	4	6	5	7	4
20	1	3	2	4	5	6	7	1	3	3	4	5	6	6	5	4	7	3	5	7	6
21	1	4	2	4	5	6	5	4	3	2	4	5	5	5	3	3	3	5	5	6	4
22	1	3	3	4	4	6	6	2	3	2	4	5	6	6	6	2	4	4	4	3	5
23	1	3	3	4	4	6	6	2	3	2	4	5	6	6	6	2	4	4	4	3	5
24	1	2	2	4	5	6	6	2	2	3	3	4	6	6	4	3	5	5	5	6	5
25	1	3	4	4	4	6	6	3	3	3	2	4	6	6	3	4	4	4	1	2	5
26	1	1	3	4	5	4	6	2	2	5	5	4	3	6	2	5	7	3	2	3	2
27	1	3	4	4	4	7	6	4	3	4	3	4	5	6	1	5	4	3	5	3	7
28	2	2	2	5	5	6	7	1	1	4	3	5	6	6	2	3	2	3	2	6	5
29	1	2	3	4	5	6	7	1	7	2	6	3	6	6	7	4	3	6	7	7	7
30	1	3	3	3	5	5	6	1	2	4	4	5	6	6	6	2	1	2	5	5	5

Table C-16: Responses of frosted glass experiment for each clothing level and distortion degree (D=16 and D=20)/Actor skin actor tone (type VI)/observation duration 0.3s

Participant ID	Frosted glass (distortion level)													
	D=16							D=20						
	Clothing level							Clothing level						
	1	2	3	4	5	6	7	1	2	3	4	5	6	7
1	5	6	4	2	4	4	2	6	5	6	4	3	6	2
2	3	4	2	3	4	5	1	2	3	1	5	4	2	5
3	2	4	5	5	3	3	4	5	1	4	4	4	4	4
4	1	3	1	4	5	2	3	5	4	5	3	5	5	2
5	3	4	2	3	6	5	6	5	4	5	5	4	6	6
6	2	4	3	3	3	5	2	1	5	1	4	5	3	4
7	2	5	2	5	7	3	6	3	3	1	7	6	4	2
8	3	2	1	5	1	4	5	3	2	5	2	3	4	4
9	2	7	4	3	5	4	6	7	6	6	3	6	6	5
10	2	6	3	2	7	4	6	3	3	4	7	5	4	3
11	1	7	4	4	4	7	4	5	6	4	6	6	7	5
12	2	6	6	4	4	5	6	4	4	3	3	5	5	4
13	6	2	1	3	1	3	6	4	4	4	2	5	5	2
14	4	5	7	5	7	5	6	5	5	5	7	7	3	5
15	4	3	4	3	3	6	3	6	5	4	5	7	5	5
16	1	2	3	2	2	3	2	3	2	3	4	6	3	3
17	4	5	5	6	4	4	6	2	5	3	4	7	4	5
18	4	4	4	7	2	6	6	5	5	4	4	4	6	6
19	2	6	2	1	3	6	5	5	6	2	5	6	3	5
20	7	3	1	3	7	7	4	2	6	7	4	2	5	5
21	2	6	1	4	6	6	1	2	4	2	6	5	1	3
22	3	1	4	4	5	4	3	4	4	5	4	5	4	4
23	3	1	4	4	5	4	3	4	4	5	4	5	4	4
24	2	4	4	4	4	5	5	5	5	3	4	6	6	5
25	2	3	3	1	5	1	5	5	3	3	4	3	5	3
26	1	1	1	2	2	3	2	1	5	1	2	2	3	1
27	5	2	7	4	6	7	3	6	6	5	5	6	6	7
28	3	1	1	3	6	5	4	3	4	2	4	5	4	3
29	7	7	5	4	7	6	7	6	7	5	6	5	6	4
30	2	2	2	1	6	7	5	4	3	1	7	6	6	4

Table C-17: Responses of frosted glass experiment for each clothing level and distortion degree (D=4, D=8 and D=12)/Actor skin actor tone (type II)/observation duration 3.0s

Participant ID	Frosted glass (distortion level)																				
	D=4							D=8							D=12						
	Clothing level							Clothing level							Clothing level						
	1	2	3	4	5	6	7	1	2	3	4	5	6	7	1	2	3	4	5	6	7
1	1	2	3	4	5	6	7	1	2	3	4	5	6	7	1	1	3	4	5	5	7
2	1	2	3	4	5	6	7	1	2	3	4	5	7	5	1	1	2	4	4	5	6
3	1	2	3	4	5	6	7	1	2	3	4	4	5	7	1	2	3	4	5	5	6
4	1	2	3	4	5	6	7	1	2	2	4	5	7	7	1	2	3	4	5	7	7
5	1	3	3	4	5	6	7	1	2	3	4	5	6	7	1	2	2	4	6	6	6
6	1	2	3	4	5	6	7	1	2	3	4	5	6	6	1	3	5	3	5	5	7
7	1	2	3	3	5	6	7	1	2	3	4	5	6	6	1	2	1	4	5	6	5
8	1	2	3	4	5	6	7	1	3	3	4	5	6	7	1	3	3	3	5	6	6
9	1	2	3	4	5	6	6	1	2	2	4	5	6	7	1	2	3	4	5	5	6
10	1	2	3	4	5	6	7	1	2	2	4	6	6	7	1	2	1	3	5	6	6
11	1	2	3	4	5	6	7	1	2	3	4	5	6	5	1	3	4	3	5	5	6
12	1	2	3	4	5	6	7	1	2	4	4	5	6	7	1	3	3	4	5	5	6
13	1	3	3	4	5	6	7	1	2	3	3	7	5	7	1	6	2	3	1	4	2
14	1	2	3	4	5	6	7	1	2	4	4	5	6	7	1	2	4	4	5	6	6
15	1	3	3	4	3	6	6	1	3	4	4	4	6	7	1	1	3	3	5	4	5
16	1	2	3	4	5	6	7	1	2	3	4	6	6	7	1	2	3	3	5	6	6
17	1	2	3	4	5	6	6	1	3	3	3	5	5	7	1	3	2	4	4	6	6
18	1	2	3	4	5	6	7	1	2	3	4	5	6	6	1	2	3	5	6	6	6
19	1	2	3	4	5	6	7	1	2	3	4	5	6	5	1	2	2	3	5	5	4
20	1	2	3	4	5	6	7	1	3	3	4	5	7	7	1	3	3	4	4	6	7
21	1	2	3	3	5	6	5	1	3	3	3	5	5	5	1	2	2	2	5	5	5
22	1	2	3	3	5	6	7	1	3	3	4	5	6	7	1	3	2	4	5	5	6
23	1	2	3	3	5	6	7	1	3	3	4	5	6	7	1	3	2	4	5	5	6
24	1	2	3	4	5	6	7	1	3	2	3	5	6	7	1	3	3	4	6	6	6
25	1	2	3	3	4	6	7	1	3	2	7	6	7	7	2	2	1	5	6	6	7
26	1	2	1	5	5	7	7	3	1	3	4	4	6	6	3	3	5	4	4	6	4
27	1	2	3	4	5	6	7	1	2	4	4	5	6	6	1	3	2	4	5	5	6
28	1	2	3	4	5	6	7	1	2	2	4	4	6	7	1	2	2	4	3	5	5
29	1	2	3	4	5	6	7	1	3	3	4	5	7	6	1	2	3	4	4	7	6
30	1	3	3	4	5	6	7	1	3	2	3	5	6	7	1	2	3	4	5	4	5

Table C-18: Responses of frosted glass experiment for each clothing level and distortion degree (D=16 and D=20)/Actor skin actor tone (type II)/observation duration 3.0s

Participant ID	Frosted glass (distortion level)													
	D=16							D=20						
	Clothing level							Clothing level						
	1	2	3	4	5	6	7	1	2	3	4	5	6	7
1	1	1	1	3	3	5	3	2	4	4	4	5	4	4
2	1	1	1	4	5	5	5	6	3	3	6	2	5	6
3	2	3	4	5	4	5	6	4	4	6	6	5	6	6
4	1	2	3	3	5	6	6	1	2	3	5	6	5	4
5	3	3	3	4	5	5	7	3	3	2	4	4	5	3
6	1	3	4	2	5	5	6	1	4	2	4	5	3	4
7	1	2	3	3	5	5	4	2	3	2	3	3	4	4
8	1	5	2	4	2	5	7	6	4	5	7	7	6	7
9	1	3	1	4	5	5	5	2	4	2	4	5	7	7
10	6	3	2	5	4	6	5	4	3	5	6	6	5	5
11	1	4	1	4	5	6	5	1	4	2	5	5	6	5
12	1	2	3	3	6	7	6	5	5	3	6	5	5	6
13	1	4	1	5	5	3	6	5	2	4	2	1	1	5
14	1	1	3	4	5	7	5	1	1	4	2	6	2	7
15	5	3	3	5	5	5	4	5	4	5	3	5	4	4
16	2	2	2	4	5	5	6	4	4	5	5	3	2	5
17	1	2	3	4	5	5	6	2	4	1	2	4	4	2
18	1	3	3	6	5	6	6	3	6	4	7	6	7	2
19	1	3	3	3	3	5	2	1	5	5	4	1	4	3
20	2	1	3	4	7	6	6	4	5	2	7	6	4	3
21	1	2	2	2	5	5	4	5	6	2	4	4	3	5
22	1	3	3	4	5	5	5	3	3	6	4	4	4	6
23	1	3	3	4	5	5	5	3	3	6	4	4	4	6
24	3	3	4	4	5	3	4	5	5	5	6	4	7	4
25	1	4	1	2	3	4	2	1	3	2	3	6	2	2
26	3	5	4	3	3	3	2	5	1	1	7	1	2	3
27	2	2	3	4	5	6	5	2	3	6	3	6	5	6
28	1	5	2	4	4	4	5	2	3	2	4	5	5	5
29	2	3	3	4	5	4	6	2	6	6	6	5	7	6
30	1	1	3	3	4	2	5	5	1	6	2	6	4	6

Table C-19: Responses of frosted glass experiment for each clothing level and distortion degree (D=4, D=8 and D=12)/Actor skin actor tone (type VI)/observation duration 3.0s

Participant ID	Frosted glass (distortion level)																				
	D=4							D=8							D=12						
	Clothing level							Clothing level							Clothing level						
	1	2	3	4	5	6	7	1	2	3	4	5	6	7	1	2	3	4	5	6	7
1	1	2	3	4	5	6	6	1	3	4	4	5	6	7	1	3	1	3	3	5	6
2	1	2	3	4	5	6	7	1	2	2	4	5	6	7	1	5	2	3	5	5	5
3	1	2	2	4	4	6	6	1	3	3	3	4	5	6	4	3	4	3	6	6	6
4	1	2	3	4	5	7	6	1	3	3	3	5	6	6	1	6	3	3	6	5	6
5	1	2	3	4	5	6	6	1	2	3	4	5	6	6	1	4	4	4	5	6	6
6	1	2	3	4	5	6	7	1	3	4	4	5	6	6	1	4	3	3	3	6	5
7	1	2	2	4	5	6	6	1	2	3	4	5	6	6	1	2	2	4	5	5	5
8	1	3	3	4	5	6	6	1	3	4	4	6	6	7	5	1	5	4	5	6	7
9	1	2	3	4	5	6	7	1	4	3	4	5	6	6	1	3	1	4	5	6	6
10	1	2	3	5	5	6	7	1	3	2	4	4	6	6	3	5	3	3	6	6	5
11	1	2	3	4	5	6	7	1	4	3	4	5	5	6	1	2	3	4	5	6	6
12	1	3	3	4	5	6	7	1	4	3	4	6	6	7	1	3	3	4	5	7	6
13	1	3	2	4	5	7	7	2	1	2	2	2	6	6	1	4	1	3	3	3	3
14	1	2	3	4	5	6	7	1	2	4	4	5	6	7	1	2	4	2	5	6	7
15	1	2	4	4	4	7	7	3	4	3	4	5	6	6	6	5	3	3	5	4	5
16	1	2	3	4	4	6	7	1	2	3	3	4	6	6	1	3	3	4	6	5	6
17	1	2	3	4	5	5	6	3	2	3	4	6	6	6	1	5	5	3	5	2	4
18	1	2	3	5	4	6	6	1	2	3	5	5	6	6	1	2	3	4	5	5	6
19	1	2	3	4	5	6	6	1	2	2	3	6	6	6	2	3	1	2	5	6	5
20	1	2	3	4	5	7	6	1	3	3	4	7	6	7	4	4	3	5	6	7	6
21	1	2	3	3	5	6	6	2	3	2	3	5	5	5	1	5	2	3	5	5	4
22	1	2	3	3	5	6	7	1	2	4	3	5	6	7	2	5	3	3	6	5	6
23	1	2	3	3	5	6	7	1	2	4	3	5	6	7	2	5	3	3	6	5	6
24	1	2	3	2	5	6	7	1	3	3	3	5	6	6	1	4	2	3	5	6	6
25	1	3	2	4	6	6	6	1	3	3	3	5	7	6	3	1	4	4	4	3	3
26	1	2	3	4	3	7	7	2	5	2	2	3	5	7	2	2	2	6	2	2	5
27	1	2	3	4	5	6	6	1	2	3	4	5	6	6	5	2	5	4	5	6	6
28	1	1	3	5	5	6	7	1	2	1	1	4	5	6	2	1	3	3	3	2	3
29	1	2	3	4	5	6	6	1	2	3	4	5	6	6	5	4	3	4	5	5	5
30	1	2	3	4	5	7	6	1	4	3	4	4	6	5	1	4	3	4	2	5	5

Table C-20: Responses of frosted glass experiment for each clothing level and distortion degree (D=16 and D=20)/Actor skin actor tone (type VI)/observation duration 3.0s

Participant ID	Frosted glass (distortion level)													
	D=16							D=20						
	Clothing level							Clothing level						
	1	2	3	4	5	6	7	1	2	3	4	5	6	7
1	3	1	3	4	4	4	3	3	5	2	5	4	3	3
2	1	3	3	5	2	5	2	3	5	5	3	5	3	5
3	5	6	4	5	5	6	6	5	5	4	5	5	4	5
4	1	4	6	2	5	5	5	6	2	5	3	5	4	6
5	3	4	6	4	4	6	5	4	5	4	3	6	4	3
6	4	3	3	4	5	6	6	3	4	5	5	5	4	5
7	2	1	4	3	3	3	5	2	2	3	2	2	3	3
8	2	6	4	4	5	5	7	7	7	2	4	7	3	4
9	1	4	2	5	7	6	4	6	5	6	6	5	3	6
10	6	5	3	4	7	4	6	5	5	5	7	4	4	4
11	4	4	4	4	5	5	7	4	5	4	5	6	6	5
12	7	7	3	4	6	6	6	3	6	6	5	6	5	4
13	6	3	5	6	2	4	2	3	6	4	5	2	5	2
14	1	6	5	5	5	7	5	2	3	5	5	7	6	5
15	2	4	4	4	6	4	4	5	7	3	5	6	5	2
16	2	3	5	4	3	5	3	4	4	2	2	2	4	2
17	2	1	2	5	5	3	5	1	2	2	2	2	6	4
18	3	5	4	4	7	6	7	7	6	5	6	7	7	5
19	2	4	2	3	6	5	5	3	5	2	4	2	4	5
20	1	5	3	5	6	7	6	4	2	2	7	7	3	2
21	3	3	3	5	5	5	5	5	5	2	5	5	6	6
22	5	3	6	3	4	5	6	3	2	5	6	4	6	5
23	5	3	6	3	4	5	6	3	2	5	5	6	4	6
24	3	3	2	4	7	4	5	6	6	2	6	5	6	7
25	1	1	1	2	2	6	3	1	2	4	2	1	4	1
26	1	2	3	3	2	3	3	2	5	1	5	5	2	3
27	5	6	2	3	5	6	6	6	5	6	7	7	7	7
28	3	3	3	1	3	4	3	5	4	5	2	3	5	5
29	2	2	3	4	6	5	6	5	7	7	7	4	7	2
30	1	4	6	5	5	3	5	1	5	5	6	4	3	5

13 June 2022 at 08:41

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Figure C-9: A copy of the permission to use the frosted glass images advertised by the company (https://www.pilkington.com/en-gb/uk/householders/decorative-glazing).

APPENDIX:D Poster presentation

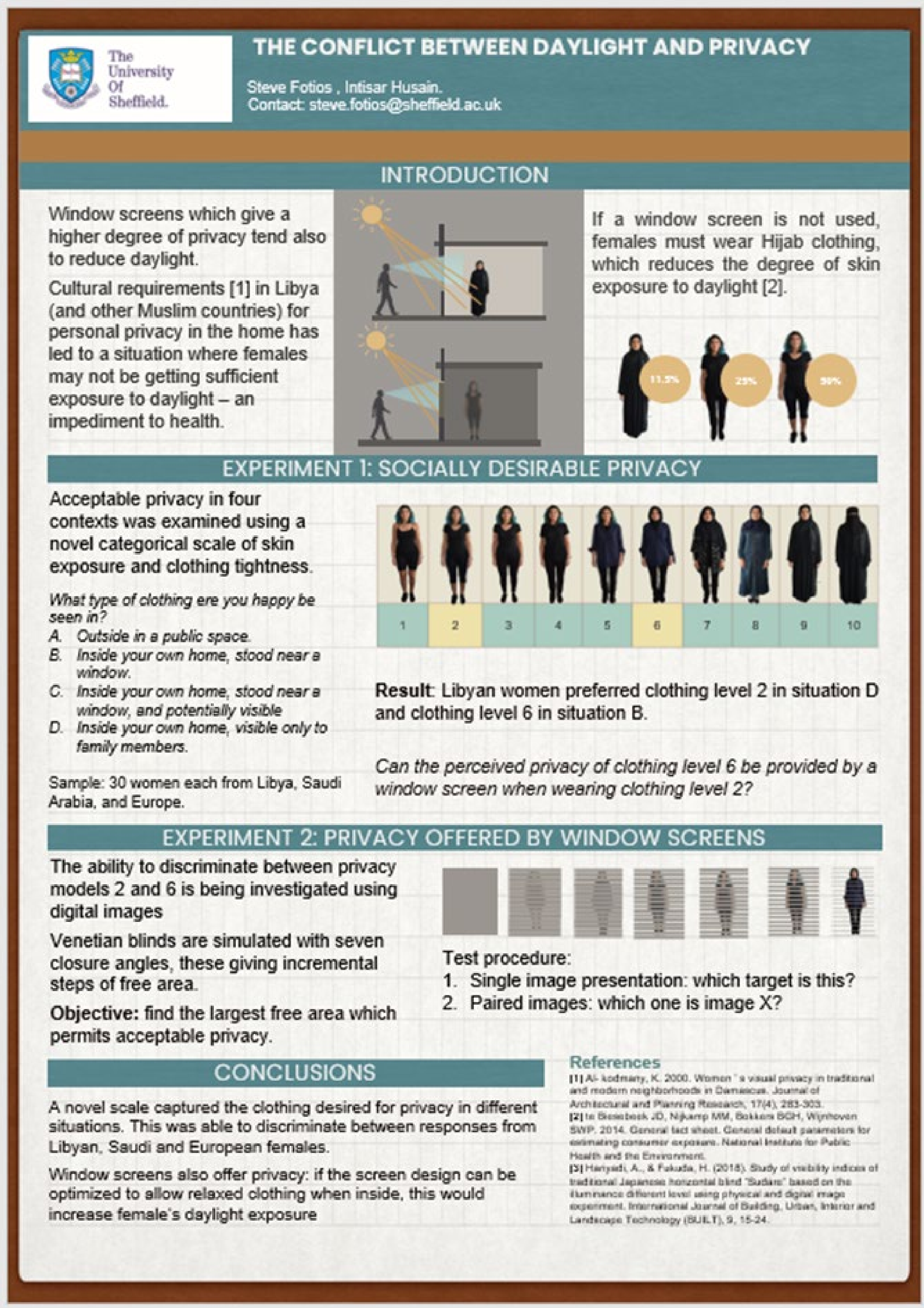

Figure D-1: Poster presented in ICEP 2019: International Conference on Environmental Psychology, Plymouth, United Kingdom

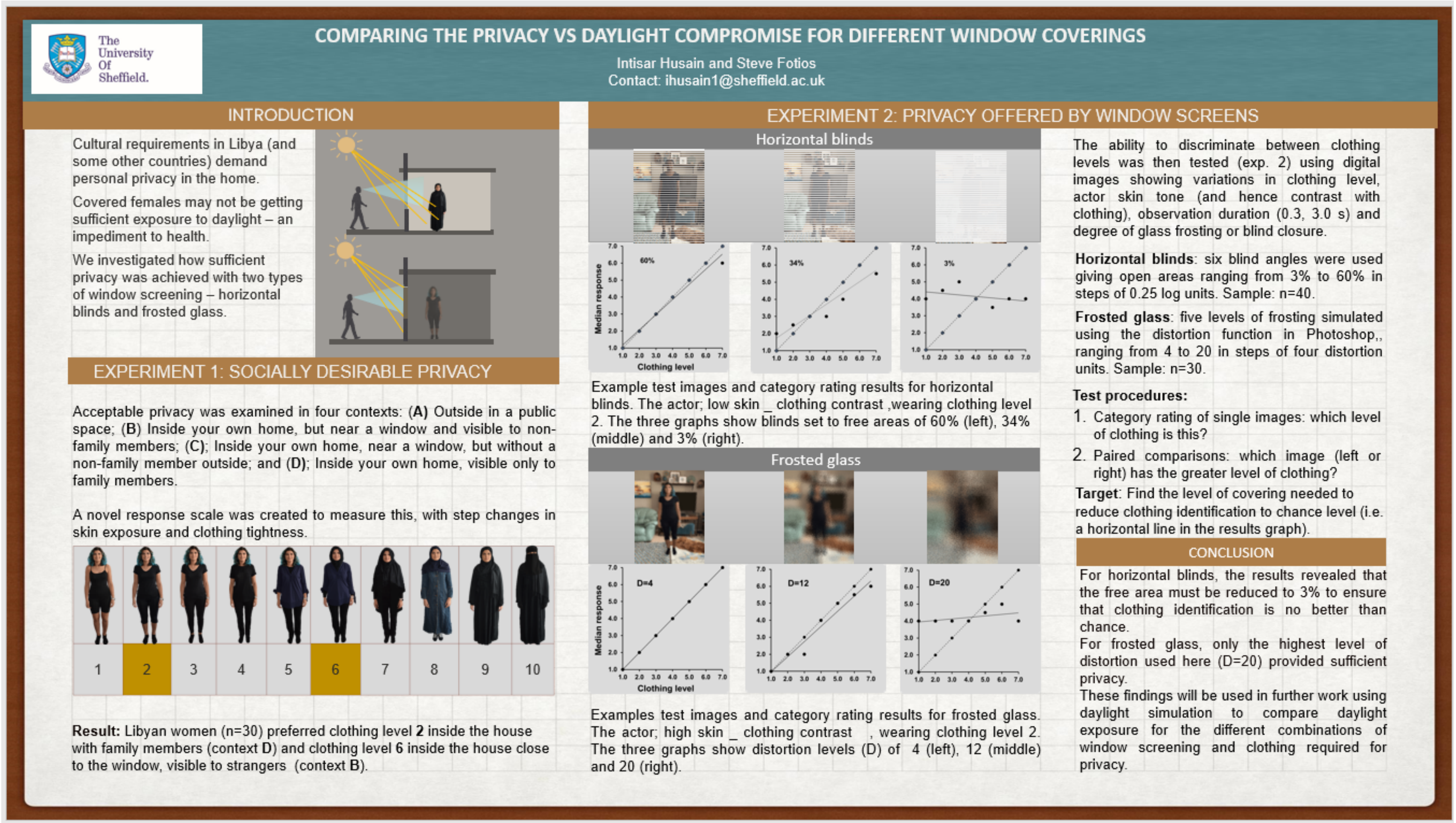

Figure D-2: Poster presented in CIE2021: International conference **"**light for life - living with light**".** Kuala Lumpur Malaysia

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