Is conscious perception necessary to direct attention? A replication of Jiang et al. (2006): Stage 1 Registered Report.

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**Abstract**

The relationship between attention and consciousness has been debated for the past few decades. Observing attentional biases induced by visual stimuli below the conscious threshold is one way of providing evidence for the independence of attention and conscious perception. Among such studies, Jiang et al. (2006) found a strong priming effect below the objective conscious threshold with high sensitivity, in showing attentional biases to nude images suppressed by continuous flash suppression (CFS). This study aims to replicate Jiang et al. by following the original design and materials as closely as possible with Bayesian analytical approaches.

Keywords: unconscious attention, continuous flash suppression, priming, consciousness, attention

**Introduction**

The relationship between attention and consciousness has been a major debate in consciousness science. Some argue that attention is just an enhanced version of conscious experience (Carrasco, 2011), therefore it cannot exist without consciousness. Others propose that conscious experience only occurs after we attend to certain stimuli. Thus, consciousness depends on the selective nature of attention (Cohen et al., 2012). These approaches have been used to suggest that attention and consciousness are not dissociable. However, another view is that attention and consciousness are separable, meaning one can function without involving the other (Jennings, 2015; Lamme, 2004). This paper will attempt to replicate a key finding bearing on whether attention can focus on an object perceived only unconsciously.

Evidence supporting a dissociation between attention and consciousness has accumulated over the past few decades (Graziano et al., 2020; Maier & Tsuchiya, 2021), both in terms of there being consciousness without attention (Braun & Julesz, 1998; Jennings, 2015), and for attention being focused on targets that are subliminal (Graziano, 2022; He et al., 1996; Pitts, Lutsyshyna & Hillyard, 2018). Also, the evidence for unconscious working memory (Soto et al., 2005; Soto et al., 2011; for a review of the controversy Gambarota et al., 2022) is relevant, given the close link between attention and working memory (Oberauer, 2019). For the debate of consciousness without attention, attention is acknowledged as responsible for certain aspects of consciousness, just not all of them. For example, through the scope of dual-task experiments, individuals were able to identify “perceptual gist” in the periphery while attending to difficult tasks with no decline in performance (Koch & Tsuchiya, 2007). For a more conceptual approach, Block (1995) promoted the idea of “phenomenal consciousness”, which is a form of consciousness consisting of experiential contents that complement the functional nature of the different “access consciousness”. Whether the evidence for phenomenal consciousness rules out attentional involvement is debatable (Jennings, 2015; Phillips, 2011), but it remains an influential idea (Cohen et al., 2012; Noah & Mangun, 2020). Another form of consciousness that might operate without attention is when individuals engage in habituated behaviours, where people perform tasks without attending to them, but with some conscious experience of performing the task (Jennings, 2015). In all these cases one might simply say there is no dissociation, there remains a degree of both awareness and attention. What about the converse type of evidence: can attention exist outside the boundary of consciousness?

Several paradigms are widely utilized in modern studies of attention and consciousness. One of the most well-known tools is the dot-probe task, developed by Halkiopoulos (1981/2021) and MacLeod et al. (1986). In dot-probe tasks, participants focus on a fixation point between 2 visual cues (often in an emotional-neutral combination) that are followed by a probe in one of their locations. If the reaction time to the probe is faster when the probe appears on the emotional side, then participants show an attentional bias toward emotional stimuli. This technique has been utilised to detect attentional biases produced by stimuli rendered subliminal by backward masking the cues (MacLeod et al., 2002; Maoz et al., 2013) or by other approaches (mentioned below). The dot-probe and other behaviour/neuroscience measures have been criticized due to their poor reliability (Schmukle, 2005; Wagenmakers et al., 2017). Poor reliability in itself is a failing only when the task is used as an individual differences measure; when used as a way of demonstrating a cognitive effect, poor to zero reliability can be a desirable feature when it reflects a virtually uniform population effect across participants (Gignac & Szodorai, 2016; Hedge et al., 2018). In testing a theory that conscious perception can dissociate from attention, what matters is that the effect exists, not that it provides a reliable individual difference measure.

While the dot probe task uses backward masking, one of the most compelling demonstrations of attention focusing on subliminal stimuli is provided by a use of the continuous flash suppression paradigm (CFS). Stemming from flash suppression and binocular rivalry, CFS was first introduced by Tsuchiya and Koch (2004) as a means to achieve more prolonged stimuli suppression. The visual field is divided by binocular rivalry in CFS, with each eye being presented with different visual stimuli. In one eye (the dominant eye), participants see dynamic colour patterns while the other eye is exposed to the designated cue. Due to interocular suppression (Tsuchiya & Koch, 2005; Tsuchiya et al., 2006), while the participants can technically “see” both colour patterns and the cue, the conscious perception of the non-dominant eye is suppressed. This paradigm is able to create unconscious perceptions of certain stimuli (Jiang et al., 2006; Jiang et al., 2007; Lapate et al., 2014; Mudrik et al., 2011; Raio et al., 2012; Tsuchiya & Koch, 2005; Watanabe et al. 2011), and it has become one of the major instruments for exploring subliminal perception.

Despite the surge of encouraging results, most CFS studies seem to be “one-off” experiments, with some of the high-profile ones failing to be replicated, demanding more replication studies to confirm important existing findings (Moors et al., 2017; Moors et al., 2019). Among this wave of criticism, Jiang et al. (2006) remains often cited for its clear results yet as far as we know, has never been replicated. Using the CFS paradigm, Jiang et al. used CFS to suppress conscious perception of a pair of nude images (with one image scrambled, and therefore unrecognisable) presented to their non-dominant eye, bilateral to the centred fixation cross. After 800ms exposure to the visual stimuli, a slightly tilted Gabor patch (1 degree clockwise or counterclockwise) appeared randomised to the left or right visual field corresponding to the location of one of the nude images previously shown. Participants were required to indicate the direction in which the Gabor patch was tilted. The accuracy of this difficult discrimination provides a measure of the amount of attention being paid to the left versus right visual field. In their study, Jiang et al. (2006) found significant spatial attention modulation induced by suppressed nude images. More specifically, people seemed to be attracted to intact, erotic yet subliminal visual stimuli that suited their sexual orientation while being repelled or at least not attracted to those images that did not suit their sexual orientation. As conscious perception was suppressed, the observed attention shifts were directed to stimuli that were outside of conscious awareness. In control trials in which the colour patterns were replaced by an identical pair of nude images to the other eye, so that the images were conscious, the attention modulation was non-significant.

To validate the capability of conscious suppression from CFS, participants in Jiang et al. (2006) went through another CFS experiment that followed the same procedure as mentioned above, except after the interocular suppression phase, they were forced to pick the side where the intact nude image had been presented. The average proportion correct was close to chance with a high degree of precision (mean±SEM= 0.4932±0.0066). This a rare example of showing strong priming effects at the objective threshold (showing no conscious knowledge of nude images) with high sensitivity. Most studies, using for example back masking, show priming below the subjective conscious threshold, while struggling to establish evidence of perception below the objective threshold (Cheesman & Merikle, 1984; Fisk & Haase, 2005; Lorentz et al., 2015). There are studies showing processing below the objective threshold (e.g. Faivre et al., 2012), but the 10% priming effect of Jiang et al. indicates an unusually strong indirect effect. There is a reason why this may be so: Jiang et al. used ecologically potent stimuli, namely naked images. Studies on unconscious integration of visual information (Jiang et al., 2007; Mudrik et al., 2011) suggest that suppression from CFS decreases as stimuli gain in significance, whether through formation, contrast, or emotional salience (Tsuchiya et al., 2009; Stein et al., 2014; Yang et al., 2007; Yang et al., 2014). The more meaningful stimuli are, as in Jiang et al., the more likely they capture attention even under subliminal conditions. Tsikandilakis et al. (2021) point out that individual thresholds for the subliminality of emotional stimuli can vary widely; Jiang et al. did in fact check for breakthrough on every trial. There is a distinction between one’s attention being drawn to a naked body before one is consciously aware of the body; and one’s attention being drawn without one ever being consciously aware of the stimulus. Jiang et al. appear to establish the latter stronger case. The strong attentional priming effect at the objective threshold from Jiang et al. is a crucial piece of evidence for the ongoing debate between attention and consciousness, and thus in need of a pre-registered replication.

Aligning with past evidence on individuals reacting to invisible negative emotion-related or emotion-inducing cues (Sagliano et al., 2020; Sasaki et al., 2018; Vizueta et al., 2012; Zald, 2003), Jiang’s study introduced sex-related stimuli to spatial attention and found strong results. The unconscious side of sexual preferences is a rarely explored aspect of cognitive psychology. Believing individuals with high-homophobic tendencies might be suppressing implicit homosexual desires, Adams, Wright, and Lohr (1996) exposed male heterosexual participants to erotic videos (heterosexual, lesbian, and male homosexual) while measuring their erectile response with a mercury-in-rubber circumferential strain gauge. After comparing the erectile data with participants’ scores on the Internalized Homophobic Scale, Adams et al. found participants with high homophobic attitudes had a greater erection than low homophobic group when viewing male homosexual pornography. When asked to give subjective reports of their experiences of arousal and erection, homophobic participants underestimated their sexual arousal in homosexual conditions (which was not the case in other conditions). The inconsistency in subjective responses when encountering sexual-related stimuli is intriguing. In a more recent study, Hung et al. (2016) explored how the human brain processes attractiveness unconsciously, and found that attractive faces broke through CFS faster than unattractive ones; they also found a similar attention-directing effect as observed in Jiang et al. (2006). Similarly, using backward masking, Tsikandilakis et al. (2019-a) showed the greater discriminability of stimuli high rater than low in attractiveness. These findings indicate the importance of validating Jiang’s assumption about subliminal cognition processing mating-related information (either nude bodies or attractive faces), directing attention to such stimuli unconsciously.

The current study will attempt a direct replication of Jiang et al. (2006). The study is theoretically important in establishing a clear dissociation between attention and conscious perception. As the effect shows attentional differences according to sexuality, the paradigm could be abused in surreptitiously discovering someone’s sexuality. It is thus also practically important to identify the potential for abuse of these techniques.

Naked male or female images are displayed in the left or right visual field. In half of the trials the images are suppressed by CFS; in the other half of trials the images are presented without suppression. A tilted Gabor patch then briefly appears randomly in the left or right visual field with participants required to indicate the direction of orientation. In addition, to measure the awareness of the naked image, participants indicate whether it was on the left or right and give their confidence. Finally, participants complete the Kinsey scale (Kinsey et al., 1948) to measure their sexuality, and rate how subjectively attractive each image was.

We now present the predictions we test, and the theories they bear on. On the theory that the CFS constrains the ability to see which side the naked images were presented at the level of the objective threshold, subjects should be close to chance at indicating which side the naked image was presented. On the theory that the CFS rendered knowledge of the side unconscious, then even if subjects’ performance were above the objective threshold, they should be at the subjective threshold in indicating which side the naked image was presented.

On the theory that the images are actually attractive to subjects according to their sexuality, subjective ratings of the attractiveness of the images should follow sexual preferences, with, for example, heterosexual people finding opposite sex images attractive and same sex images unattractive, and vice versa for homosexual participants.

Given these manipulation checks are passed, we can test the main hypothesis. On the theory that attention can be drawn to subliminal images of the sex preferred by one’s sexuality, attentional priming should be above chance for each of males and females, for each sexuality, for the images of the preferred sex. Jiang et al. (2006) found evidence for attentional repulsion to naked images of the non-preferred sex only for male participants. We plan to test repulsion effects for both sexes, and also for different sexualities, depending on the number that we recruit.

On the theory that priming effects from naked images only exist in unconscious conditions, there should be no priming effect in conscious conditions.

On the theory that homophobic heterosexual men are unconsciously attracted to naked men, this group should show attentional attraction to naked male images; non-homophobic heterosexual men will not show such attraction but rather repulsion.

These hypotheses are population effects. In fact, in our initial pilot we will not run enough subjects to obtain sensitive evidence for all of these hypotheses. As we will be using Bayes factors, this won’t prevent the data being informative. The main aim is to make sure the procedure runs as it should, and to determine the sort of error variance the paradigm produces in our setup, so as to plan the main pre-registered study.

**Pilot Study**

Relevant descriptive statistics for determining a stopping rule, primarily error variances were not reported in the original paper, thus the main aim of the pilot was to obtain some estimates while making sure the experimental procedure ran smoothly.

**Participants**.

In total 21 participants (11 males and 10 females) were recruited via Sussex SONA participant pool, in exchange for credits, ages ranged from 18 to 35 years, with an average of 24.5 years. As for the sexual orientation groups based on the Kinsey scale results, there was 1 homosexual male, 3 bisexual males, 7 heterosexual males, 4 bisexual females, and 6 heterosexual females.

The information sheet stated the experiment consists of explicit nude images, with queries about their sexual preferences. To protect participants’ privacy, the experiment did not collect any personally identifying information beyond sexuality, age and sex. The SONA advertisement instructed participants to wear glasses (or contact lenses) to the experiment if they had any eyesight refractive problems (myopia, hyperopia, astigmatism), and that people with a squint (strabismus) were excluded.

**Materials**

The experiment was generated with PsychoPy. Code is available in OSF osf.io/82xua.

*Images*. The Gabor patches used in the experiment were produced by an open-source online generator (Mathôt, 2014) with the following parameters: size: 96, envelope: gaussian, standard deviation: 20, frequency: 0.15, and phase: 0.5. Following the description from Jiang et al. (2006), one Gabor patch was tilted 1° to the left while the other one was tilted to the right.

The nude images, following Jiang et al. (2006), were obtained from the International Affective Picture System (IAPS). The original paper did not specify the actual image set they used, thus we used 3 criteria based on their Figure 1 (which showed image No. 4141 as an example of a nude woman). The image must: 1) be a single person facing front with minimal clothing; 2) present both primary and secondary sex characteristics (genital area and bare chest); 3) have a simple background with minimal visual obstructions to the subject. Based on these conditions, 4 female images (No. 4141, 4142, 4235, and 4240) and 4 male images (No. 4460, 4490, 4550, and 4561) were selected. To standardize, every image was matted with Adobe’s Photoshop and cropped into the same size and shape without compromising the subject. The images are contained in OSF osf.io/82xua.

The experimenter found that, for him, the original nude images constantly broke through the masking. This may have resulted from the high contrast differences in human facial and body features. Hence, to ensure conscious suppression, the contrast and saturation were each reduced by 50% at which point they no longer broke through for the experimenter.

*Questionnaires.* The survey was constructed online with Qualtrics. The items contained the Kinsey Scale (following the procedure of Jiang et al., 2006, to determine sexuality), a series of questions that asked for participant’s explicit attitudes towards different sexual orientations (heterosexual, homosexual, bisexual, asexual) (to determine homophobia, though attitude to other sexualities could be determined; these questions were not used by Jang et al., 2006); and subjective ratings of the attractiveness of the nude images used in the experiment (these questions were not used by Jiang et al., 2006; see Appendix 1).

The Kinsey scale derived from Kinsey et al. (1948), which in our project consists of 9 items (α = .817), asking participants’ preferences for sex-related behaviours and psychological/physiological intimacies toward people of the same or opposite gender, e.g. “To whom are you attracted?” with response options, “1 – Only people of the same sex as me”, “2 – Mostly people of the same sex as me”, “3 – Both men and women”, “4 – Mostly people of the opposite sex to me”, and “5 – Only people of the opposite sex to me” (See Appendix 1 for the full scale). Participants scoring 1 were considered “exclusively homosexual”, while those with a score of 5 were classified as “exclusively heterosexual”. There was an extra category for asexual participants if they chose “not applicable” in all sex-related items. In the second experiment involving non-heterosexual participants, Jiang et al. (2006) assigned homosexual and bisexual participants to the same analytical group without specifying the cut-off threshold. Since Kinsey did not register bisexuality as a defined category (Kinsey et al., 1998; Stange et al., 2011), the project classified participants with a score between 2.5 and 3.5 as “bisexual”. There was a discrepancy between participants’ responses in sexual and intimacy preferences, in which most of the participants expressed comfort to socialise (Mean = 2.88, SD = 0.312) and establish emotional bonds (Mean = 3.02, SD = 0.561) with people of both same and opposite gender, pulling the overall score towards the “bisexual” category. To focus on what may be most relevant for the study, the project utilised only sex-related items (7 items, α = .871) to gauge participants’ sexual orientations.

The survey of explicit attitudes towards different sexual orientations (12 Items, α = .882) was constructed as a simple attitude survey. Participants expressed their feelings for 4 different sexual orientations (heterosexual, homosexual, bisexual, and asexual) under 3 hypothetical conditions (e.g. “I would feel \_\_\_\_ about being heterosexual, if it were my sexuality”, with response options, “1 – Very comfortable”, “2 – comfortable”, “3 – Neutral”, “4 – Uncomfortable”, and “5 – Very uncomfortable”. See the rest of the items in Appendix 1). A higher score on a 5-point Likert scale signified a stronger negative attitude towards a given sexual orientation and vice versa. The average score for each of the 4 sexual orientations fell between 1.42 and 2.06, with an overall average of 1.78 (SD = 0.804).

In the rating of attractiveness, participants were instructed to rate every image on a 5-point Likert Scale, ranging from “5 – aroused”, “4 – intrigued” to “3 – indifferent”, “2 – repelled” and “1 – disgusted”. The scale point labels were designed to reflect attitudes that might attract or repel attention.

**Procedure***.*

Participants’ vision was divided by a mirror stereoscope mounted on a chinrest positioned 40cm from the monitor. Participants manually calibrated the horizontal and vertical location of 2 dim-grey square blocks (6.86° \* 6.86°) on the screen with a fixation cross (1.07° \* 1.07°) in the centre of each, until the 2 blocks were experienced to merge (thus ensuring the images to each eye were aligned). To ensure participants could distinguish the left vs right orientation of the Gabor patches (2.5° × 2.5°, exactly as for Jiang et al., 2006), there were 10 practice trials, in which 100ms exposure of randomised tilted 1° to the left/right Gabor patches appeared in the centre of each block with instructions for the participants to identify the orientations. If the participants could not identify all 10 patches correctly, the practice trials started over again.

**A picture containing text, screenshot, diagram, rectangle

Description automatically generated**

**Figure 1** CFS experiment timeline

After establishing basic accuracy for the Gabor patches, indicating that the participant understood the task probing attention, the participants proceeded to the real trials (see Figure 1). Trials were randomly unconscious and conscious displays of the naked images (3.01° × 6.15°, close to Jiang et al.’s 4.1o × 6.2o). In the unconscious condition, continuous flash suppression was used, so that Mondrians (3.22° × 6.43°) were displayed within the dim-grey block presented to the dominant eye; within the other block, a pair of nude images (defined as the “cue”) was displayed bilateral to the fixation cross with one image scrambled and the other intact. In the conscious condition, the naked images were presented to both eyes. The unconscious and conscious displays each lasted 800ms before a short blank phase for 100ms. Then, in both conscious and unconscious trials, a Gabor patch (randomly tilted 1° clockwise or counter-clockwise) was randomly presented on the left or right side of the fixation cross for 100ms. After the Gabor patch, participants indicated the orientation of the Gabor patch by pressing the right arrow key (for clockwise) and the left arrow key (for counter-clockwise), followed by a confidence rating (“how confident are you with the answer”) and a manipulation check (“did you see the nude image”), all answered with the left and right arrow keys. Any “unconscious” trial for which the participant indicated they saw the image was excluded from analysis.

There were 64 possible scenarios (2 genders \* 4 images each \* 2 image locations\* 2 Gabor patch locations\* 2 orientations), each repeated once to yield 128 trials for the unconscious trials; likewise, there were 128 conscious trials. Jiang et al. (2006) presented 64 unconscious trials and 64 conscious trials. For this stage, the exclusion criterion for participants was a > 20% breakthrough rate based on their response to the question, “did you see the nude image?”.

After the main trials, an awareness check was run, with an almost identical procedure, except the orientation task was substituted with a naked image discrimination task: Participants indicated which side the intact naked image was on with the left and right arrow keys, followed by the same confidence ratings and question asking if the image was seen. These trials serve as an indicator of conscious suppression from CFS. There were 160 trials of the awareness check. Jiang et al. (2006) do not report how many trials they ran of the awareness measure. The exclusion criteria for this stage were either a breakthrough rate higher than 20%, or the participant responds to 20% of the unconscious trials with the same answer in a row.

**Analytical Method**

Bayes factors (*B*) were used to represent the strength of the evidence supporting the research hypothesis (H1) compared to the null hypothesis (H0) (Tsikandilakis et al., 2019-b; Wagenmakers et al., 2017). BHN(0, x) denotes a Bayes factor where the model of H1 is a half-normal distribution with a mode of zero, and a standard deviation of x, which is the roughly predicted value based on theory (Dienes, 2021; Dienes & Mclatchie, 2017). The half-normal distribution is applicable when a theory makes a directional prediction (e.g., the apparent subliminal attractions and repulsions from Jiang et al., 2006). A threshold of 3 was used for drawing conclusions from Bayes factors. To explore the sensitivity of conclusions to the model of H1, for every *B* we report a corresponding Robustness Region (Dienes, 2019; Dienes, 2021). Robustness Regions are expressed as RRB>3 [x1, x2] or RRB<1/3 [x1, x2] or RR1/3<B<3 [x1, x2], where x1 and x2 represent the smallest and the largest standard deviations in the model of H1 that yield the same conclusion (Dienes, 2021). All Bayes factors were calculated by the online calculator: <https://harry-tattan-birch.shinyapps.io/bayes-factor-calculator/>

**Results**

The pilot replicated the procedure of the first experiment from Jiang et al. (2006), as close as we could determine. In their experiment 1, they ran only heterosexual participants. Similarly, in our case, the collected samples for non-heterosexual participants were too small to engage in any practical analysis. Complete data for these analyses are at OSF osf.io/82xua.

*Subliminality of the images*. For this stage of analysis, a total of 11 participants were excluded for analysis of subliminality, with three of them exceeding the breakthrough threshold, and the rest (eight) delivering invalid responses, leaving 10 participants to enter this stage of analysis. Overall, there were four participants being excluded from either stage of the experiment due to breakthrough. The proportion correct discrimination of the side of the intact image in unconscious trials was .550, SEM = 0.018, 95% CI [.52, .59]. Objective performance of unconscious and conscious trials can be tested against chance with a rough default: the maximum possible performance is 0.5 above chance. With such assumption, one heuristic is to use a half-Cauchy with a mode of 0 (i.e. 0 above chance) and a scale factor of 0.5/7 = .07 (Dienes, 2019). For unconscious trials, (M=.550, SD=0.057), t(9)=2.79, p=.010, BHC(0, .07 proportion correct units) = 6.64 RRB>3 [.005, .23]; and (M=.992, SD=0.020), t(9)=78.85, p<.001, BHC(0, .07 proportion correct units) = 3.6×1014, RRB>3 [0.02, 143] for conscious trials. That is, there was moderate evidence supporting participants’ performance being above chance for unconscious trials, and the evidence was strong for performance in conscious trials being above chance.

*Attractiveness of the images*. The scale points labelled as “5 - Aroused”, “4 -Attracted”, “3 - Indifferent”, “2 - Repelled”, and “1 - Disgusted”. That is, the higher the rating, the stronger the subjective attraction. Endpoint values are possible, though unlikely to be elicited by a glimpse at an image. Thus, the most likely range of scores is 1 Likert unit either side of the midpoint, leading to a model of H1 with SD = 0.5 Likert units.

Table 1 indicates that heterosexual males were subjectively attracted to the female images, with moderate evidence they were subjectively repelled from the male images. The evidence was insensitive for females. Thus, this manipulation check is only partially supported.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Heterosexual Females  (N=5) | | | | | |  | Heterosexual Males  (N=7) | | | | | |
|  | *Mdiff* | *SE* | *t* | *p* | B | RR |  | *Mdiff* | *SE* | *t* | *p* | B | RR |
| F images | \*-0.200 | 0.184 | -1.089 | 0.169 | 1.03 | [0, 1.91] |  | 0.714 | 0.158 | 4.510 | 0.002 | 44.96 | [0.22, 5.86] |
| M images | 0.000 | 0.440 | 0.000 | 0.500 | 0.65 | [0, 1.33] |  | \*-0.500 | 0.211 | -2.366 | 0.028 | 5.09 | [0.18, 1.32] |

**Table 1** Subjective ratings of attractiveness toward test images for participants in the CFS experiment (compare to the value of 3). Positive values indicate subjective attractiveness.

\* = negative values are predicted

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Heterosexual Females  (N=5) | |  | Heterosexual Males  (N=7) | | |
|  | Mean | SD |  | Mean | SD |
| Heterosexual | 1.867 | 0.901 |  | 1.667 | 0.745 |
| Homosexual | 2.067 | 0.760 |  | 2.333 | 1.071 |
| Bisexual | 2.133 | 0.730 |  | 2.333 | 1.106 |
| Asexual | 2.067 | 0.760 |  | 2.333 | 0.694 |

**Table 2** Descriptive statistics for participants’ attitudes toward different sexual orientations in the CFS experiment. The scale points are 1 = “Very Comfortable”, 3 = “Neutral”, 5 = “Very Uncomfortable”.

*Homophobia*. No individual heterosexual male nor female participants expressed negative attitudes (a score higher than 3) toward any of the 4 sexual orientations (see Table 2 for means). Therefore, the theory concerning homophobia was not testable. Indeed, it may not be testable even with a much larger N drawn from University of Sussex undergraduates.

*Test of the main theory*. On the theory of subliminal attraction and repulsion, Jiang et al. (2006) defined the attentional effects as the difference in proportion correct between the aligned (Gabor patches appeared on the same side as the intact nude images) and not-aligned (Gabor patches appeared on the opposite side to the scrambled nude images) conditions. Thus, a positive score indicates attentional attraction, and a negative score indicates repulsion. The attentional effects for each gender×sexual orientation group were not precisely specified in Jiang et al. but generally lay around 0.1 (difference in proportion correct) on graphs for unconscious trials. In contrast, the conscious trials were reported only as non-significant, with no descriptive statistics. Using these results as the roughly predicted effect, the SD of the model of H1 was set to 0.1. At this stage, three participants (one heterosexual female, one homosexual male, and one heterosexual male) exceeded the 20% breakthrough rate threshold and were excluded from the analysis.

Testing the theory of nude images’ subliminal attentional effects, separate tests were performed for male and female heterosexual participants for male and female images. This constitutes four tests of attentional shift for unconscious and conscious trials. Naturally, with our small N, we do not expect to obtain sensitive results for this pilot.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Heterosexual Females  (N=5) | | | | | |  | Heterosexual Males  (N=7) | | | | | |
|  | *Mdiff* | *SE* | *t* | *p* | B | RR |  | *Mdiff* | *SE* | *t* | *p* | B | RR |
| F images (UnCon) | \*-0.066 | 0.051 | -1.278 | 0.135 | 1.58 | [0, 0.69] |  | 0.015 | 0.028 | 0.524 | 0.310 | 0.44 | [0, 0.15] |
| M images (UnCon) | 0.020 | 0.045 | 0.435 | 0.343 | 0.60 | [0, 0.21] |  | \*-0.028 | 0.034 | -0.833 | 0.218 | 0.71 | [0, 0.25] |
| F images (Con) | \*-0.044 | 0.019 | -2.333 | 0.040 | 2.87 | [0, 1.00] |  | 0.063 | 0.039 | 1.595 | 0.081 | 2.01 | [0, 0.82] |
| M images (Con) | -0.019 | 0.055 | -0.343 | 0.374 | 0.40 | [0, 0.13] |  | \*0.009 | 0.030 | 0.295 | 0.389 | 0.24 | [0.07, 0.16] |

**Table 3** Attentional shift (difference in proportion correct) for participants in the CFS experiment. Positive values indicate attentional attraction.

\* = negative values are predicted

There was moderate evidence for H0 i.e., for the absence of an attentional repulsion effect, in heterosexual male participants viewing male nude images in conscious trials, while no evidence for all the other tests (see Table 3).

**Discussion**

The pilot aimed to replicate the procedure of Jiang et al. (2006), as closely as possible using CFS. In terms of the first manipulation check, the subliminality of the nude images, there was evidence that subjects were above chance in discriminating the side of the naked image, and hence above the objective threshold. The proportion correct may also be an underestimate. 8 of 21 total participants engaged in stereotyped responses, defined operationally as more than 20% of the trials (i.e. 16) in a row eliciting the same left/right response.

In analysing priming in the pilot, we removed trials from the unconscious condition where participants indicated they saw the image. Post hoc selection of trials can lead to regression to the mean effects (Shanks, 2017), whereby the true proportion of in reality seen trials, in a subset nominally selected to be unseen trials, is best estimated by a mean closer to that in the total of all trials (i.e. the proportion of in reality seen trials is not zero in that subset of trials selected as nominally unseen). The effect arises because of noise in the measurement of whether a trial is seen or unseen. Thus, the priming effect of the nominally unseen trials may be the priming contributed by contamination from in-reality-seen trials. Given Jiang et al. (2006) claim that conscious trials do not lead to priming, only unconscious trials do, then regression to the mean could not be the explanation for any unconscious priming obtained. However, considering the small sample size, the pilot did not provide sufficient evidence to either support or reject Jiang’s conclusion regarding the existence of priming in the conscious condition. Their conclusion was based on the non-significant priming effects in the conscious condition, which is insufficient grounds to accept the null hypothesis. However, according to the supplementary material from Skora et al. (2023), the contamination of conscious data may only become a threat when it’s more than 20%, unless performance on conscious trials is large. As a precautionary measure, the procedure for determining whether the proportion correct in the unconscious trials exceeds what could maximally be produced by regression to the mean (i.e. contamination by conscious perception) used by Dienes (2022), Jurchis and Dienes (2023), and Skora et al. (2023), will be employed in the main experiment. The procedure estimates the maximum contamination there could be in order to provide an upper limit on what priming could be in the unconscious condition, given no priming effect in genuine unconscious trials, combined with a contribution to priming by those conscious trials mismeasured as unconscious. This enables an interval H0 for priming in the unconscious condition to be used, with the upper limit of the null interval being the most priming could be, given contamination by conscious trials. This brief explanation is spelt out in detail, with the relevant equations described, in Dienes (2022), and Skora et al. (2023; Supplementary materials). The interval (rather than point) model of H0 will be used in the Bayes factor for testing priming effects.

There was largely insensitive evidence supporting the claim that there is no conscious priming by nude images in CFS. Also using CFS, Lapate et al. (2014) found participants' emotional responses (measured with SCRs) were significantly related to their subjective evaluations of neutral faces only when the priming from emotional faces was unconscious, despite SCRs being observed in both conditions. One possibility for the Jiang et al. paradigm is that attention is moved more quickly in the conscious versus unconscious condition and had already returned to centre by the time the Gabor patch came to be judged (maybe especially in participants who believe they should not be staring at naked bodies in lab conditions). That is, the timings of the paradigm may have become optimized for unconscious but not conscious conditions.

In terms of the second manipulation check (not included in Jiang et al.) that the nude images picked for the experiments are attractive or unattractive to participants, as appropriate, there was evidence this check was passed for heterosexual males, but the evidence was inconclusive for females. The wording used in the rating scale could be responsible for this inconclusive result. Ratings such as “aroused” and “disgusted” might be too extreme for participants to choose in a laboratory setting with a glimpse of the images. We will change the scale for the main experiment. While the images may turn out not to pass this check, as we are attempting to replicate Jiang et al. (2006) as closely as we can, a failure to pass this check in the main experiment will be an interesting fact concerning the paradigm, at least as applied to UK participants in the 2020s.

Testing the theory regarding an individual’s homophobic tendency, the participants universally possessed positive explicit attitudes toward different sexual orientations. Developed countries’ societal attitudes toward LGBTQ have progressed over the past few decades, especially among the younger generation (Ayoub & Garretson, 2017; Siva Ilango et al., 2020). Though the UK society is definitely not “homophobic-free”, it seems unlikely we will gather enough high-homophobic participants for analysis with any reasonably sized sample of Sussex students. Social expectation bias might be another factor at play. Despite guaranteed anonymity, homophobic participants might suppress their genuine attitudes. Thus, we will not pre-register any hypothesis concerning this prediction, but keep the scale in for exploration.

Concerning the main theory to be tested, of subliminal attentional effects from nude images, the data were not evidential either way – an expected outcome. But now we are in a position to estimate the required sample size. The lack of convincing evidence with the current sample size does have an immediate important practical implication: With the number of trials used, the procedure is far too noisy to be used as a surreptitious sexuality detector for a single individual. An order of magnitude more trials would be needed in principle.

The level of discrimination accuracy with the current version of Gabor patches also requires attention. CFS participants, on average, performed at 82.6% accuracy (SD = 0.125), with 3 participants hitting 100% accuracy in some conditions. The current parameters of the Gabor patches might not be the most optimal. That is, there may be a ceiling effect so that attention cannot improve performance by much. Ideally, we should keep performance on the patches around 60-80% with no priming. We will shift subjects towards this region by an initial staircasing in the practice trials on the contrast of Gabor patches.

We also noticed a difference in our stimuli and those of Jiang et al. (2006). Their scrambled images had a rectangular shape (see their Figure 1); our scrambled images had a body outline (see our Figure 1). If unconscious attention is based on low frequency information, a body outline may be what is drawing attention, not the internal high frequency details. Thus, for the main study we will scramble the rectangle containing the image, as Jiang et al. did, so low frequency information cannot draw attention to the scrambled image (see Figure 2).

**一張含有 螢幕擷取畫面, 文字, 圖表, Rectangle 的圖片

自動產生的描述**

**Figure 2** NewCFS experiment timeline

Given the difficulty of recruiting non-heterosexual participants, we will make predictions and ensure sensitivity only for heterosexual participants, while running any other participant who turns up for exploratory analyses.

**Main Study**

We now present the predictions we test, and the theories they bear on. On the theory that the CFS constrained seeing which side the naked images were at the objective threshold, subjects should be at chance at indicating which side the naked image was. On the theory that the CFS rendered knowledge of the side subliminal, then even if subjects are above the objective threshold, they should be at the subjective threshold in indicating which side the image was on.

On the theory that the images are actually attractive to subjects according to their sexuality, subjective ratings of the attractiveness of the images should follow sexual preferences, with, in particular, heterosexual people finding opposite sex images sexually attractive and same sex images sexually unattractive. (We do not guarantee we will collect enough data for homosexual participants.)

On the theory that conscious perception allows the attentional shift to be overcome by the time the Gabor patch is to be judged, there should be no conscious priming.

Given these manipulation checks are passed, we can test the main hypothesis. On the theory that attention can be drawn to subliminal images of the sex preferred by one’s sexuality, attentional priming should be above chance for each heterosexual males and females for the images of the opposite sex. Given the greater consistency of the attraction rather than the repulsion effect in Jiang et al., we will only guarantee enough data for the attraction effect.

**Method**

*Participants*. We estimated the needed sample size for each of the predictions. We set the threshold for the stopping rule to 5 and 1/5 to ensure the robustness of the decision threshold (a *B*>3 or <1/3).

The SD of the proportion of correct answers for the nude image location discrimination task for unconscious and conscious trials was .113 and .020 (N = 10), respectively. The 95% CI on the ratio of the corresponding variances (SD squared) was [11.90, 90.75]. For testing discrimination for unconscious trials, the SD of 0.11 was divided by √N and used as the SE in a Bayes factor calculator for a half-Cauchy model with a mode of 0 and scale factor of .5/7 = .07 (this follows from the maximum proportion correct can be above chance = 0.5; and the rough maximum plausible value for a Cauchy can be taken to be scale factor×7: Dienes, 2019). Assuming a .07 proportion difference in proportion of correct for H1 and 0 for H0, an N of 16 was required to find B > 5 and an N of 11 for a B > 3 if H1 were true (and the sample mean difference was .07) (an N of 46 was required to find B < 1/5 and an N of 16 for a B <1/3 if H0 were true and the sample mean difference was 0). We will run until the stopping rule is reached, that is until Bayes factors for the proportion of correct from unconscious trials reach the lower (1/5) or higher (5) threshold for each of male and female participants, or a maximum N of 100 is reached.

Using a fully informed scale factor would be better than the above method: Dienes (2015) recommends using the priming found in the conscious condition as a way of estimating what discrimination performance would be needed in the nominal unconscious condition in order for it to explain priming. While the latter method better motivates the model of H1, if there is no priming in the conscious condition (as Jiang et al. 2006 claim), this method cannot be used. However, there may be conscious priming. Thus if we obtain evidence for conscious priming, then we will use the method of Dienes (2015) to ensure that the test of objective awareness in the unconscious condition is appropriate, we will estimate the level of objective performance expected given the amount of “unconscious” priming, assuming the same ratio of discrimination performance above chance to priming as in the conscious condition. A possible problem is that this method assumes a linear relation between priming and discrimination task performance, which may not be reasonable over a large range. Thus if the estimate is larger than .07, we will revert to the .07 estimate so as not to bias evidence in favour of H0. This estimate will be used as the SD of a half-normal in the model of H1.

For the ratings of attractiveness, the SD of expected attractive and repulsive ratings was 1.028 and .606, respectively, for all participants whose sexuality allowed a clear prediction of attraction and repulsion (N = 12). Treating the population error variance as the same in all cases, yields a rough overall estimate of the SD of the subjective ratings of √((1.0282 + .6062)/2) = .844. This was divided by √N and used as the SE in a Bayes factor calculator, assuming a .5 difference in attractiveness ratings for H1 and 0 for H0, until the Bayes factor threshold was reached (Dienes, 2015), an N of 14 was required to find B > 5 if H1 were true (and the sample mean were .5) (an N of 72 was required to find B < 1/5 if H0 were true and the sample mean were 0). Thus, we will run until the stopping rule is reached, that is until Bayes factors for subjective attractive or repelling ratings reach the lower (1/5) or higher (5) threshold for each male and female participant, or a maximum N of 100 is reached.

For the priming effect, the SD of attraction and repulsion for unconscious trials was .097 and .097, respectively, for all participants whose sexuality allowed a clear prediction of attraction and repulsion (N = 12), and .109 and .069 for the conscious trials (N = 12). In the unconscious condition, the 95% CI on the ratio of variances was [0.29, 3.47], and [0.45, 5.49] for conscious trials. For simplicity, treating the population error variance as the same in all cases, yields a rough overall estimate of the SD of the priming effect of √((.0972 + .0972 + .1092 + .0692)/4) = .094. This was divided by √N and used as the SE in a Bayes factor calculator, assuming a .10 priming of proportion correct for H1 gathered from Jiang et al. (2006) and 0 for H0, until the Bayes factor threshold was reached (Dienes, 2015), an N of 24 was required to find B < 1/5 if H0 were true (and the sample mean were 0) (an N of 6 was required to find B > 5 if H1 were true and the sample mean were 0.1). We will run until the stopping rule is reached for an attraction priming effect to reach the lower (1/5) or higher (5) threshold for each of male and female participant, or a maximum N of 100 is reached.

For the absence of a priming effect in conscious trials, the SD of attraction and repulsion for conscious trials was .097 and .097 (N = 12). Treating the population error variance as the same in all cases yields a rough overall estimate of the SD of the priming effect of √((.1092 + .0692)/2) = .091. Same as the estimation for the priming effect, this was divided by √N and used as the SE in a Bayes factor calculator, assuming a .10 priming of proportion correct for H1 and 0 for H0, until the Bayes factor threshold was reached. An N of 22 was required to find B < 1/5 if H0 were true, and an N of 5 was required to find B > 5 if H1 were true. We will run until the stopping rule is reached for all pre-registered tests, in this case, until Bayes factors for a conscious priming effect reach the lower (1/5) or higher (5) threshold for each male and female participant or a maximum N of 100 is reached.

**Procedure.** The same procedure as the pilot will be used with the following exceptions. To prevent participants from giving stereotyped responses in the direct test, further instructions will be provided at the start of each test. Participants will be told: “Please make a guess even if you do not see anything. Go by what you thought you might have seen, even weakly, on each trial, without deciding in advance what your response will be. The correct answer will be left or right randomly; thus, say left or right about equally often, without deciding on any pattern for your answers in advance”.

For measuring subjective attractiveness, the options will be changed to be less extreme. The survey is now a 5-point Likert scale with the question, “How personally sexually attractive to you is this image?”. For the ratings, we will use ”indifferent” as the centre point 0, “very unattractive” as -2, “moderately unattractive” as -1, “moderately attractive” as 1, and “very attractive” as 2. This should keep participants’ responses within the “subjective attractiveness” concept, corresponding to the attentional effects we aim for.

To tackle the ceiling effect observed in participants’ proportion of accuracy in identifying the Gabor patches, the main study will adapt the staircase measure to customise the contrast of Gabor patches for each participant. The Gabor patch staircase will be added after the practice trials. The staircase works as a round of 10 trials, with Gabor patches (tilted 1° clockwise or counterclockwise) randomly appearing on the left or right to the centre focus cross for 100ms each time, followed by an orientation identification task. To mimic the attention shift proposed in Jiang et al. (2006), an arrow appears for 300ms in the centre of participants’ eyesight, indicating the location of the Gabor patch will be. The proportion of accuracy for these 10 trials will be the reference for staircasing. If the participant’s performance in accuracy is higher than 80%, the procedure will start over with Gabor patches of 10% less contrast. If the participant performs worse than 60%, the contrast increases 5% for the next round. Once the participant’s performance falls into the 80-60% interval, another round of trials will proceed with the same contrast to ensure the accuracy of the result. If the second round’s performance still meets the threshold, the staircasing ends.

Other minor adjustments include a change of wording in the confidence check (from “somewhat confident” to “some confidence”) to imply any confidence is relevant. The confidence check for Gabor patches identification task will be removed since it is not crucial to the research questions (see Figure 2).

**Analysis**. For each prediction, we specify the test of that prediction. Same as for the pilot, Bayes factors (*B*) will be used to represent the strength of the evidence supporting the alternative hypothesis (H1) compared to the null hypothesis (H0). A threshold of 3 and 1/3 will be used for drawing conclusions from Bayes factors.

For the prediction of subliminality, the proportion of correct discrimination of the side of intact nude images in the direct test will be used to determine whether perception is at the objective threshold. The model of H1 will be the probability distribution of a half-Cauchy, with a mode of .0 and a scale factor of 0.5/7 = .07 proportion correct above 0.5; but if conscious priming is found for a gender of participants, the method of Dienes (2015) will be used to determine an expected discrimination performance; if this is less than .07 it will be used as the SD of a half-normal

For the prediction of subjective attractiveness, the model of H1 will be a normal distribution with a mean of 0 and an SD of 0.5 Likert units. We will test male and female heterosexual participants separately for the attractiveness of nude images of their opposite sex.

For the prediction of attentional effects, the proportion of difference in performance of accuracy in the Gabor patch identification task will be tested. Using Jiang et al. (2006) to inform the roughly expected effect size, the model of H1 will be a half-normal distribution with a mean of 0 and an SD of 0.1 proportion correct units. H0 will be modelled by a uniform distribution going from 0 to a maximum defined by the highest priming that could be produced by contamination by conscious trials, as per the procedure given in the supplementary materials of Skora et al. (2023). (Note we did not use this procedure in the pilot, because we did not find evidence for conscious priming.) We will test for heterosexual participants’ subliminal attention being attracted to the location of nude images of their opposite sex with a separate test for men and women for the unconscious trials.

**Exclusions**. For the attentional task, trials will be excluded from the unconscious condition if participants indicate they saw the image. Whole participants will be excluded if on the awareness discrimination task they use the same “left” or “right” response more than 16 trials in a row at any point in the test, or report they saw the naked image on more than 20% of unconscious trials.

Study Design Template.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Question | Hypothesis | Sampling plan | Analysis Plan | Rationale for deciding the sensitivity of the test for confirming or disconfirming the hypothesis | Interpretation given different outcomes | Theory that could be shown wrong by the outcomes |
| Under CFS, is the level of discrimination performance for whether the naked image is on the left or right above objective threshold? | Participants’ knowledge of nude image location will be suppressed below objective threshold by the CFS. | The data collection will run until Bayes factor crosses a threshold (5 or 1/5) or until N= 100 participants are reached. | The Bayes factor on proportion of correct will be calculated for unconscious and conscious trials, respectively. The model of H1 will be a half-Cauchy with a mode 0 and a scale factor of .07 The procedure of Dienes (2015) will be used in the unconscious condition if its estimated performance is lower than .07 above chance.. The DV will be the proportion correct above chance. | A Bayes factor >3 indicates evidence for H1, while a B<1/3 indicates evidence for H0. We showed we will be able to recruit enough participants to achieve at least this level of evidence. | If the evidence for unconscious trials supports H0, we will conclude that the CFS effectively rendered conscious knowledge unconscious; if B > 3, we will conclude that perception was above objective threshold; if B is between these ranges we will draw no conclusions regarding objective threshold. However, as we discard trials when the participant said they saw, if performance is above objective threshold, we will still conclude that perception was below subjective threshold.  If the evidence for conscious trials supports H1, we can conclude that the participants were above objective threshold for discriminating the nude location during trials; if the evidence supports H0, then the participants could not consciously perceive experiment stimuli. | The CFS is able to render perception below the objective threshold. |
| Are opposite sex nude images used in Jiang et al. (2006) sexually attractive for heterosexual contemporary University of Sussex students? | Heterosexual participants rate nude images of their opposite sex to be attractive (a score higher than “indifferent”) | Data collection will run until each Bayes factor crosses a threshold (5 or 1/5) or a maximum N of 100 is reached. | For heterosexual participants only, two Bayes factors on subjective attractiveness ratings, one for each of male and female participants, for the opposite sex images. The model of H1 will be a half-normal with an SD of 0.5 attractiveness units above the H0 value. The H0 value is the mid-point of the scale (0). | A Bayes factor >3 indicates good evidence for H1, while a B<1/3 indicates good evidence for H0. We have shown we will be able to recruit enough participants to reach at this level of evidence. | We will draw conclusions for each participant sex separately. If the results support H1, then the images are attractive. If the results support H0, then the opposite sex nude images are not subjectively attractive, which indicates an attentional effect would not be predicted in those cases | The opposite sex nude images are subjectively attractive to heterosexual participants. |
| Is attention attracted to subliminal images of the opposite sex? | In heterosexual participants, subliminal images of the opposite sex attract attention. | Data collection will run until each Bayes factor crosses a threshold (5 or 1/5) or a maximum N of 100 is reached. | For heterosexual participants, two Bayes factors will be calculated, one for each of males and females. The dependent variable will be the difference in proportion correct Gabor discrimination on the side of the nude image versus the other side. The model of H1 will be a half-normal with an SD of .10 proportion correct units. The model of H0 will be a uniform from 0 to max, where max is defined as per Dienes (2022). | A Bayes factor >3 indicates good evidence for H1, while a B<1/3 suggests good evidence for H0. We have shown we can collect enough participants to reach at this level of evidence. | We will draw conclusions for each participant sex separately. If the results support H1, then subliminal naked images of the opposite sex are able to attract attention. If the results support H0, then subliminal naked images of the opposite sex are not able to attract attention. | In heterosexual people, attention is attracted to opposite sex nude images, even when suppressed by CFS. |
| Is attention attracted to consciously perceived images of the opposite sex? | In heterosexual participants, images of the opposite sex does not attract attention when presented consciously. | Data collection will run until each Bayes factor crosses a threshold (5 or 1/5) or a maximum N of 100 is reached. | For heterosexual participants, two Bayes factors will be calculated, one for each of males and females. The dependent variable will be the difference in proportion correct Gabor discrimination on the side of the nude image versus the other side. The model of H1 will be a half-normal with an SD of .10 proportion correct units. H0 will be 0. | A Bayes factor >3 indicates good evidence for H1, while a B<1/3 suggests good evidence for H0. We have shown we can collect enough participants to reach at this level of evidence. | We will draw conclusions for each participant sex separately. If the results support H1, then consciously presented naked images of the opposite sex are able to attract attention. If the results support H0, then consciously presented naked images of the opposite sex are not able to attract attention. | In heterosexual people, attention is attracted to opposite sex nude images when presented consciously. |

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Appendix 1 – Research Survey Items

1. To whom are you attracted?
   1. Only people of the same sex as me
   2. Mostly people of the same sex as me
   3. Both men and women
   4. Mostly people of the opposite sex to me
   5. Only people of the opposite sex to me
2. Who have you had sex with?
   1. Only people of the same sex as me
   2. Mostly people of the same sex as me
   3. Both men and women
   4. Mostly people of the opposite sex to me
   5. Only people of the opposite sex to me
3. Who have you had sexual fantasies about?
   1. Only people of the same sex as me
   2. Mostly people of the same sex as me
   3. Both men and women
   4. Mostly people of the opposite sex to me
   5. Only people of the opposite sex to me
4. With whom do you form strong emotional bonds?
   1. Only people of the same sex as me
   2. Mostly people of the same sex as me
   3. Both men and women
   4. Mostly people of the opposite sex to me
   5. Only people of the opposite sex to me
5. Who do you feel the most comfortable socialising with?
   1. Only people of the same sex as me
   2. Mostly people of the same sex as me
   3. Both men and women
   4. Mostly people of the opposite sex to me
   5. Only people of the opposite sex to me
6. The idea of having sex with someone of the opposite sex from mine is:
   1. Desirable
   2. Interesting
   3. Tolerable
   4. Negative
   5. Disgusting
7. The idea of having sex with someone of the same sex as mine is:
   1. Desirable
   2. Interesting
   3. Tolerable
   4. Negative
   5. Disgusting
8. The idea of engaging in intimate physical contact with someone of the opposite sex as mine is:
   1. Desirable
   2. Interesting
   3. Tolerable
   4. Negative
   5. Disgusting
9. The idea of engaging in intimate physical contact with someone of the same sex as mine is:
   1. Desirable
   2. Interesting
   3. Tolerable
   4. Negative
   5. Disgusting
10. I would feel \_\_\_\_\_\_ about being heterosexual, if it were my sexuality:
    1. Very comfortable
    2. Comfortable
    3. Neutral
    4. Uncomfortable
    5. Very uncomfortable
11. I would feel \_\_\_\_\_\_ about being homosexual, if it were my sexuality:
    1. Very comfortable
    2. Comfortable
    3. Neutral
    4. Uncomfortable
    5. Very uncomfortable
12. I would feel \_\_\_\_\_\_ about being bisexual, if it were my sexuality:
    1. Very comfortable
    2. Comfortable
    3. Neutral
    4. Uncomfortable
    5. Very uncomfortable
13. I would feel \_\_\_\_\_\_ about being asexual, if it were my sexuality:
    1. Very comfortable
    2. Comfortable
    3. Neutral
    4. Uncomfortable
    5. Very uncomfortable
14. I would feel \_\_\_\_\_\_\_ about my close friends being heterosexual:
    1. Very comfortable
    2. Comfortable
    3. Neutral
    4. Uncomfortable
    5. Very uncomfortable
15. I would feel \_\_\_\_\_\_\_ about my close friends being homosexual:
    1. Very comfortable
    2. Comfortable
    3. Neutral
    4. Uncomfortable
    5. Very uncomfortable
16. I would feel \_\_\_\_\_\_\_ about my close friends being bisexual:
    1. Very comfortable
    2. Comfortable
    3. Neutral
    4. Uncomfortable
    5. Very uncomfortable
17. I would feel \_\_\_\_\_\_\_ about my close friends being asexual:
    1. Very comfortable
    2. Comfortable
    3. Neutral
    4. Uncomfortable
    5. Very uncomfortable
18. I would feel \_\_\_\_\_\_\_ to interact with strangers that are heterosexual:
    1. Very comfortable
    2. Comfortable
    3. Neutral
    4. Uncomfortable
    5. Very uncomfortable
19. I would feel \_\_\_\_\_\_\_ to interact with strangers that are homosexual:
    1. Very comfortable
    2. Comfortable
    3. Neutral
    4. Uncomfortable
    5. Very uncomfortable
20. I would feel \_\_\_\_\_\_\_ to interact with strangers that are bisexual:
    1. Very comfortable
    2. Comfortable
    3. Neutral
    4. Uncomfortable
    5. Very uncomfortable
21. I would feel \_\_\_\_\_\_\_ to interact with strangers that are asexual:
    1. Very comfortable
    2. Comfortable
    3. Neutral
    4. Uncomfortable
    5. Very uncomfortable

Asked for each image:

I feel \_\_\_\_\_\_\_\_ by this image:

i. Disgusted

ii. Repelled

iii. Indifferent

iv. Attracted

v. Aroused